495 270 MANAGED LANES STUDY

APPENDIX B
ALTERNATIVES TECHNICAL REPORT
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U.S. Department of Transportation
Federal Highway Administration

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

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ABBREVIATIONS AND ACRONYMS

AA	Alternatives Analysis
AASHTO	American Association of State Highway and Transportation Officials
ADT	Average Daily Traffic
ARDS	Alternatives Retained for Detailed Study
ATM	Active Traffic Management
BRT	Bus Rapid Transit
CCT	Corridor Cities Transitway
C-D	Collector-Distributor
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CLRP	Constrained Long Range Plan
CSXT	CSX Transportation
CTB	Consolidated Transportation Bond
DEIS	Draft Environmental Impact Statement
DMS	Dynamic Message Sign
DSL	Dynamic Speed Limit
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESD	Environmental Site Design
ETL	Express Toll Lanes
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
FIDS	Forest Interior Dwelling Species
FTA	Federal Transit Administration
GI	Green Infrastructure
GIS	Geographic Information Systems
GP	General Purpose
HCS	Highway Capacity Software
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
IAWG	Interagency Working Group
ICC	Intercounty Connector
ICM	Innovative Congestion Management
LOD	Limits of Disturbance
LOS	Level of Service
MARC	Maryland Area Regional Commuter
MDNR	Maryland Department of Natural Resources
MDOT SHA	Maryland Department of Transportation State Highway Administration
MSTM	Maryland Statewide Transportation Model

MTA	Maryland Transit Administration
MWCOG	Metropolitan Washington Council of Governments
NB	Northbound
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NEXT	Northern Extension Study
PTI	Planning Time Index
QW	Queue Warning
ROD	Record of Decision
SB	Southbound
SPA	Special Protection Areas
SPUI	Single Point Urban Interchange
TDM	Transportation Demand Management
TEAs	Targeted Ecological Areas
TFAD	Travel Forecasting and Analysis Division
TPB	Transportation Planning Board
TSM	Transportation System Management
TTI	Travel Time Index
USACE	United States Army Corps of Engineers
VDOT	Virginia Department of Transportation
VMT	Vehicle Miles Traveled
WMATA	Washington Metropolitan Area Transit Authority

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1 INTRODUCTION

1.1 Overview

The Federal Highway Administration (FHWA), as the Lead Federal Agency, and the Maryland Department of Transportation State Highway Administration (MDOT SHA), as the Local Project Sponsor, are preparing an Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA) for the I-495 & I-270 Managed Lanes Study (Study). The Study is evaluating potential transportation improvements to portions of the I-495 and I-270 corridors in Montgomery and Prince George's Counties, Maryland, and Fairfax County, Virginia.

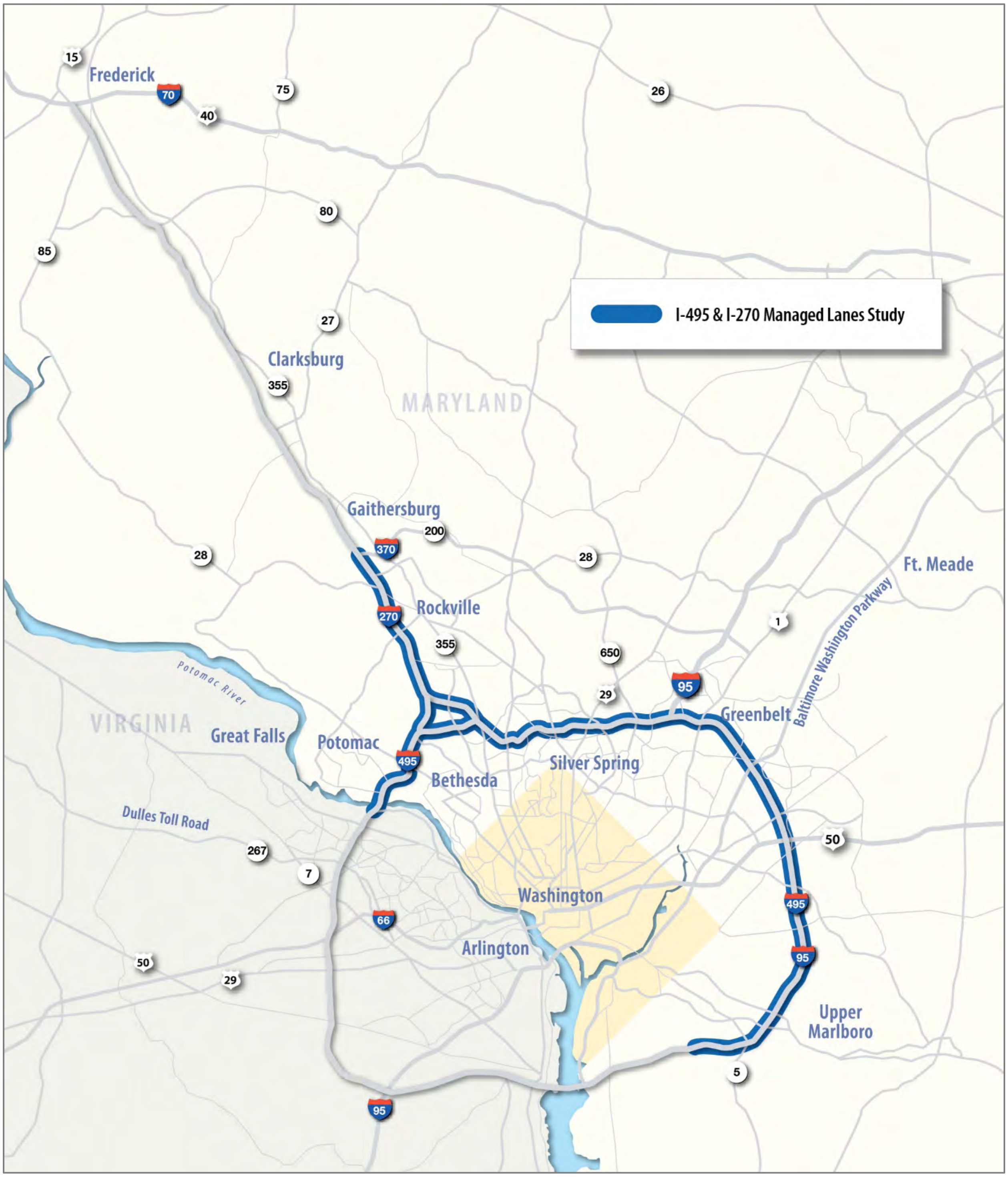
This EIS is being prepared in accordance with FHWA and Council on Environmental Quality (CEQ) regulations implementing NEPA and provisions of the Fixing America's Surface Transportation (FAST) Act. The content of the EIS also conforms to CEQ guidelines, which provide direction regarding implementation of the procedural provisions of NEPA, and the FHWA's Guidance for *Preparing and Processing Environmental and Section 4(f) Documents* (Technical Advisory T6640.8A, October 1987).

The purpose of the Alternatives Technical Report is to document the development and evaluation of alternatives for the Study. This technical report supports Chapter 2 of the Draft EIS and provides additional detail on: previous studies, design assumptions, limits of disturbance (LOD), elements of design, right-of-way and property effects, preliminary cost estimates, and selection of the ARDS. The report begins with a description of the Study corridors and a summary of the Purpose and Need.

1.2 Study Corridors

I-495 and I-270 in Maryland are the two most heavily traveled freeways in the National Capital Region, each with Average Annual Daily Traffic volume up to 260,000 vehicles per day in 2018 (MDOT SHA, 2019). I-495 is the only circumferential route in the region that provides interregional connections to many radial routes in the region, such as I-270, US 29 (Colesville Road), I-95, the Baltimore-Washington Parkway, US 50 (John Hanson Highway), and MD 5 (Branch Avenue). I-270 is the only freeway link between I-495 and the fast-growing northwest suburbs in northern Montgomery County and the suburban areas in Frederick County. In addition to heavy commuter traffic demand, I-495 provides connectivity along the East Coast, as it merges with I-95 in Maryland for 25 miles around the east side of Washington, DC (**Figure 1-1**).

Figure 1-1: Study Corridors



1.3 Study Purpose and Need

The purpose of the Study is to develop a travel demand management solution(s) that addresses congestion and improves trip reliability on I-495 and I-270 within the Study limits and enhances existing and planned multimodal mobility and connectivity. The Study will address the following needs:

- **Accommodate Existing Traffic and Long-Term Traffic Growth** - High travel demand from commuter, business, and recreational trips results in severe congestion from 7 to 10 hours per day on the Study corridors, which is expected to deteriorate further by the planning horizon year of 2040. Additional roadway capacity is needed to address existing and future travel demand and congestion, reduce travel times, and allow travelers to use the facilities efficiently.

- **Enhance Trip Reliability** - Congestion on I-495 and I-270 results in unpredictable travel times. Travelers and freight commodities place a high value on reaching their destinations in a timely and safe manner, and in recent years, the Study corridors have become so unreliable that uncertain travel times are experienced daily. More dependable travel times are needed to ensure trip reliability.

- **Provide Additional Roadway Travel Choices** - Travelers on I-495 and I-270 do not have enough roadway options for efficient travel during extensive periods of congestion. Additional roadway management options are needed to improve travel choices, while retaining the general purpose (GP) lanes.

- **Accommodate Homeland Security** - The National Capital Region is considered the main hub of government, military, and community installations related to homeland security. These agencies and installations rely on quick, unobstructed roadway access during a homeland security threat. Additional capacity would assist in accommodating a population evacuation and improving emergency response access should an event related to homeland security occur.

- **Improve Movement of Goods and Services** - I-495 and I-270 are major regional transportation networks that support the movement of passenger and freight travel within the National Capital Region. Existing congestion along both corridors increases the cost of doing business due to longer travel times and unreliable trips. The effects of this congestion on the movement of goods and services is a detriment to the health of the local, regional, and national economy. Efficient and reliable highway movement is necessary to accommodate passenger and freight travel, moving goods and services through the region.

Additional roadway capacity and improvements to enhance reliability must be financially viable. MDOT's traditional funding sources would be unable to effectively finance, construct, operate, and maintain improvements of this magnitude. Revenue sources that provide adequate funding, such as pricing options, are needed to achieve congestion relief and address existing high travel demand.

Given the highly constrained area surrounding the interstates in the Study corridors, MDOT SHA recognizes the need to plan and design this project in an environmentally responsible manner. MDOT SHA will strive to avoid and minimize community, natural, cultural, and other environmental impacts, and mitigate for any unavoidable impacts at an equal or greater value. MDOT SHA will work with our Federal, State, and Local resource agency partners in a streamlined, collaborative, and cooperative way to meet all regulatory requirements to ensure the protection of significant environmental resources. Any build alternatives will offset unavoidable impacts while prioritizing and coordinating comprehensive mitigation measures in or near the Study area, which are meaningful to the environment and the community.

Throughout the development of the alternatives for the Study several key words have been used. These include:

- **GP Lanes** are lanes on a freeway or expressway that are open to all motor vehicles.[1]
- **Managed Lanes** are highway facilities, or a set of lanes, where operational strategies are proactively implemented and managed in response to changing conditions.[2]
- **High-Occupancy Toll (HOT) Lanes** are High-Occupancy Vehicle (HOV) facilities that allow lower-occupancy vehicles, such as solo drivers, to use the facilities in return for toll payments, which could vary by time of day and level of congestion. May also charge lower-occupancy HOVs.[1]
- **Express Toll Lanes (ETL)** are dedicated managed lanes within highway rights-of-way that motorists may use by paying a variably priced toll.[3]
- **HOV Lanes** are any preferential lane designated for exclusive use by vehicles with two or more occupants for all or part of a day, including a designated lane on a freeway, other highway or a street, or independent roadway on a separate right-of-way.[4]
- **Reversible Lanes** are facilities in which the direction of traffic flow can be changed at different times of the day to match peak direction of travel, typically inbound in the morning and outbound in the afternoon.[1]

[1] *National Cooperative Highway Research Program, Research Report 835, Guidelines for Implementing Managed Lanes*. Transportation Research Board. 2016

[2] https://ops.fhwa.dot.gov/publications/managelanes_primer/index.htm

[3] https://www.fhwa.dot.gov/ipd/tolling_and_pricing/defined/demand_mgmt_tool.aspx

[4] https://ops.fhwa.dot.gov/freewaymgmt/hovguidance/glossary.htm

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2 EXISTING CONDITIONS

2.1 I-495

The Federal government approved construction of I-495 in 1956 and construction began in 1957. The first section, from MD 355 to MD 185, opened to traffic in 1962 and the last section was opened in 1964. The original construction of all 41.7 miles of I-495 in Maryland was six lanes, three in each direction. I-495 has been widened in segments over time to its current configuration as a six to eight-lane freeway in each direction plus auxiliary lanes in some locations.

The portion of I-495 within the Study corridor extends from 0.7 miles south of the American Legion Bridge in Fairfax County, Virginia to 1.2 miles west of MD 5 in Prince George's County, Maryland. The total length of this portion of the corridor is approximately 37 miles. The posted speed limit along I-495 is 55 miles per hour (mph). The limits of the I-495 Study corridor are shown in **Figure 1-1**.

In Fairfax County, north of the Virginia Department of Transportation (VDOT) 495 Express Lanes section, I-495 is an eight-lane roadway. In Montgomery County, I-495 enters Maryland on the American Legion Bridge over the Potomac River as a ten-lane section with eight through lanes and two auxiliary lanes that connect Clara Barton Parkway in Maryland and George Washington Parkway in Virginia. Moving east, I-495 remains eight lanes except between the I-270 spurs where it is six lanes wide. I-495 continues east through Prince George's County as an eight-lane roadway. This eastern half of I-495 is also designated as I-95 and constitutes a link in the Maine to Florida I-95 system. There are acceleration, deceleration, and auxiliary lanes throughout the limits of I-495 in Maryland.

The mainline typical section includes 12-foot travel lanes. The right (outside) shoulder varies between ten and 12 feet but is as narrow as a one-foot offset in select locations, such as across bridges and between crossroad abutments and piers. The left (median) shoulder varies between ten and 15 feet but is as narrow as three feet wide in select locations, such as across bridges and between crossroad abutments and piers. The lane widths meet current American Association of State Highway and Transportation Officials (AASHTO) standards; however, shoulder widths less than ten feet do not meet current design standards per *A Policy on Geometric Design of Highways and Streets* (AASHTO, 2011), which is ten to 12 feet.

A concrete barrier separates the inner loop and outer loop on I-495 from Fairfax County to south of the interchange at the I-270 West Spur. Between the I-270 West Spur and I-270 East Spur interchanges, there is a grass median along I-495 that varies to a maximum of 36 feet wide. From the I-270 East Spur interchange to west of the I-95 interchange, there is concrete barrier in the median along I-495. From east of the I-95 interchange to west of MD 5, the median along I-495 is paved or grass and varies in width to a maximum of 54 feet wide. Over 24 miles of noise barriers extend along both sides of I-495 through both Montgomery and Prince George's Counties.

The existing I-495 right-of-way within this portion of the Study corridor ranges in width between 150 and 300 feet. The right-of-way is 150 feet wide between the I-270 East Spur and MD 193. A number of radial roadway networks starting in Washington, DC intersect I-495 over its 36.7 miles in the Study corridor and 27 interchanges connect these radial routes to I-495. The following interchanges are located along I-495 within the Study limits (listed clockwise starting in the west):

- Exit 43 – George Washington Parkway (in Virginia)
- Exit 41 – Clara Barton Parkway
- Exit 40 – Cabin John Parkway
- Exit 39 – MD 190 (River Road)
- Exit 38 – I-270 West Spur
- Exit 36 – MD 187 (Old Georgetown Road)
- Exit 35 – I-270 East Spur
- Exit 34 – MD 355 (Rockville Pike)
- Exit 33 – MD 185 (Connecticut Avenue)
- Exit 31 – MD 97 (Georgia Avenue)
- Exit 30 – US 29 (Colesville Road)
- Exit 29 – MD 193 (University Boulevard)
- Exit 28 – MD 650 (New Hampshire Avenue)
- Exit 27 – I-95
- Exit 25 – US 1 (Baltimore Avenue)
- Exit 24 – Greenbelt Metrorail Station
- Exit 23 – MD 201 (Kenilworth Avenue)
- Exit 22 – Baltimore-Washington Parkway
- Exit 20 – MD 450 (Annapolis Road)
- Exit 19 – US 50 (John Hanson Highway)
- Exit 17 – MD 202 (Landover Road)
- Exit 16 – Arena Drive
- Exit 15 – MD 214 (Central Avenue)
- Exit 13 – Ritchie Marlboro Road
- Exit 11 – MD 4 (Pennsylvania Avenue)
- Exit 9 – MD 337 (Forestville Road / Allentown Road)
- Exit 7 – MD 5 (Branch Avenue)

Several of these existing interchanges are system-to-system connections. These interchanges are the I-270 West Spur, the I-270 East Spur, I-95, the Baltimore-Washington Parkway, and US 50. In addition to the existing interchanges, there are several existing grade-separated rail crossings within this portion of the I-495 Study corridor. The rail crossing locations are as follows:

- Washington Metropolitan Area Transit Authority (WMATA) Metrorail Red Line parallel to MD 355
- CSX Transportation (CSXT) parallel to Seminary Road
- CSXT / WMATA Metrorail Green Line east of US 1
- Amtrak / CSXT south of MD 450
- WMATA Metrorail Blue and Silver Line north of MD 214

There are also two, grade-separated pedestrian crossings across I-495 within this portion of the Study corridor. The locations of the pedestrian crossings are:

- Bethesda Trolley Trail east of MD 187
- Forest Glen pedestrian bridge at MD 97

Numerous large and small retail centers, schools, sports stadiums, and major government and corporate employment centers are located immediately adjacent to I-495. The area surrounding the I-495 Study corridor is highly populated and consists of low, medium and high-density residential uses. Within much of Montgomery County, the corridor is flanked by low-density homes and parkland. Within Prince George's County, the corridor consists of low density residential, numerous commercial centers and neighborhood parks.

2.2 I-270

The oldest portions of I-270, originally known as US 240, were constructed from 1953 to 1960 between Bethesda and Frederick. These routes were incorporated into I-70S in 1956 after the creation of the Interstate System. The section of I-70S, north of the spur, was renumbered to I-270 in 1975, making a single highway designation from Frederick County to the Capital Beltway (AARoads, 2014). Today, I-270 is a fully access-controlled interstate with the number of lanes varying between four and twelve.

The portion of I-270 within the Study corridor extends from I-495 to 0.7 miles north of I-370 in Montgomery County, Maryland. I-370 connects to MD 200 (the Intercounty Connector (ICC)), the all-electronic toll highway that connects to I-95, north of I-495. I-370 also provides access to a park-and-ride lot and the Shady Grove Metro station, the northern-most station on the WMATA Metrorail Red Line. The total length of this portion of the I-270 corridor is approximately 11 miles. The posted speed limit along this portion of I-270 is 55 mph. The limits of the I-270 Study corridor are shown in **Figure 1-1**.

North of I-495, the I-270 East Spur and the I-270 West Spur are both six-lane roadways, with the left lane in each direction designated as an HOV lane during peak periods. North of the spurs, I-270 continues towards I-370 as a twelve-lane section with five GP lanes and one HOV lane in each direction. Just south of Montrose Road through I-370, the lanes on I-270 are barrier-separated for an express-local system with one HOV lane and 3 GP lanes in the express section and 2 GP lanes in the local section in each direction. The roadway remains a twelve-lane section throughout the express-local system with acceleration, deceleration, and auxiliary lanes. Within the express-local system limits, there are slip lanes between the express lanes and the local lanes and there is no direct access from the express lanes to/from interchange ramps.

The mainline typical section includes 12-foot travel lanes. The right (outside) shoulder varies between ten and 12 feet but is as narrow as a one-foot offset in select locations, such as across bridges and in between crossroad abutments and piers. The left (median) shoulder varies between ten and 12 feet but is as narrow as three feet wide in select locations, such as across bridges and in between crossroad abutments and piers. Within the express-local system limits, the left (median) shoulder adjacent to the local lanes varies between two and 12 feet wide. The right (outside) shoulder adjacent to the local lanes varies between ten and 12 feet but is as narrow as a two-foot offset in select locations. The lane widths along I-270 meet current AASHTO standards; however, shoulder widths less than ten feet do not meet current design standards per *A Policy on Geometric Design of Highways and Streets* (AASHTO, 2011), which is ten to 12 feet. The only exception would be left shoulder widths along the local lanes, which in two-lane sections would only need a four-foot shoulder to meet AASHTO guidelines.

A concrete barrier separates the northbound (NB) and southbound (SB) directions along the I-270 mainline north of the Y-split, along the I-270 West Spur, and along the I-270 East Spur. Concrete barrier separates the express and local lanes throughout the length of the express-local system within the Study corridor.

The existing I-270 right-of-way within this portion of the I-270 Study corridor ranges in width between 250 and 300 feet. Various east-west roadways intersect I-270 within the Study limits and eight interchanges connect these east-west routes to I-270. The following interchanges are located along I-270 within the project limits (listed south to north):

- Exit 1 (West Spur) – Democracy Boulevard
- Westlake Terrace (West Spur) – only HOV ramps to/from the north
- Exit 1A / 1B (East Spur) – MD 187 (Old Georgetown Road) / Rockledge Boulevard
- Exit 4 – Montrose Road
- Exit 5 – MD 189 (Falls Road)
- Exit 6 – MD 28 (W Montgomery Avenue)
- Exit 8 – Shady Grove Road
- Exit 9 – I-370

The interchange at I-370 and the I-270 termini at I-495 are system-to-system connections. There are no grade-separated rail crossings within this portion of I-270. There are two grade-separated pedestrian crossings across I-270 within this portion of the Study corridor. The locations of the pedestrian crossings are:

- Bethesda Trolley Trail south of MD 187 (East Spur); and
- Pedestrian bridge parallel to and south of MD 28.

The southern portion of I-270 near the East and West Spurs consists of medium density residential land use with schools and mixed-use development. Suburban residential development and retail/commercial development continues along I-270 north of the spurs. Major government and corporate employment centers as well as commercial development are located adjacent to I-270 especially north of MD 28 to the interchange with I-370. Noise barriers are located along approximately 5.8 miles of the length of the I-270 corridor.

3

3 PREVIOUS STUDIES/ALTERNATIVES PREVIOUSLY CONSIDERED

Alternatives development and evaluation for the I-495 & I-270 Managed Lanes Study was informed by numerous previous studies completed by MDOT SHA, MDOT Maryland Transit Administration (MTA) and VDOT including the Capital Beltway HOV Feasibility Study; the Capital Beltway/Purple Line Study; the I-270/US 15 Multi-Modal Corridor Study; the 2004 Capital Beltway Study; the West Side Mobility Study; and the I-270 Innovative Congestion Management (ICM) projects. Each of these studies included, in part, proposed transportation solutions reflecting some of the operational and/or engineering alternatives that were considered in development of the Preliminary Range of Alternatives. In particular, the studies evaluated the implementation of managed lanes including ETLs, HOV lanes, HOT lanes and parallel transit facilities on I-495, I-270, and I-95. These studies considered the potential to provide additional capacity along I-495 and I-270 that would connect with other regional transportation facilities. The solutions retained in these studies are listed in the respective sections below.

3.1 Capital Beltway HOV Feasibility Study

In 1992, the MDOT SHA initiated the Capital Beltway HOV Feasibility Study (MDOT SHA, 1992), which was renamed the Capital Beltway Corridor Transportation Study in 1998. The purpose of the study was to investigate the physical feasibility of adding an HOV lane on the Maryland portion of the Capital Beltway. This study concluded that the physical feasibility of implementing HOV lanes varies throughout the project area; however, the majority of the Capital Beltway would be able to accommodate an additional lane, or the median lane would need to be converted to accommodate an HOV lane.

3.2 Capital Beltway/Purple Line Study

In 1996, the Capital Beltway/Purple Line Study was initiated by MDOT SHA and MDOT MTA, which focused on multimodal transportation improvements in the Capital Beltway corridor and identified adding an HOV lane to I-495 and constructing the Purple Line as a transit alignment inside the Beltway. This study also concluded that fixed guideway transit was not recommended wholly along the Capital Beltway itself.

In 2003, the transit and highway portions of the Capital Beltway/Purple Line Study were separated into two independent studies, the Purple Line Project and the Capital Beltway Study (MDOT SHA et al., 2013), with the justification that both projects were needed to meet the demands of the corridor. The Purple Line Project Final Environmental Impact Statement (FEIS) and Draft Section 4(f) Evaluation was signed in 2013 and a Record of Decision (ROD) was issued in 2014. This project is currently under construction with operation scheduled to begin in 2022 on a 16-mile, two-track light rail system from Bethesda to New Carrollton.

3.3 I-270/US 15 Multi-Modal Corridor Study

In May 2002, the FHWA and Federal Transit Administration (FTA) published a Draft Environmental Impact Statement (DEIS) for the I-270/US 15 Multi-Modal Corridor Study for public review and comment. The DEIS evaluated the impacts of 35 miles of highway improvements along the I-270/US 15 corridor and a 13.5-mile Corridor Cities Transitway (CCT). The DEIS evaluated three build alternatives (plus No Build and Transportation System Management (TSM)) from the Shady Grove Metrorail Station in Montgomery County to north of Biggs Ford Road in Frederick County; two of the build alternatives included HOV lanes.[5] A selected alternative from the DEIS alternatives was not determined following the June 2002 Public Hearing.

In 2003, MDOT initiated a feasibility evaluation of ETLs for I-270. A subsequent Alternatives Analysis/Environmental Assessment (AA/EA) was completed in 2009 to evaluate the environmental effects of the two ETL alternatives and reviewed the previously studied CCT alternatives using the updated ridership forecasting model to provide a comparison of overall study area conditions to the DEIS alternatives. The results of the AA/EA were presented at a 2009 public hearing; however, a final NEPA decision document was not prepared nor was a selected alternative determined by MDOT following the public hearing.

In November 2010, the MDOT MTA completed a Supplemental Environmental Assessment to provide more detailed environmental and engineering analysis on new CCT alternatives to better serve the proposed developments of Crown Farm, Life Sciences Center, and Kentlands. In December 2011, FHWA and FTA jointly concurred that the CCT had independent utility from the highway components of the I-270/US 15 Multi-Modal Corridor Study and the CCT would proceed with NEPA compliance separate from the highway alternatives of the I-270 Multi-Modal Corridor Study. MDOT MTA prepared an EA including alternative analysis and environmental technical studies. MDOT MTA published the EA with a preferred alternative in 2017. However, funding for design and construction of the project has been deferred until 2023; therefore, a final environmental document has not been prepared.

3.4 2004 Capital Beltway Study

The 2004 Capital Beltway Study focused on roadway improvements that would address congestion on the Beltway from the American Legion Bridge to the Woodrow Wilson Bridge. MDOT SHA carried three alternatives forward into the Alternatives Retained for Detailed Study (ARDS): 1) No Build; 2) Build Alternative 2 – six GP lanes and four ETLs; and 3) Build Alternative 3 – eight GP lanes and two ETLs. In 2005, preliminary environmental technical reports were prepared analyzing the potential impacts to these three alternatives, in anticipation of completing the NEPA process. However, due to changes in transportation priorities, the NEPA process for the Capital Beltway Study was not completed and a DEIS was not published. A brief description of the ARDS, excluding the No Build, is provided below.

[5] Transportation System Management (TSM) are actions that improve the operation and coordination of transportation services and facilities.

3.4.1 Alternative 2 – 6&4 Build Alternative (6 General Purpose & 4 Express Toll Lanes includes TSM/Transportation Demand Management (TDM) Strategies)[6]

This alternative would have provided one additional lane per direction that would have been tolled and would have converted one existing GP lane per direction to be tolled. Both lanes would have been concurrent flow and marked using pavement striping (no barrier separation from the GP lanes). The proposed typical section would have included six GP lanes and four ETLs (**Figure 3-1**).

Figure 3-1: 6 General Purpose & 4 Express Toll Lanes Typical Section

TSM/TDM included measures to optimize the existing transportation system (TSM) and measures to affect the demand on the existing system (TDM). The strategies were improvements that would have increased safety and enhanced operation without any increase in lane capacity. The TDM strategies focused on system demand and techniques to change drivers' behavior. Typical solutions would have included modest interchange improvements, employer participating flexible work hour or telecommuting programs, and parking restrictions/fees.

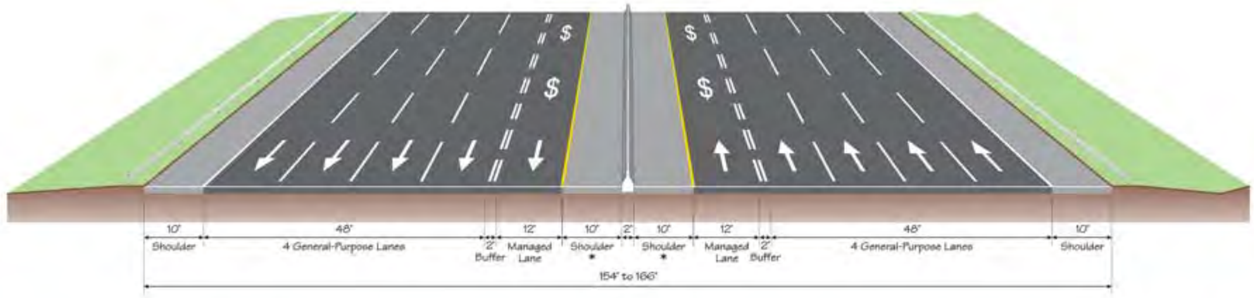
3.4.2 Alternative 3 – 8&2 Build Alternative (8 General Purpose & 2 Express Toll Lanes includes TSM/TDM Strategies)

This alternative would have provided one additional concurrent flow (no barrier separation) lane per direction that would have been tolled. The typical section would have included eight GP lanes and two ETLs (**Figure 3-2**).

A modified version of Alternative 3 has been included in this study as Alternative 5. More detail on Alternative 5 is provided in **Section 4.2**.

[6] Travel Demand Management (TDM) is a variety of strategies, techniques, or incentives aimed at providing the most efficient and effective use of existing transportation services and facilities (e.g., rideshare and telecommuting promotion, managed lanes, preferential parking, road pricing, etc.)

Figure 3-2: 8 General Purpose Lanes & 2 Express Toll Lanes Typical Section



* INSIDE SHOULDERS VARY FROM 4' TO 10'

3.5 West Side Mobility Study

The 2009 West Side Mobility Study, a joint study conducted by MDOT SHA and VDOT, evaluated potential improvements along I-495, the I-270 spurs, and the I-270 mainline between the VDOT I-495 Express Lanes and I-370/ICC/MD 200 (MDOT and VDOT, 2009). In this feasibility study, a wide range of short-term, mid-term and long-term improvements were considered. The study resulted in a narrowed range of three long-term alternatives for further study: Alternative 1, Alternative 4 and Alternative 5. The recommended alternatives included road widening and would provide a managed lane system consisting of one or two managed lanes in both directions that would connect the VDOT Express lanes with the all-electronic toll lanes on MD 200. A brief description of the recommended long-term alternatives is provided below.

3.5.1 Alternative 1: One-Lane Managed Lane System

Alternative 1 would have provided a one-lane managed lane system in each direction throughout the study corridor. The American Legion Bridge would have been widened to accommodate one extra lane per direction, resulting in a total of six lanes per direction plus full shoulders. This alternative would have provided one managed lane, four GP lanes, and one auxiliary lane per direction across the bridge. The section of the Capital Beltway located in Maryland between the American Legion Bridge and the I-270 West Spur would have been widened by one lane in each direction resulting in a total of five lanes per direction. This alternative would have provided one managed lane and four GP lanes per direction along the Capital Beltway.

There would have been no widening on the I-270 Spurs or mainline, but the existing peak period HOV lanes would have been converted to managed lanes. This would have provided one managed lane and two to three GP lanes on the I-270 West Spur; one managed lane and two to three GP lanes on the I-270 East Spur; one managed lane and five GP lanes on the I-270 mainline south of Montrose Road; and one managed lane, three GP lanes, and two Collector-Distributer (C-D) Road lanes on I-270 north of Montrose Road.

A modified version of Alternative 1 has been included in this study as Alternative 5. More detail on Alternative 5 is provided in Section 4.2.

3.5.2 Alternative 4: Two-Lane Managed Lane System

Alternative 4 would have provided a two-lane managed lane system in each direction throughout the study corridor. The American Legion Bridge would have been widened to accommodate one extra lane per direction, and this alternative would have also included converting one GP lane to a managed lane to provide two managed lanes, three GP lanes, and one auxiliary lane per direction. The section of the Capital Beltway located in Maryland between the American Legion Bridge and I-270 West Spur would have been widened by one lane in each direction, and this alternative would have included converting one GP lane to a managed lane to provide two managed lanes and three GP lanes per direction.

The I-270 West Spur would have been widened to accommodate one additional lane and a concrete traffic barrier between the median two lanes, which would have been operated as managed lanes, and the GP lanes. The HOV lane would have been converted to a managed lane. The I-270 East Spur would have been widened to accommodate a concrete traffic barrier between the median lane, which would have been converted from a peak period HOV lane to a managed lane, and the GP lanes. The total number of lanes on the I-270 East Spur would have been the same as the existing condition.

The I-270 mainline between the Y-Split interchange and the start of the C-D Road system south of Montrose Road would have been widened to provide an additional lane. The left two lanes in each direction would have been operated as managed lanes and separated from the right five lanes by a four-foot buffer. The HOV lane would have been converted to a managed lane. Within the C-D Road section, from south of Montrose Road to I-370, the mainline would have been reconfigured and widened to provide an additional lane. The left two lanes in each direction would have been operated as managed lanes and separated from the GP lanes by a concrete traffic barrier. The HOV lane would have been converted to a managed lane. The concrete barrier between the mainline and C-D Road would have been removed, and the GP and C-D Road lanes would have been separated by a four-foot buffer.

3.5.3 Alternative 5: Two-Lane Managed Lane System with Restriping

Alternative 5 would have provided a two-lane managed lane system in both directions throughout the study corridor; however, the additional capacity in the I-270 mainline corridor would have been provided by restriping the section in each direction between the median barrier and outside barrier separating the C-D Road from the GP lanes.

The American Legion Bridge would have been widened to accommodate one extra lane per direction, and this alternative would have also include converting one GP lane to a managed lane to provide two managed lanes, three GP lanes, and one auxiliary lane per direction, similar to Alternative 4. The section of the Capital Beltway located in Maryland between the American Legion Bridge and I-270 West Spur would have been widened by one lane in each direction, and this alternative would have included converting one GP lane to a managed lane to provide two managed lanes and three GP lanes per direction, similar to Alternative 4.

The I-270 West Spur would have been widened to accommodate one additional lane and a concrete traffic barrier between the median two lanes, which would have been operated as managed lanes, and the GP lanes. The HOV lane would have been converted to a managed lane. The I-270 East Spur would have been widened to accommodate a concrete traffic barrier between the median lane, which would have been converted from a peak period HOV lane to a managed lane, and the GP lanes. The total number of lanes on the I-270 East Spur would have been the same as the existing condition.

The I-270 mainline between the Y-Split interchange and the start of the C-D Road system south of Montrose Road would have been widened to provide an additional lane. The left two lanes in each direction would have been operated as managed lanes and separated from the right five lanes by a four-foot buffer. The HOV lanes would have been converted to managed lanes. Within the C-D Road section, from south of Montrose Road to I-370, the mainline would have been restriped to provide an additional lane and a two-foot buffer between the left two lanes, which would have been operated as managed lanes, and the remainder of the highway. To accommodate the additional lane and two-foot buffer on the mainline, the median shoulder would have been reduced to a two-foot offset and the right shoulder would have been reduced to nine feet. The HOV lanes would have been converted to managed lanes.

3.6 I-270 Innovative Congestion Management

In April 2017, the Governor of Maryland announced the $100 million I-270 ICM Contract to be implemented as a progressive design-build contract. The I-270 ICM is providing a series of projects to improve mobility and safety at key points along I-270. The programmatic approach is to implement a series of improvement projects targeted to reduce congestion at key bottlenecks along the corridor. The overall program would consist of distinct improvements that increase capacity and vehicular throughput and address safety deficiencies by strategically reducing or eliminating these existing bottlenecks. The projects that make up this contract will result in an automated, smart traffic system on I-270 between I-70 and I-495. Improvements include the addition of GP lanes, the addition or extension of auxiliary lanes, and corridor wide adaptive ramp metering. The additional lanes are being added through the narrowing of lanes and shoulders along with minimal widening where needed.

All improvements are being implemented within the existing roadway right-of-way and are anticipated to be completed in 2021; therefore, the improvements were assumed to be part of the existing conditions along I-270 during the development of the alternatives for this Study. A brief description of the I-270 ICM improvements within the Study corridor is provided below.

3.6.1 Southbound 5A (SB 5A): Reconfigure Exit Lanes to I-370

This improvement involves restriping SB I-270 approaching the exit to I-370 so the outside lane becomes the right lane on the two-lane exit ramp to I-370. The interior lane next to the right lane on I-270 will become a choice lane for vehicles to exit on the ramp to I-370 or continue south on I-270. This improvement was constructed and is open to traffic.

3.6.2 Southbound 6 (SB 6): Create Auxiliary Lane in Local Lanes South of Shady Grove Road

This improvement involves creating a third local lane by providing an auxiliary lane between the slip ramps on SB I-270 south of Shady Grove Road. The entrance slip ramp from the express lanes will be connected to the first exit slip ramp to the express lanes. As of May 2020, this improvement is under construction.

3.6.3 Southbound 7 (SB 7): Create Auxiliary Lane in Local Lanes Between MD 28 and MD 189

This improvement involves creating an auxiliary (third) lane in the local lanes on SB I-270 by connecting the entrance from MD 28 to the exit to MD 189. As of May 2020, this improvement is planned to be completed by the end of 2020.

3.6.4 Southbound 8 (SB 8): Reconfigure Local Lanes Between MD 189 and Montrose Road

This improvement involves developing a third lane in the local lanes on SB I-270 by connecting the entrance ramp from MD 189 with the exit ramp to Montrose Road. The existing inside (left) local lane becomes a dedicated exit at the slip ramp to the express lanes north of Montrose Road and two lanes continue to the exit to Montrose Road. As of May 2020, this improvement is under construction.

3.6.5 Southbound 10 (SB 10): Maintain Three Lanes from I-270 and Drop Right Lane on I-495 at I-270/I-495 Merge

This improvement involves restriping the I-495 outer loop at the merge with the SB I-270 West Spur. Instead of dropping the inside (left) lane from the I-270 spur, the three lanes from I-270 would continue on I-495 and the right lane on I-495 would drop to maintain five lanes. This improvement was constructed and is open to traffic.

3.6.6 Southbound 12 (SB 12): Create Additional Travel Lane Between Montrose Road and Democracy Boulevard

This improvement consists of restriping SB I-270 to provide an additional travel lane within the existing typical section from the slip ramp entrance to the express lanes north of Montrose Road to the interchange at Democracy Boulevard on the West Spur, a distance of approximately 3.1 miles. As of May 2020, this improvement is under construction.

3.6.7 Northbound 1 (NB 1): Create Additional Travel Lane Between Democracy Boulevard and Montrose Road

This improvement involves restriping NB I-270 to provide an additional travel lane within the existing typical section between the entrance from Democracy Boulevard on the I-270 West Spur to the slip ramp exit to the local lanes just north of Montrose Road, a distance of approximately 2.7 miles. As of May 2020, this improvement is under construction.

3.6.8 Northbound 2 (NB 2): Create Auxiliary Lane in Local Lanes Between MD 189 and MD 28

This improvement involves creating an auxiliary (third) lane in the local lanes on NB I-270 by connecting the entrance from MD 189 to the exit to MD 28. This concept also involves restriping the NB express lanes within the existing typical section to create an auxiliary lane by connecting the entrance slip ramp from the local lanes south of MD 28 with the exit slip ramp to the local lanes north of MD 28. As of May 2020, this improvement is planned to be completed by the end of 2020.

3.6.9 Northbound 3 (NB 3): Close Loop Ramp from NB Shady Grove Road to NB I-270; Close Slip Ramp to Express Lanes North of Shady Grove Road

This improvement involves closing the existing loop ramp from NB Shady Grove Road to NB I-270. NB Shady Grove Road will be reconfigured to provide dual left turn lanes in the median north of the existing bridge over I-270, and a new left turn spur will be constructed at the existing intersection to connect with the existing entrance ramp from SB Shady Grove Road.

This improvement also involves closing the slip ramp exit from the local lanes on NB I-270 to the express lanes south of the I-370 interchange. The left (third) local lane that drops at the slip ramp in the existing configuration will be extended to connect with the exit to I-370. As of May 2020, this improvement is planned to be completed by the end of 2020.

3.6.10 Adaptive Ramp Metering

Adaptive ramp meters will be installed at every SB and NB entrance ramp from the arterials to I-270, including the ramp from I-370 to SB I-270. As of May 2020, this improvement is planned to be completed by the end of 2020.

Similar short-term roadway and technological improvements as those proposed as part of the I-270 ICM were evaluated as Alternative 2 in the Preliminary Range of Alternatives for this Study and will be considered as part of each ARDS. More detail on Alternative 2 is provided in **Section 4.2** of this report.

4

4 ALTERNATIVES DEVELOPMENT PROCESS AND INITIAL SCREENING OF ALTERNATIVES

This section of the report documents the alternatives development and evaluation process from the Preliminary Range of Alternatives to the Screened Alternatives. This section includes:

- Identification of the Preliminary Range of Alternatives;
- Description of the criteria and methodology used to screen the Preliminary Range of Alternatives;
- Evaluation of the alternatives using the screening criteria;
- Identification of the Screened Alternatives;
- Evaluation of the Screened Alternatives using the screening criteria;
- Consideration of agency and public input; and
- Identification of the steps for evaluating the ARDS.

4.1 Overview of Alternatives Development and Screening Process

The alternatives identified and documented in this report were conceived from previous studies and planning documents, based on proposed engineering improvements, and include input from Federal, State, and local regulatory agencies and the public during the NEPA scoping process, including four Public Scoping Workshops held April 17, 18, 19 and 24, 2018. Specific agency and public comments related to the alternatives received during the scoping period included retaining GP lanes; including TDM solutions; adding or retaining existing HOV options; incorporating transit elements; and combining managed lanes and HOV on I-270. (Information from the NEPA scoping period, including public comments, is included in the *Scoping Report* available on the project website, https://495-270-p3.com/.)

Additional agency and public comments received during and after the July 2018 Public Workshops resulted in the inclusion of Alternative 13C as well as modifications to the preliminary alternatives. These changes are discussed in more detail in **Section 4.2**.

The initial screening of alternatives considered the initiatives and projects outlined in *Visualize2045* Plan, the latest Constrained Long-Range Plan (CLRP) which was approved by the National Capital Region

Transportation Planning Board (TPB) on October 17, 2018.[7] The *Visualize2045* Plan identified Seven Aspirational Initiatives for a Better Future. One of the seven initiatives was "Expand Express Highway Network", which includes congestion-free toll roads, building on an emerging toll road network and new opportunities for transit for express buses to travel in the toll lanes. See this link for more information on this initiative:

http://mwcog.maps.arcgis.com/apps/Cascade/index.html?appid=debc2550777b4cc2bae2364c7712a151

Three specific, financially constrained projects in the *Visualize2045* Plan are:

- CLRP-constrained element ID-1182: I-95/I-495 component of Traffic Relief Plan to include two managed lanes in each direction, between the Baltimore Washington Parkway and the Virginia State Line/Potomac River

  http://www1.mwcog.org/clrp/projects/clrp-report.asp?PROJECT_ID=1182
- CLRP-constrained element ID-3281: I-95/I-495 component of Traffic Relief Plan to include two managed lanes in each direction, between the Baltimore Washington Parkway and the Virginia State Line/Potomac River at the American Legion Bridge

  http://www1.mwcog.org/clrp/projects/clrp-report.asp?PROJECT_ID=3281
- CLRP-constrained element ID-1186: I-270 component of Traffic Relief Plan, to include two managed lanes in each direction, between I-495 and I-70/US 40

  http://www1.mwcog.org/clrp/projects/clrp-report.asp?PROJECT_ID=1186

Whether an alternative was consistent with the *Visualize2045* Plan was also considered in the initial screening process.

The MDOT SHA developed a Preliminary Range of Alternatives including the No Build, GP lanes, managed lanes, and transit alternatives. To narrow the Preliminary Range of Alternatives, the MDOT SHA performed an assessment to determine the reasonableness and feasibility of each alternative. One of the key elements of the NEPA process is determining which alternatives from this list will be subject to detailed analysis in the EIS. To reach that decision, the project sponsor and Lead Federal Agency must perform evaluations concerning the ability of an alternative to meet the Study's stated Purpose and Need. The Council on Environmental Quality guidance states that "reasonable alternatives include those that are practical and feasible from the technical and economic standpoint and using common sense…"[8] In creating a "reasonable range of alternatives," application of any single or group of factors relevant to satisfying the Study's goal can lead to an alternative being eliminated during this screening process. In general, an alternative that does not meet the Study's Purpose and Need does not have to be considered in the EIS.

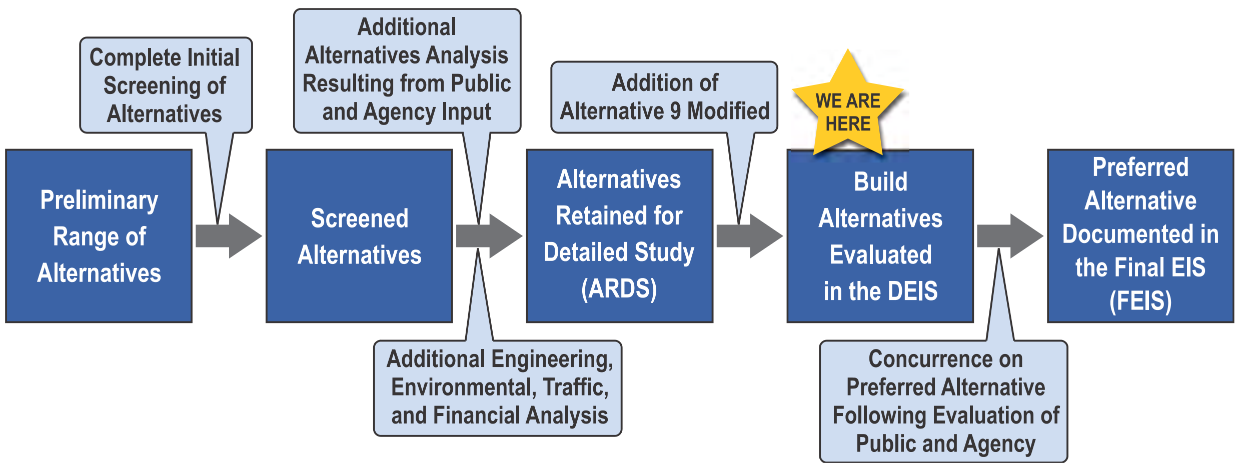
[7] https://www.mwcog.org/*Visualize2045*/document-library/

[8] CEQ, "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations" (March 16, 1981), Question 2a.

The initial step in the screening of alternatives included an assessment of the Preliminary Range of Alternatives by applying the screening criteria related to the Study's Purpose and Need. Using currently available information at that time, an alternative was recommended to be dropped from further consideration if it clearly did not meet the Study's Purpose and Need. Based on the initial screening, MDOT SHA recommended that eight alternatives be dropped from further consideration. The remaining Screened Alternatives met some elements of the Purpose and Need, but required additional analysis to determine their viability to adequately meet the Purpose and Need or for being financially viable.

Through this screening process, the environmental impacts, traffic analyses and financial viability resulting from the Screened Alternatives were considered when determining the reasonableness of the alternatives and subsequently the ultimate recommendations of ARDS, and are documented in this report, the environmental technical reports, and the DEIS. The alternatives screening process used for this Study is illustrated in **Figure 4-1**.

Figure 4-1: Alternatives Evaluation Process



4.2 Preliminary Range of Alternatives

As described in **Chapter 3** of this report, MDOT SHA, MDOT MTA, and VDOT have performed numerous studies to evaluate a myriad of transportation solutions on I-495 and I-270. Options from these previous studies and planning documents were incorporated into the list of Preliminary Range of Alternatives for this Study. In particular, MDOT SHA reviewed alternatives that had been assessed to some level of detail from the following studies: the 1998 Capital Beltway HOV Feasibility Study, 2002 Capital Beltway/Purple Line Study, 2002 I-270/US 15 Multi-Modal Corridor Study, 2004 Capital Beltway Study, and the 2009 West Side Mobility Study. As noted in Section 4.5, input from Federal, State, and local regulatory agencies and the public during the NEPA scoping process, including four Public Scoping Workshops held April 17, 18, 19 and 24, 2018 was considered in the development of preliminary alternatives. Some of the agency and public comments related to the alternatives received during the scoping period included incorporating transit elements; retaining GP lanes; including TDM solutions; adding or retaining existing HOV options; and combining priced managed lanes and HOV lanes on I-270.

A total of 15 alternatives were identified, including a No Build Alternative, TSM/ TDM, transit alternatives, and highway build alternatives. Within the highway build alternatives, GP lanes and managed lanes were considered. The management solutions included HOV lanes, and Priced Managed lanes,[9] which may include ETL and HOT lanes. The transit alternatives considered three transit modes: heavy rail, light rail, and bus. Some of the alternatives have lettered options which reflect whether the options are exclusively applicable to I-495 or I-270 or are related to a specific transit mode.

Vehicle eligibility includes restricting the use of managed lanes to specific types of vehicles. A common eligibility restriction on managed lanes is requiring a minimum vehicle occupancy, such as three or more occupants (HOV 3+). Occupancy restrictions allow for the movement of more people relative to the total number of vehicles. Priced managed lane facilities often implement a combination of variable tolling and vehicle occupancy requirements whereby high occupancy vehicles can use the facility for a reduced toll rate or free of charge. These lanes are labeled as HOT lanes. Access control limits the locations where vehicles can access the managed lanes. This approach reduces the potential turbulence associated with unlimited access where vehicles weave in and out of lanes at any location, allows for less tolling infrastructure, and for more effective vehicle eligibility enforcement.

The Preliminary Range of Alternatives presented to the public and agencies in July 2018 included:

- Alternative 1: No Build
- Alternative 2: Transportation System Management/Transportation Demand Management (TSM/TDM)
- Alternative 3: Add 1 GP Lane
- Alternative 4: 1-Lane, HOV Managed Lane Network
- Alternative 5: 1-Lane, Priced Managed Lane Network
- Alternative 6: Add 2 GP Lanes
- Alternative 7: 2-Lane, HOV Managed Lanes Network
- Alternative 8: 2-Lane, Priced Managed Lanes Network on I-495 and 1-Lane Priced and 1-Lane HOV Managed Lane Network on I-270
- Alternative 9: 2-Lane, Priced Managed Lanes Network

[9] **Priced Managed Lanes** combines two highway management tools:
Congestion Pricing: The use of pricing to moderate demand during peak periods is common in sectors such as power and air travel. Similarly, the concept of value pricing within the highway sector involves the introduction of road user charges that vary with the level of congestion and/or time of day, providing incentives for motorists to shift some trips to off-peak times, less-congested routes, or alternative modes. Higher prices may also encourage motorists to combine lower-valued trips with other journeys or eliminate them entirely. When peak-period volumes are high, a shift in a relatively small proportion of trips can lead to substantial reductions in overall congestion levels and more reliable travel times.
Lane Management: The rationale for lane management is to maintain a superior level of service and provide an alternative to general purpose lanes during peak travel periods. Lane management involves restricting access to designated highway lanes based on occupancy or vehicle type. By limiting the number of vehicles in designated lanes, it is possible to maintain a desirable level of traffic service. Managed lanes are separated from general purpose lanes by differentiating pavement striping or physical barriers, with entry often but not always limited to designated locations.
(https://ops.fhwa.dot.gov/publications/fhwahop13007/pmlg1_0.htm#12)

- Alternative 10: 2-Lane, Priced Managed Lanes Network on I-495 and I-270 and retain 1 HOV Managed Lane Network on I-270 only
- Alternative 11: Collector-Distributor (C-D) Lanes on I-495
- Alternative 12A: Contraflow Lane[10] on I-495
- Alternative 12B: Contraflow Lane on I-270
- Alternative 13A: Priced Managed Reversible Lanes[11] Network on I-495
- Alternative 13B: Priced Managed Reversible Lanes Network on I-270
- Alternative 14A: Heavy Rail[12]
- Alternative 14B: Light Rail[13]
- Alternative 14C: Fixed Guideway Bus Rapid Transit (BRT)[14] (off alignment)
- Alternative 15: Dedicated Bus Managed Lane Network on I-495 and I-270

Table 4-1 presents a summary of the Preliminary Range of Alternatives. Following **Table 4-1**, **Figure 4-2** includes four pages of the typical sections of the Preliminary Range of Alternatives.

Modifications to the Preliminary Range of Alternatives were made in response to agency and public input received during and after the Alternatives Public Workshops held July 17, 18, 24 and 25, 2018. In response to agency and public comments to retain alternatives that maintain the HOV lanes on I-270, MDOT SHA defined priced managed lanes as HOT or ETL and added Alternative 13C: Priced Managed Reversible Lanes Network and 1-Lane HOV Managed Lane Network on I-270 (refer to **Table 4-2)**. On I-270, Alternative 13C would maintain the one existing HOV lane in each direction and adds two ETL reversible lanes. Refer to Section 4.4.16 for additional information on this alternative. For alternatives that would retain the existing HOV lanes on I-270 (8, 10, 13C), the added priced manages lanes were defined as ETL, where all vehicles in the ETL would be tolled. For alternatives that would involve the conversion of the existing HOV lanes on I-270 (5, 9, 13B), the priced managed lanes were defined as HOT lanes. For purposes of this

[10] **Contraflow Lane** is a lane operating adjacent to but in the opposite direction of the normal flow of traffic and designated for peak-direction travel; separated by a movable barrier at high speed lanes.
[11] **Reversible Lane** is a facility in which the direction of traffic flow can be changed at different times of the day to match peak direction of travel, typically inbound in the morning and outbound in the afternoon.
NOTE: Unless otherwise noted, the definitions for the terms above are from the *National Cooperative Highway Research Program, Research Report 835, Guidelines for Implementing Managed Lanes*. Transportation Research Board. 2016.
[12] **Heavy Rail** is a mode of transit service (also called metro, subway, rapid transit, or rapid rail) operating on an electric railway with the capacity for a heavy volume of traffic. It is characterized by high speed and rapid acceleration passenger rail cars operating singly or in multi-car trains on fixed rails; separate rights-of-way from which all other vehicular and foot traffic are excluded; sophisticated signaling, and high platform loading. (http://www.apta.com/resources/statistics/Pages/glossary.aspx)
[13] **Light Rail** is a mode of transit service (also called streetcar, tramway, or trolley) operating passenger rail cars singly (or in short, usually two-car or three-car trains) on fixed rails in right-of-way that is often separated from other traffic for part or much of the way. Light rail vehicles are typically driven electrically with power being drawn from an overhead electric line via a trolley or a pantograph; driven by an operator on board the vehicle; and may have either high-platform loading or low-level boarding using steps. (http://www.apta.com/resources/statistics/Pages/glossary.aspx)
[14] **Bus Rapid Transit** is a high-quality bus-based transit system that delivers fast and efficient service that may include dedicated lanes, busways, traffic signal priority, off-board fare collection, elevated platforms and enhanced stations. (https://www.transit.dot.gov/research-innovation/bus-rapid-transit)

study, the existing HOV 2+ lanes would be converted to HOT lanes, which could include the following potential toll pricing structure:

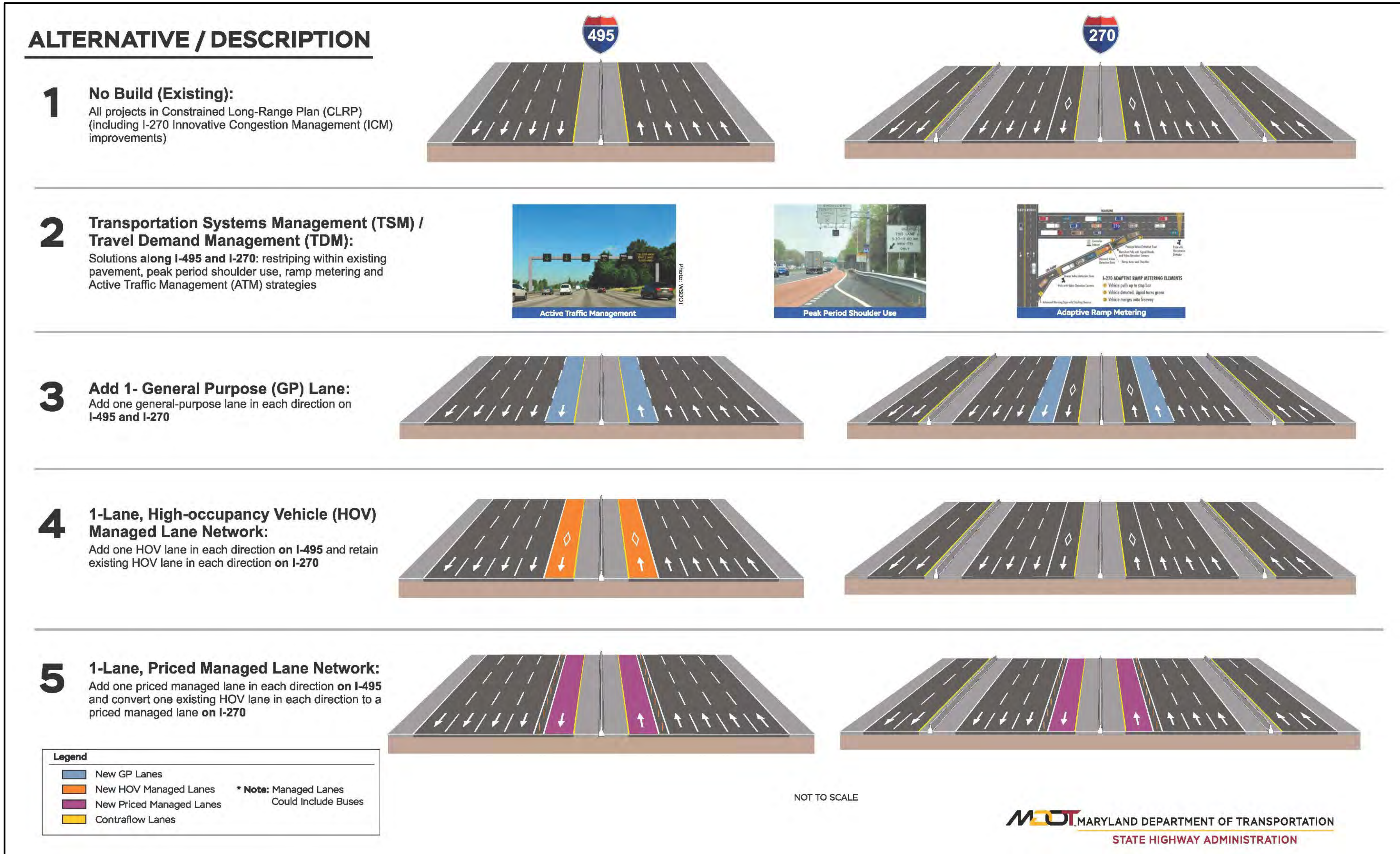
1. Qualifying or eligible HOVs (HOV 3+) may use the managed lanes for free (under 23 U.S.C 166 authority) or at a reduced cost (under Value Pricing Pilot Program [VPPP] authority). The decision regarding the use of reduced toll or no toll for eligible HOVs has not been made for this Study, but is anticipated prior to the FEIS.

2. All other lower-occupancy vehicles (two-occupant and single occupant vehicles [SOV]) may be tolled at the full toll rate.

Table 4-1: Summary of Preliminary Range of Alternatives

	Alternative No.	Name	Description	Applicable Roadway	Typical Lane Configuration
	1	No Build	No Build includes all projects in financially CLRP (including I-270 ICM improvements)	I-495 I-270	8 GP Lanes 10 GP Lanes + 2 HOV
	2	TSM/TDM	TSM/TDM solutions **along I-495 and I-270** including restriping within existing pavement, peak period shoulder use, ramp metering and ATM	I-495 I-270	8 GP Lanes 10 GP Lanes + 2 HOV
1 Lane	3	Add 1 GP Lane	Add one GP lane in each direction **on I-495 and I-270**	I-495 I-270	10 GP Lanes 12 GP Lanes + 2 HOV
1 Lane	4	1-Lane, HOV Managed Lane Network	Add one HOV lane in each direction **on I-495** and retain existing HOV lane in each direction **on I-270**	I-495	8 GP Lanes + 2 HOV
1 Lane	5	1-Lane, Priced Managed Lane Network	Add one priced managed lane in each direction **on I-495** and convert one existing HOV lane in each direction to a priced managed lane **on I-270**	I-495 I-270	8 GP Lanes + 2 PML 10 GP Lanes + 2 PML
2 Lane	6	Add 2 GP Lanes	Add two GP lanes in each direction **on I-495 and I-270**	I-495 I-270	12 GP Lanes 14 GP Lanes + 2 HOV
2 Lane	7	2-Lane, HOV Managed Lanes Network	Add two HOV lanes in each direction **on I-495** and retain one existing HOV lane and add one HOV lane in each direction **on I-270**	I-495 I-270	8 GP Lanes + 4 HOV 10 GP Lanes + 4 HOV
2 Lane	8	2-Lane, Priced Managed Lanes Network on I-495 1-Lane Priced and 1-Lane, HOV Managed Lane network on I-270 only	Add two priced managed lanes in each direction **on I-495** and add one priced managed lane in each direction and retain one existing HOV lane in each direction **on I-270**	I-495 I-270	8 GP Lanes + 4 PML 10 GP Lanes + 2 HOV + 2 PML
2 Lane	9	2-Lane, Priced Managed Lanes Network	Add two priced managed lanes in each direction **on I-495** and convert one existing HOV lane to a priced managed lane and add one priced managed lane in each direction **on I-270**	I-495 I-270	8 GP Lanes + 4 PML 10 GP Lanes + 4 PML
2 Lane	10	2-Lane, Priced Managed Lanes Network and retain 1-Lane HOV Managed Lane Network on I-270 only	Add two priced managed lanes in each direction **on I-495** and **on I-270** and retain one existing HOV lane in each direction on **I-270 only**	I-495 I-270	8 GP Lanes + 4 PML 10 GP Lanes + 2 HOV + 4 PML
2 Lane	11	Collector/Distributor on I-495	Physically separate traffic using C-D lanes, adding two GP lanes in each direction **on I-495**	I-495	12 GP Lanes
Reversible	12A	Contraflow Lane on I-495	Convert existing GP lane **on I-495** to contraflow lane during peak periods	I-495	8 GP Lanes
Reversible	12B	Contraflow Lane on I-270	Convert existing HOV lane **on I-270** to contraflow lane during peak periods	I-270	10 GP Lanes + 2 HOV
Reversible	13A	Priced Managed, Reversible Lanes Network on I-495	Add two priced managed reversible lanes **on I-495**	I-495	8 GP Lanes + 2 Reversible
Reversible	13B	Priced Managed, Reversible Lanes Network on I-270	Convert existing HOV lanes to two priced managed reversible lanes **on I-270**	I-270	10 GP Lanes + 2 Reversible
Reversible	13C	Priced Managed, Reversible Lanes Network and HOV Managed Lane Network on I-270 only	Add two priced managed reversible lanes and retain one existing HOV lane in each direction **on I-270**	I-270	10 GP Lanes + 2 Reversible + 2 HOV
Transit	14A	Heavy Rail	Heavy rail transit	I-495 I-270	N/A
Transit	14B	Light Rail	Light rail transit	I-495 I-270	N/A
Transit	14C	Fixed Guideway BRT (off alignment)	Fixed guideway BRT off alignment of existing roadway	I-495 I-270	N/A
Transit	15	Dedicated Bus Managed Lane Network on I-495 and I-270	Add one dedicated bus lane on I-495 and I-270	I-495 I-270	8 GP + 2 Bus lanes 6 GP + 2 HOV + 2 Bus Lanes

Figure 4-2: Typical Sections of the Preliminary Range of Alternatives

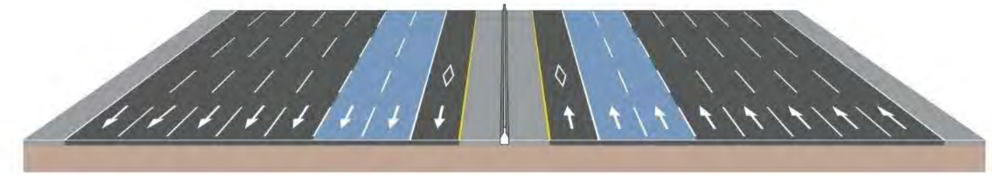


ALTERNATIVE / DESCRIPTION

I-495 | I-270

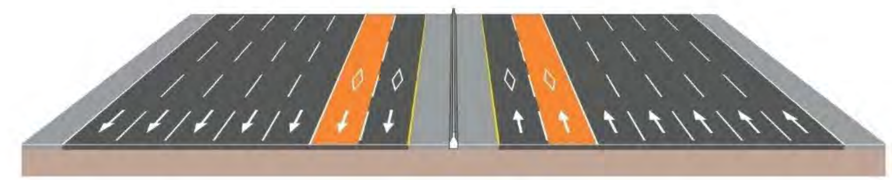
6 Add 2 General Purpose (GP) Lanes:

Add two general-purpose lanes in each direction **on I-495 and I-270**



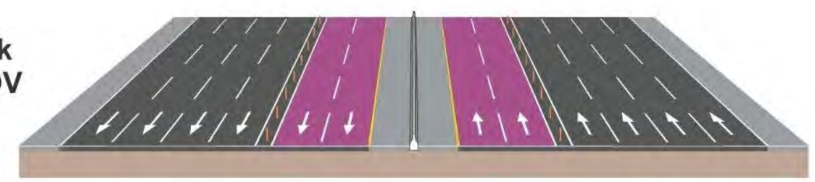
7 2-Lane, High-occupancy Vehicle (HOV) Managed Lane Network:

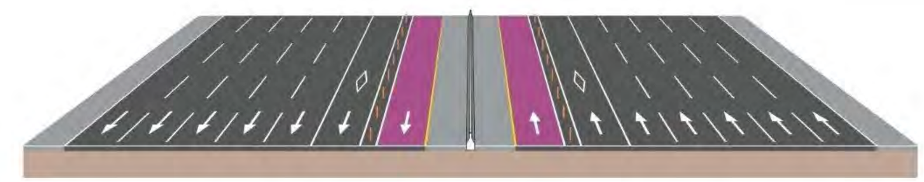
Add two HOV managed lanes in each direction **on I-495** and retain one existing HOV lane and add one HOV managed lane in each direction **on I-270**



8 2-Lane, Priced Managed Lanes Network on I-495, 1-Lane Priced and 1-Lane, HOV Managed Lane network on I-270 only

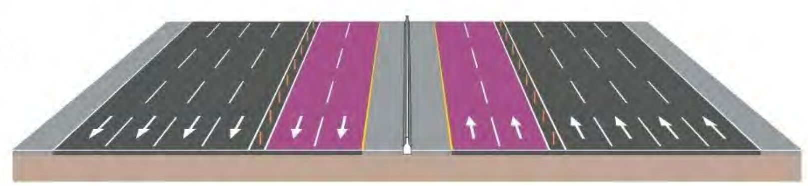
Add two priced managed lanes in each direction **on I-495** and add one priced managed lane and retain one HOV lane in each direction **on I-270**

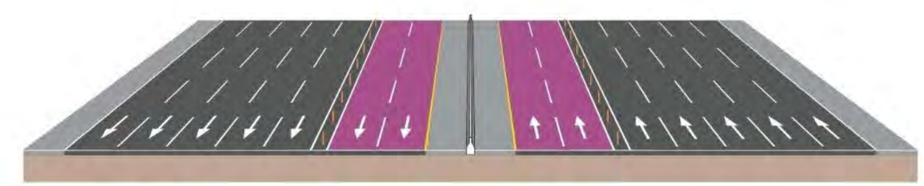




9 2-Lane, Priced Managed Lane Network:

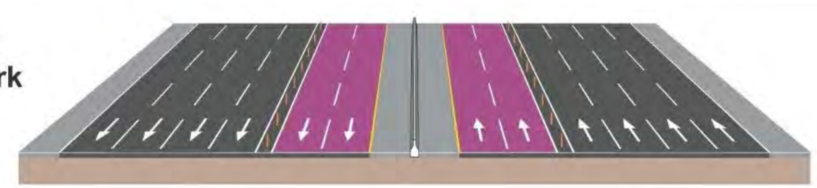
Add two priced managed lanes in each direction **on I-495** and convert one existing HOV lane to a priced managed lane and add one priced managed lane in each direction **on I-270**

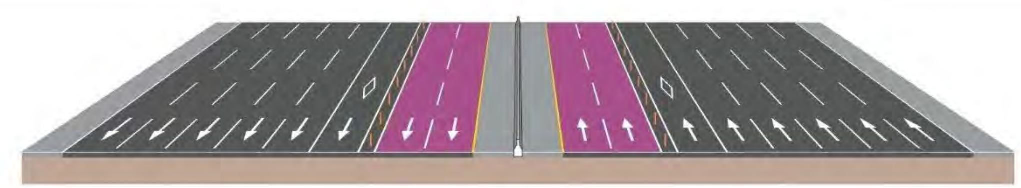




10 2-Lane, Priced Managed Lane Network and 1-Lane HOV Managed Lane Network on I-270 only

Add two priced managed lanes in each direction **on I-495 and on I-270** and retain one existing HOV lane in each direction **on I-270 only**





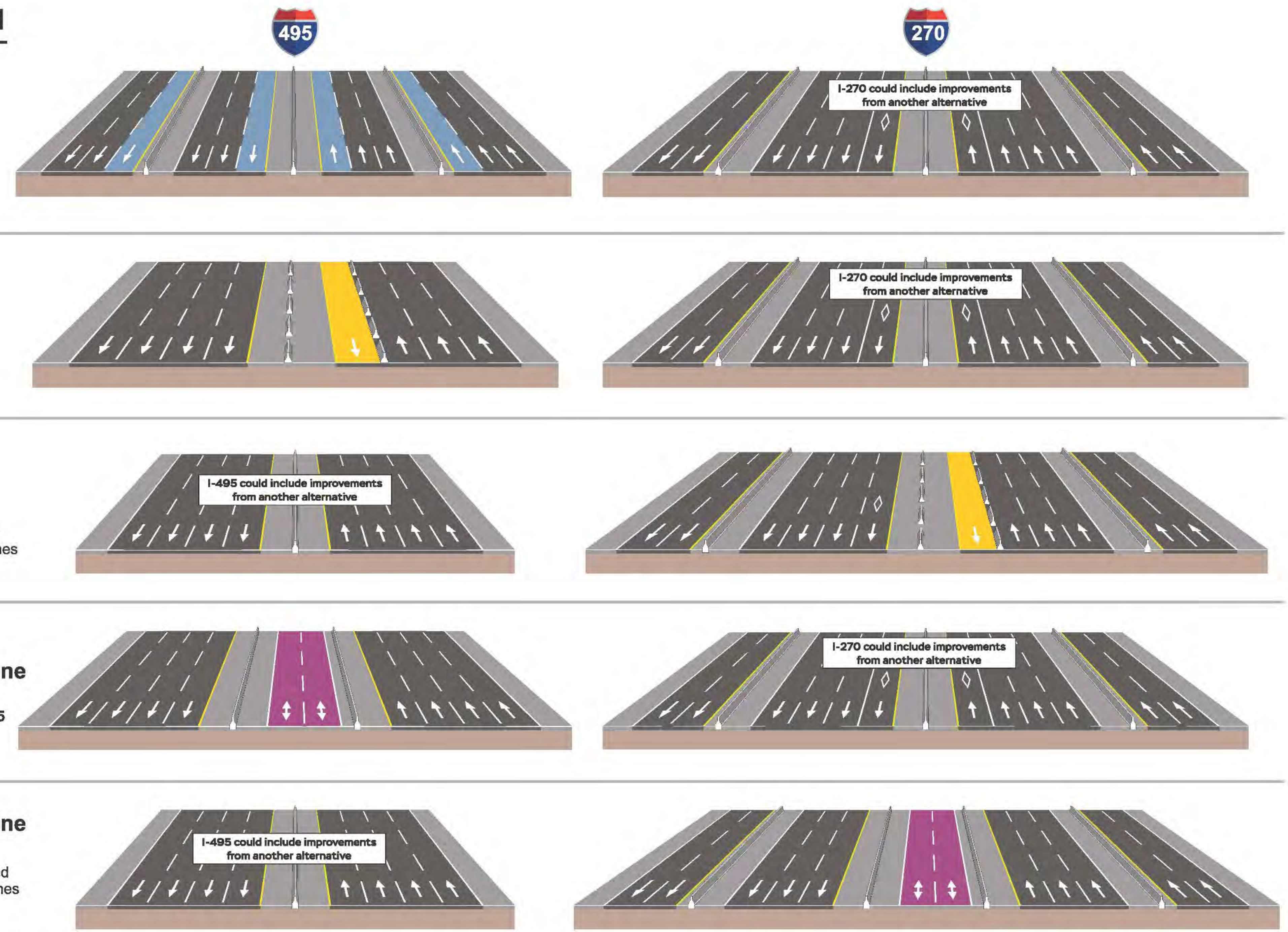
Legend

- New GP Lanes
- New HOV Managed Lanes
- New Priced Managed Lanes
- Contraflow Lanes

* **Note:** Managed Lanes Could Include Buses

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

ALTERNATIVE / DESCRIPTION



11 **Collector/Distributor on I-495:**
Physically separate traffic using collector-distributor (C-D) lanes, adding two GP lanes in each direction **on I-495**; retain existing lanes **on I-270**

12A **Contraflow on I-495:**
Convert existing general-purpose lane **on I-495** to contraflow lane during peak periods

12B **Contraflow on I-270:**
Convert existing HOV lane **on I-270** to contraflow lane during peak periods while maintaining GP lanes

13A **Priced Managed, Reversible Lane Network on I-495:**
Add two priced managed reversible lanes **on I-495**

13B **Priced Managed, Reversible Lane Network on I-270:**
Convert existing HOV lanes to two priced managed reversible lanes **on I-270** while maintaining GP lanes

Legend
- New GP Lanes
- New HOV Managed Lanes
- New Priced Managed Lanes
- Contraflow Lanes

*** Note:** Managed Lanes Could Include Buses

MARYLAND DEPARTMENT OF TRANSPORTATION
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ALTERNATIVE / DESCRIPTION

13C Priced Managed, Reversible Lane Network and 1-Lane HOV Managed Lane Network on I-270

14A Heavy Rail

This alternative considers heavy rail transit parallel to the existing I-495 and/or I-270 corridors. Heavy Rail is a mode of transit service (also called metro, subway, rapid transit, or rapid rail) operating on an electric railway with the capacity for a heavy volume of traffic. It is characterized by high speed and rapid acceleration passenger rail cars operating singly or in multi-car trains on fixed rails.

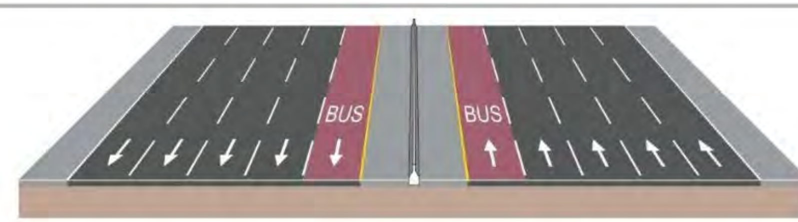
14B Light Rail

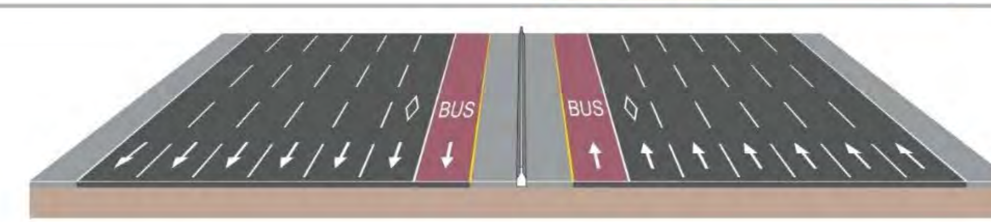
This alternative considers light rail transit parallel to the existing I-495 and/or I-270 corridors, such as the Purple Line currently under construction. Light Rail is a mode of transit service (also called streetcar, tramway, or trolley) operating passenger rail cars singly (or in short, usually two-car or three-car, trains) on fixed rails. Light rail vehicles are typically driven electrically with power being drawn from an overhead electric line via a trolley or a pantograph and driven by an operator on board the vehicle.

14C Fixed Guideway Bus Rapid Transit (Off Alignment)

This alternative considers fixed guideway bus rapid transit (BRT) along a new alignment parallel to the existing I-495 and/or I-270 corridors. Bus Rapid Transit is a high-quality bus-based transit system that delivers fast and efficient service that may include dedicated lanes, busways, traffic signal priority, off-board fare collection, elevated platforms and enhanced stations.

15 Dedicated Bus Managed Lane on I-495 and I-270 Roadways





Legend
- New GP Lanes
- New HOV Managed Lanes
- New Priced Managed Lanes
- Contraflow Lanes

* **Note:** Managed Lanes Could Include Buses

NOT TO SCALE

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Table 4-2: Comparison of Alternatives Nomenclature Between the Preliminary Range of Alternatives and the Screened Alternatives

	Preliminary Range of Alternatives Description		New Description for Screened Alternatives	
Alt No.	Name	Description	Name	Description
5	1-Lane, Priced Managed Lane Network	Add one priced managed lane in each direction on I-495 and convert one existing HOV lane in each direction to a priced managed lane on I-270	1-Lane, HOT Managed Lane Network	Add one HOT managed lane in each direction on I-495 and convert one existing HOV lane in each direction to HOT managed lane on I-270
8	2-Lane, Priced Managed Lanes Network on I-495 1-Lane Priced and 1-Lane, HOV Managed Lane network on I-270 only	Add two priced managed lanes in each direction on I-495 and add one priced managed lane in each direction and retain one existing HOV lane in each direction on I-270	2-Lane, ETL Managed Network on I-495 1-Lane ETL and 1-Lane, HOV Managed Lane network on I-270 only	Add two ETL managed lanes in each direction on I-495 and add one ETL managed lane in each direction and retain one existing HOV lane in each direction on I-270
9	2-Lane, Priced Managed Lanes Network	Add two priced managed lanes in each direction on I-495 and convert one existing HOV lane to a priced managed lane and add one priced managed lane in each direction on I-270	2-Lane, HOT Managed Lane Network	Add two HOT managed lanes in each direction on I-495 and convert one existing HOV lane to a HOT managed lane and add one HOT managed lane in each direction on I-270
10	2-Lane, Priced Managed Lanes Network and retain 1-Lane HOV Managed Lane Network on I-270 only	Add two priced managed lanes in each direction on I-495 and on I-270 and retain one existing HOV lane in each direction on I-270 only	2-Lane, ETL Managed Network on I-495; 2-Lane ETL and 1-Lane, HOV Managed Lane network on I-270 only	Add two ETL managed lanes in each direction on I-495 and on I-270 and retain one existing HOV lane in each direction on I-270 only
13B	Priced Managed, Reversible Lanes Network on I-270	Convert existing HOV lanes to two priced managed reversible lanes on I-270	HOT Managed Reversible Lane on I-270	Converts the existing HOV lanes in both directions to two HOT managed, reversible lanes on I-270
13C	Alternative was added following the July 2018 public meetings in response to public and agency comments		ETL Managed Reversible Lanes and one HOV Managed Lane Network on I-270	Retains the existing HOV lanes in both directions and adds two ETL managed, reversible lanes on I-270

4.3 Screening Criteria for Preliminary Range of Alternatives

The initial step in the screening of alternatives included an assessment of the Preliminary Range of Alternatives by applying the screening criteria related to the Study's Purpose and Need, as well as other concerns, such as regional planning and ability to provide a revenue source, as permitted by FHWA guidance.

As described in the following paragraphs, fifteen criteria, under six major elements related to the Study's Purpose and Need, were used to evaluate and screen the Preliminary Range of Alternatives to the Screened Alternatives. Alternatives that failed to meet the Study's Purpose and Need, based on the available information, were recommended to be dropped from further consideration.

4.3.1 Homeland Security[15]

Quick, unobstructed roadway access is needed during a homeland security threat causing populations to evacuate. Alternatives with additional capacity would assist in accommodating a population evacuation and improving emergency response. With a response of "Yes or No," each alternative was assessed considering whether the alternative provides additional capacity to assist in accommodating population evacuation.

4.3.2 Movement of Goods and Services

Efficient and reliable highway movement is necessary to accommodate passenger and freight travel, and to move goods and services through the region. The ability to move freight, services, and commuting employees through the Study corridors will increasingly depend on the performance of the existing travel lanes on I-495 and I-270. This criterion indicates whether the alternative improves reliability specifically for movement of freight, services, and commuting employees. With a response of "High, Medium, or Low," *does the alternative enhance the movement of freight, services and commuting employees by providing a more reliable trip?*

A rating of "Low" is given for alternatives that would:

- Not improve trip reliability on the Study corridors; or
- Only improve trip reliability in one direction on the Study corridors.

A rating of "Medium" is given for alternatives that would:

- Provide an option that enhances trip reliability in both directions in the near-term, but not at all times and not in the long-term. These alternatives reflect an improvement in trip reliability compared to the No Build but could not consistently provide trip reliability in the long-term.

A rating of "High" is given for alternatives that would:

- Provide an option that enhances trip reliability consistently, in both directions in the near-term and long-term.

4.3.3 Financial Viability

The State of Maryland is committed to providing timely transportation improvements that can accommodate existing and long-term traffic growth. Typical roadway infrastructure improvements are funded through use of Maryland's Transportation Trust Fund. However, the State's traditional funding sources, including the Trust Fund, are unable to effectively finance, construct, operate, and maintain highway systems of the magnitude which may be needed to enhance trip reliability in these Study corridors due to the fiscal constraints of the program and the other State-wide transportation needs. For these types of large projects, such as the I-495 & I-270 Managed Lanes Study, revenue sources that provide adequate funding are needed to support more immediate capacity improvements. The use of alternative funding approaches, such as pricing or tolling or fares, provides the potential to address

[15] Homeland Security is defined by the National Strategy for Homeland Security as "a concerted national effort to prevent terrorist attacks within the United States, reduce America's vulnerability to terrorism, and minimize the damage and recover from attacks that do occur". 2017 Edition – Revision 2, issued October 16, 2017 https://www.dhs.gov/sites/default/files/publications/18_0116_MGMT_DHS-Lexicon.pdf

needed large-scale improvements decades earlier than would otherwise be realized using traditional funding and allows the project to be fiscally-constrained in the metropolitan transportation plan. For example, if MDOT SHA were to fund the construction of one GP lane per direction and re-allocate its entire capital plan expansion budget ($1.4 billion over the next six years), it would take more than a decade to deliver this alternative. This approach would also leave no additional funding available for other MDOT SHA capital projects across the State of Maryland during that timeframe. While MDOT could issue Consolidated Transportation Bonds (CTBs) to finance the construction of GP lanes, MDOT statute imposes a debt limit on CTBs issued and only $1.1 billion of capacity is expected to remain by the end of FY2019. This amount would not be sufficient to construct the GP lanes on I-495 and I-270.

Does this alternative provide a revenue source? Because detailed financial analysis was not available at the time of the initial screening, whether the alternative provides a revenue source from pricing options, tolling or fares that could provide funding is indicated through a "Yes or No" response.

4.3.4 Multimodal Connectivity

Severe congestion on I-495 and I-270 adversely affects the regional and local roadway network, especially in and around the interchanges and arterial roads in the Study area corridors. The congestion on these corridors also has negative effects on access to and usage of other transportation modes, such as transit. Besides enhanced performance on I-495 and I-270 themselves, improvements to provide congestion relief on these facilities will also enhance existing and proposed multimodal transportation services by improving connectivity and mobility through enhancing trip reliability and providing additional travel choices for efficient travel during times of extensive congestion. Improved connections to park-and-ride lots, Metrorail, bus, and other transit facilities are anticipated to occur as a result of addressing congestion on these regional roadways, thus providing a system wide approach to addressing overall transportation needs in the National Capital Region.

Would the alternative enhance connectivity to and between existing transit facilities near the corridor? This criterion considers whether the alternative could enhance access to existing transit facilities and accommodate reliable, more efficient transit service through a "High, Medium, or Low" response. A rating of "High" would both enhance connectivity to and between existing transit facilities near the corridor and provide opportunities for new or modified transit service. A "Medium" rating would provide for one or the other and a "Low" would minimally or not provide for either.

4.3.5 Environmental

Given the highly constrained area surrounding the Study corridors, the potential for environmental effects to environmental features is recognized. Therefore, this criterion was considered as an initial screening criterion as presented to the agencies and public in July 2018. However, consideration of environmental impacts was not a differentiator between the preliminary alternatives at this point in the alternatives screening process. Most of the alternatives are located along the existing I-495 and I-270 corridors and, therefore, have similar physical footprints that only vary based on operational differences. The exception are the two rail transit alternatives, which could potentially have more environmental impacts as they would be on new alignments. The Screened Alternatives were analyzed for environmental impacts.

4.4 Preliminary Range of Alternatives Screening

The following sections describe an assessment of the Preliminary Range of Alternatives by applying the screening criteria related to the Study's Purpose and Need, as well as other concerns, such as regional planning and ability to provide a revenue source that led to the recommendation of carrying an alternative forward for further development and environmental evaluation. Typical sections for each alternative, as shown in **Figure 4-2**, are also included with each discussion.

Following the narrative discussion of the alternatives, **Table 4-3** summarizes the screening results with the seven Screened Alternatives shaded green. **Figure 4-19** shows the typical sections of the Screened Alternatives.

It should be noted that under any alternative with managed lanes, mass transit (buses) would be permitted to use these lanes without being tolled per approval by the Maryland Board of Public Works.[16]

4.4.1 Alternative 1: No Build

The No Build Alternative, often called the base case, includes all projects in the 2040 CLRP for the National Capital Region adopted by the MWCOG - TPB (**Figure 4-3**). The No Build Alternative includes other projects impacting the facilities that are subject to this Study. Specifically, the CLRP reflects the extension of the I-495 express lanes in Virginia from the Dulles Toll Road interchange to the American Legion Bridge. The No Build Alternative also includes the I-270 ICM Contract Project, which is providing a series of projects to improve mobility and safety at key points along I-270 targeted to reduce congestion at key bottlenecks along the corridor. All improvements are being implemented within the existing roadway right-of-way and are anticipated to be completed by the end of 2019. While these improvements will improve mobility and safety, they will not address the long-term capacity need for the I-270 corridor.

Figure 4-3: Alternative 1: No Build Typical Sections

Routine maintenance and safety improvements along I-495 and I-270 are included in the No Build Alternative. However, it does not include new improvements to I-495 and I-270. Alternative 1 does not meet the Study's Purpose and Need as it does not achieve the following: accommodate existing and future long-term traffic, enhance trip reliability, provide an additional roadway travel choice, accommodate Homeland Security, improve the movement of goods and services, nor enhance multimodal connectivity. This alternative would not provide a revenue source. Also, Alternative 1 is not consistent with the *Visualize2045* Plan. However, consistent with NEPA requirements, ***Alternative 1: No Build was carried forward for further evaluation*** to serve as a base case for comparing the other alternatives.

4.4.2 Engineering Considerations

A. Existing Traffic and Long-Term Traffic Growth

This criterion considers that additional capacity is needed to address existing and long-term traffic growth. *Does the alternative accommodate existing traffic and long-term traffic growth?*

[16] https://bpw.maryland.gov/MeetingDocs/2019-Jun-5-Agenda.pdf

A rating of "Low" for accommodating existing traffic and long-term traffic growth was given for alternatives that would:

- Not improve long-term traffic congestion along Study area roadway; or
- Only improve long-term traffic congestion in one direction; or
- Not improve long-term traffic congestion throughout the Study area (i.e. reduces congestion only in isolated areas).

A rating of "Medium" was given for alternatives that would:

- Relieve long-term traffic congestion by reducing average travel times and volume-to-capacity ratios during some peak hours in the majority of the Study area in the future design year (2040). However, some locations would continue to experience congestion during certain future peak hours; or
- Address existing congestion but not long-term traffic growth.

A rating of "High" was given for alternatives that would:

- Relieve long-term traffic congestion by reducing average travel times and volume-to-capacity ratios within the Study area corridors during all peak hours in the future design year (2040).

Detailed traffic analyses were not performed on the Preliminary Range of Alternatives as part of this initial screening. Preliminary traffic analysis, when available, and professional engineering judgement based on knowledge and experience were used to recommend a preliminary alternative be dropped from further consideration. During this initial screening step, preliminary traffic analyses were performed using available traffic data (including traffic count volumes and existing speeds) and planning-level tools, such as Highway Capacity Software (HCS), to evaluate an alternative when available. In some cases, the preliminary traffic analyses results were enough to determine that an alternative will not address existing traffic and long-term traffic growth. These alternatives were given a response of "Low." However, additional analysis was performed for the recommended Screened Alternatives to determine the projected impacts on existing traffic and long-term traffic growth. This additional analysis included projecting future traffic volumes using the Metropolitan Washington Council of Governments (MWCOG) regional forecasting model and coding the volumes into a VISSIM traffic simulation model to determine corridor travel times, speeds, density, and Level of Service (LOS).

B. Trip Reliability

More dependable travel times are needed to ensure trip reliability. The MDOT SHA 2017 Maryland State Highway Mobility Report[17] notes that a more reliable freeway system allows for trips to be better planned and meet expectations of the motorists using the network to minimize cost implications and improve the quality of life.

MDOT SHA evaluates trip reliability using the Planning Time Index (PTI). PTI reflects the 95th percentile travel time for a section of roadway and represents the total time motorists should allow to ensure they arrive at their destination on-time. More dependable and predictable travel times are needed to ensure

[17] https://www.roads.maryland.gov/OPPEN/2017_Mobility_Report.pdf

trip reliability. Many factors cause variability in travel time on a road, such as incidents, weather, surges in demand due to special events, and capacity reductions due to work zones, which makes it difficult for users to predict future trip times. However, trip reliability can be enhanced by providing additional roadway capacity and/or managing demand on the system. Transit systems can also provide good trip reliability if they are able to adhere to posted schedules. A response of "High" would indicate a more predictable travel time is provided by that alternative. This criterion is included to determine if the alternative provides an option that enhances trip reliability. *Does the alternative enhance trip reliability?*

A rating of "Low" is given for alternatives that would:

- Not improve trip reliability on the Study corridors; or
- Only improve trip reliability in one direction on the Study corridors.

A rating of "Medium" is given for alternatives that would:

- Provide an option that enhances trip reliability in both directions in the near-term, but not at all times and not in the long-term. These alternatives reflect an improvement in trip reliability compared to the No Build but could not consistently provide travel time reliability in the long-term.

A rating of "High" is given for alternatives that would:

- Provide an option that enhances trip reliability consistently, in both directions in the near-term and long-term.

C. Additional Roadway Travel Choice

On I-495, existing low-occupancy vehicle, truck, bus, carpool, and vanpool users are limited to GP lanes along this roadway. These users must either plan for recurring delays during peak periods, attempt to bypass high-volume ramps/locations using arterial streets, or adjust their travel schedule to avoid these typical delays. In addition, other than choosing alternate non-freeway routes, no highway options exist for roadway users to avoid non-recurring delays, such as during crashes, which can close travel lanes on these interstates in the Study corridors. Additional roadway management options are needed to improve travel choice for time-sensitive trips, provide opportunities to bypass delays, and manage demand, while improving reliability and maintaining the existing number of GP lanes in the Study corridors. This criterion indicates whether an additional roadway management option (i.e., HOV, Priced Managed Lanes, bus) is provided for an alternative.

Does the alternative provide an additional travel choice while retaining, existing full-time GP lanes? This criterion indicates whether an additional roadway travel choice is provided for each alternative on I-495 and I-270 through a "Yes or No" response. A "Yes" indicates the alternative will provide travelers with an option for a less congested trip through a roadway management strategy. A "No" indicates the alternative will not provide roadway travelers with an option for a less congested trip.

D. Ease of Usage for Travelers

Will implementation of the alternative likely require certain complex operating configurations that could lead to driver confusion? Ease of usage for travelers is determined by factors such as safety, enforcement, signing, and decision points/access. Alternatives with "High" ease of usage enable efficient and safe operations more easily by having one type of lane operations and more than two access points (i.e. GP only). A rating of "Medium" would have include two types of lane operations and at two access points (i.e., GP and HOV). A rating of "Low" would have a more complex operating configuration such as including three types of lane operations and one access point (i.e., GP, HOV, and ETL).

Connectivity to VDOT's Express Lane system and whether drivers need to enter or exit lanes to meet the operating requirements in each state is a consideration under this criterion. VDOT's managed lanes are operated as HOT lanes. However, none of the alternatives will directly match the operating scheme that VDOT and their concessionaire use considering the tolling regime (toll rates and algorithms) and business rules (truck and bus toll policies, violation rules, etc.), even if HOT lanes are chosen in Maryland. MDOT SHA and VDOT are coordinating efforts between studies and regardless of the alternative chosen, a transition area that accommodates the preferred alternative in an effort to maintain ease of use for the traveler will be developed. Therefore, this part of the screening criteria would be similar for all alternatives and was not specifically documented within each alternative.

4.4.3 Alternative 2: TSM/TDM

TSM/TDM strategies are improvements to existing facilities that improve the operation and coordination of transportation services and facilities. The TSM options could include interchange reconfigurations, modifications to turn lanes and acceleration/deceleration lanes, ramp metering, peak period shoulder use, enhancements to parallel roadway networks, enhanced traveler information, etc. TDM strategies focus on system demand and ways to change drivers' behavior aimed at providing the most efficient and effective use of existing transportation services and facilities. Options include rideshare and telecommuting promotion, park-and-ride lots, flexible work hours, carpool subsidies, and transit subsidies; all of which are most effective on a regional basis and commonly implemented through employers.

Benefits from TSM/TDM solutions have a limited lifespan and cannot be expected to provide long-term (2040) improvements over existing conditions. This is demonstrated by the ongoing I-270 ICM Contract that is implementing some of these TSM/TDM strategies with construction anticipated to be completed by the end of 2019. These improvements include restriping the existing road to provide additional travel lanes, extending acceleration and deceleration lanes, modifying existing lane configurations, installing adaptive ramp metering at all interchanges, and ATM. Alternative 2 considers TSM/TDM solutions on I-495 and additional TSM/TDM solutions to I-270 in addition to those being implemented with the ICM improvements.

The proposed ICM improvements are anticipated to provide traffic operational benefits in the short-term. For example, in the AM peak, as virtually all of the relevant congestion measures indicate, the I-270 network with the ICM improvements performs better than under the existing (2015) conditions. Overall, detailed modeling of the I-270 ICM improvements also indicated that as traffic continues to increase, the traffic operations are expected to return to existing levels of congestion by 2040. Based on the 2040 modeling from the ICM Improvement Contract and VISSIM modeling on the No Build Alternative for this Study,[18] I-270 would accommodate upwards of 19 percent more vehicles in the northern section and 7 percent more vehicles around I-495 during the peak hour. Similar results would be expected on I-495 if

[18] Traffic data (including ADT, AM and PM peak hour volumes) were from the I-270 Corridor Existing Volumes provided by MDOT SHA, April 25, 2016.

these types of improvements were implemented; the benefit would be recognized in the short-term but could not be sustained for the long-term.

Because the actions that would likely be included as part of TSM/TDM solutions would only address a small fraction of congestion challenges and only do so in the short-term, Alternative 2 would not accommodate existing and future long-term traffic, nor would these measures enhance trip reliability. In addition, Alternative 2 does not directly provide an additional travel choice, accommodate Homeland Security, improve the movement of goods and services, nor enhance multimodal connectivity; and it does not provide a revenue source. Also, Alternative 2 is not consistent with the *Visualize2045* Plan. For these reasons, ***MDOT SHA dropped Alternative 2 from further consideration,*** as a standalone alternative, because it would not address the long-term congestion and demand on I-495 and I-270.

While Alternative 2: TSM/TDM was not advanced for further study, there are many TSM/TDM elements that are included in the Build Alternatives advanced for further study. These include:

- Managed lanes are a demand management strategy. Additionally, HOT or ETL include congestion pricing, which is an effective demand management strategy.
- Provisions for transit use of the managed lanes, which can facilitate faster transit service along I-495 and I-270 and new bus transit routes. All build alternatives would also include direct/indirect connections between the managed lanes and existing transit stations/centers.
- Maintaining the adaptive ramp metering being implemented on the interchange entrance ramps along I-270 as part of MDOT SHA's on-going I-270 ICM project. Adaptive ramp metering is an approach that manages the flow of traffic onto the freeway mainline during periods of high demand with the goal of preventing traffic flow breakdown at interchange ramp merge points.
- Needed changes at interchange ramp terminals and intersecting roadways to optimize lane configurations and traffic signal timing to provide adequate traffic flow along the crossroads.
- Enhancements to acceleration and deceleration lanes to meet AASHTO design guidelines, which can improve traffic operations along the mainline in locations where current design does not meet design guidelines.

In addition, MDOT SHA as part of the detailed studies, is considering additional TSM/TDM strategies that could be incorporated into the Build Alternatives. These include:

- Pedestrian and bicycle enhancements within the Study area.
- Additional access to/from transit stations/centers.

4.4.4 Alternative 3: Add 1 GP Lane

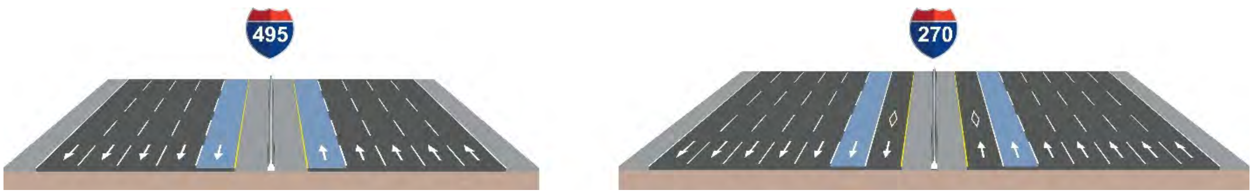
This alternative consists of adding one GP lane in each direction (**Figure 4-4**). In March 2018, a sensitivity analysis was conducted by the MDOT SHA Travel Forecasting and Analysis Division (TFAD), using the Maryland Statewide Transportation Model (MSTM). The analysis indicated that adding a lane to I-495 and I-270 within the Study corridors would be projected to attract more traffic than the No Build conditions in 2040:

- Up to a 40 percent increase in traffic on I-495 between the American Legion Bridge and I-95;
- Up to a 10 percent increase in traffic on I-495 east of I-95; and

- Up to a 10 percent increase in traffic on I-270 SB, north of I-495.

Based on the March 2018 sensitivity analysis, adding one additional lane in a four-lane section (a 25 percent increase in roadway capacity) would address approximately 25 percent of the traffic growth. However, because the latent demand is up to a 40 percent increase between the American Legion Bridge and I-95, I-495 would still be over capacity even if one GP lane were added.

Figure 4-4: Alternative 3 Typical Sections



Using HCS, TFAD indicated that multiple freeway segments within the Study area would be projected to operate at LOS F under Alternative 3, given these increases in traffic demand. Because this alternative only involves the addition of GP lanes, an HCS analysis was an appropriate evaluation tool. More complex modeling is required for alternatives that have a mix of traffic in managed lanes and GP lanes.

Additionally, adding one GP lane would not provide reliable travel times nor an additional roadway choice to provide an option for generally free-flowing travel on I-495.

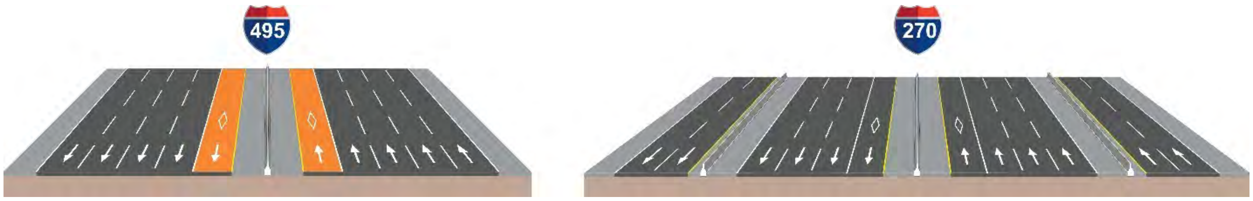
There is no readily available revenue source for development of this alternative, and therefore, is not likely to be financially self-sufficient. If MDOT SHA were to fund the construction of one GP lane per direction and re-allocate its entire capital plan expansion budget ($1.4 billion over the next six years), it would take more than a decade to deliver Alternative 3. This approach would also leave no additional funding available for other MDOT SHA capital projects across the State of Maryland during that timeframe. While MDOT could issue CTBs to finance the construction of GP lanes, MDOT statute imposes a debt limit on CTBs issued and only $1.1 billion of capacity is expected to remain by the end of FY2019. This amount is not sufficient to construct the GP lanes on I-495 and I-270.

While Alternative 3 would be expected to provide some congestion relief in the near term, failing (LOS F) conditions would be expected to return in many locations during the future design year's 2040 peak periods due to latent traffic demand and traffic growth expected to fill all the lanes. Alternative 3 does not meet the Study's Purpose and Need as it does not accommodate existing and future long-term traffic, does not enhance trip reliability, and does not provide an additional travel choice. Even though this alternative adds capacity, based on the results of the preliminary traffic analysis as described above, it would not accommodate Homeland Security, nor would it improve the movement of goods and services. Lastly, this alternative would not provide a revenue source for development of the alternative. Alternative 3 is not consistent with the *Visualize2045* Plan. For these reasons, ***MDOT SHA dropped Alternative 3 from further consideration.***

4.4.5 Alternative 4: 1-Lane HOV Managed Lane Network

This alternative consists of adding one HOV lane in each direction on I-495 (**Figure 4-5**). Under this alternative, no changes would be made to the existing HOV lanes on I-270. I-270 currently includes one HOV lane in the SB direction during the AM peak period and one HOV lane in the NB direction during the PM peak period. The HOV lanes accommodate all traffic during off-peak periods.

Figure 4-5: Alternative 4 Typical Sections



The performance of the existing HOV system on I-270 was reviewed to help evaluate the potential advantages and disadvantages of Alternative 4. MDOT SHA regularly collects data on the existing HOV networks in Maryland. MDOT SHA performed an extensive study of HOV operations in 2013,[19] including occupancy counts, with supplemental speed data collected in 2017[20] and 2018.[21] The data indicates the following regarding the existing HOV operations on I-270:

- The HOV lane carries an average of approximately 800 vehicles/hour in the SB direction and 900 vehicles/hour in the NB direction. Based on these volumes, the lanes are not being utilized to their maximum potential to relieve congestion.[22] For comparison, the capacity of an HOV lane is between 1,600 and 1,800 vehicles/hour, according to the FHWA *Guide for Highway Capacity and Operations Analysis of Active Transportation and Demand Management Strategies* document (June 2013).
- The average speed in the SB I-270 HOV lane was 41 miles per hour (mph) in 2017 during the AM peak period, based on a study conducted by MDOT SHA. While this was 32 percent higher than the average speed in the adjacent GP lanes (31.1 mph) during the same time period, it was still below the federally-accepted speed of 45 mph for a managed lane. Supplemental data was collected by MDOT SHA in June 2018 following the completion of restriping along I-270 SB at the junction with the I-495 Outer Loop as part of the I-270 ICM program. This change improved speeds on SB I-270 in both the HOV lane (average speed of 45 mph) and the GP lanes (average speed of 36 mph).
- The average speed in the NB HOV lane was 51 mph in 2017 during the PM peak period, compared to 41.8 mph in the adjacent GP lanes during the same time period (March 9, 2017 letter from MDOT SHA to FHWA).
- Only about 75 percent of HOV-eligible vehicles use the HOV lane (i.e., 25 percent of the vehicles with two or more occupants traveled in the GP lanes). This is the case in both the SB and the NB directions. This occurrence suggests that a portion of eligible vehicles will not use HOV for other reasons (inconvenience of moving over into the HOV lane, comfort staying in GP lanes, etc.), even if it was operating at or near free-flow conditions.[23]
- The HOV violation rate is high and varies greatly depending on location. The average violation rate ranged between 8 percent and 48 percent during the 2013 occupancy count, with an average violation rate of 24 percent throughout the I-270 corridor (MDOT SHA, HOV Performance Facts, Summer 2013 HOV Report). This rate indicates that it is difficult to enforce HOV in this area. A

[19] "HOV Performance Facts on I-270" and a 1-page table summarizing vehicle occupancy, prepared by MDOT SHA

[20] The 2017 data was included in a letter dated March 9, 2017 from MDOT SHA to FHWA certifying operations of the HOV lanes.

[21] The 2018 data is raw data from travel time runs conducted by MDOT SHA TFAD.

[22] MDOT SHA, HOV Performance Facts, Summer 2013 HOV Report

[23] MDOT SHA, I-270 Corridor High Occupancy Vehicle Lane Operations data collected in Summer 2013

large percentage of vehicles using the HOV lanes are single-occupant vehicles, which neutralizes some of the expected benefit of the HOV lanes.

Based on this review, the existing HOV lanes on I-270 experience mixed results. In the NB direction, the HOV lane currently provides a reliable trip during a typical PM peak period. In the SB direction, the HOV lane had been operating at speeds lower than the federally-accepted speed of 45 mph during the AM peak period until the ICM improvements were made in Spring 2018 along SB I-270 to improve the merge with I-495. However, it is unlikely that these speeds could be maintained through the design year of 2040 due to anticipated traffic growth in the Study area corridors. The proposed ICM improvements are anticipated to provide traffic operational benefits in the short-term. However, during the PM peak, overall congestion levels would be expected to return to pre-improvement levels by about 2040; this includes consideration of the ICM Project improvements currently under construction. Also, despite the travel time savings in the HOV lanes, the HOV lanes are currently underutilized and a significant portion of HOV-eligible vehicles (25 percent) choose to travel in the GP lanes, while the HOV violation rate is high.

If an HOV lane were added along I-495, it would be expected to operate with inconsistent performance (similar to the existing performance in the I-270 HOV lanes) and would not likely provide a reliable trip during the peak periods in the design year. Furthermore, incidents (crashes, disabled vehicles, weather events), may close or restrict traffic flow in the HOV lanes. Also, during incidents, traffic cannot be controlled and could become overcrowded if all HOV eligible vehicles, plus violators, try to use the HOV lane.

Although detailed traffic data is not available at this time, the historic trends of the existing I-270 HOV lane indicate that adding a one-lane HOV system on I-495 would not meet the long-term growth in the corridor. Additionally, based on the current operations of the existing I-270 HOV lanes, this alternative would have limitations with trip reliability on I-495 because it is only adding a 1-lane HOV system. Along I-270, Alternative 4 provides no physical improvement compared to the No Build; therefore, it would not be able to accommodate existing and long-term traffic growth throughout the Study area corridors or provide for a reliable trip.

Additionally, relatively recent research from 2016 performed under the supervision of the National Highway Cooperative Research Program assessed trends in development of HOV versus priced managed lanes. It concluded "while many projects operate as HOV lanes, since 1995, the number of projects applying tolling either as HOT or express lanes has grown. This trend is expected to continue."[24] This statement supports that agencies nationwide are turning to priced managed lanes instead of HOV lanes to address congestion issues.

Regarding financial viability, there is not a readily available revenue source for development of this alternative. If MDOT SHA were to fund the construction of one HOV lane per direction and re-allocate its entire capital plan expansion budget ($1.4 billion over the next six years), it would take more than a decade to deliver Alternative 4. This approach would also leave no additional funding available for other MDOT SHA capital projects across the State of Maryland during that timeframe. While MDOT could issue CTBs to finance the construction of GP lanes, MDOT statute imposes a debt limit on CTBs issued and only

[24] NCHRP, Research Report 835, *Guidelines for Implementing Managed Lanes*, December 2016, page 9 http://www.trb.org/NCHRP/Blurbs/175082.aspx

$1.1 billion of capacity is expected to remain by the end of FY2019. This amount is not sufficient to construct the HOV lanes on I-495.

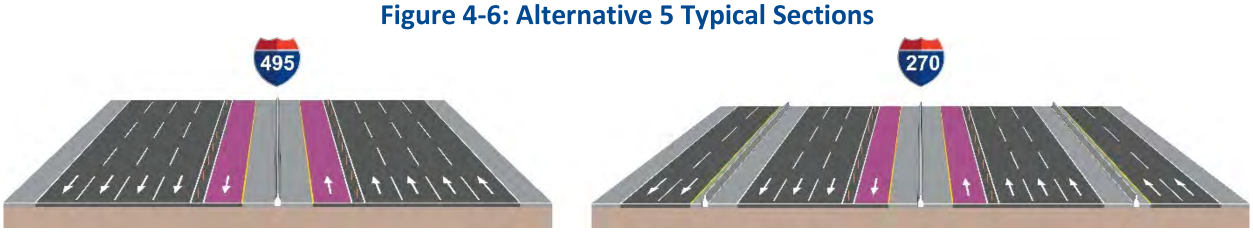
Because Alternative 4 would not include any improvements on I-270, it would not accommodate existing and long-term traffic growth or provide an additional roadway travel choice on I-270. Alternative 4 would be expected to operate with inconsistent performance along I-495, similar to the existing I-270 HOV system as explained above and, therefore, would not meet long-term traffic growth on I-495 or enhance trip reliability during the peak period. Additionally, this alternative does not provide a revenue source. Lastly, Alternative 4 is not consistent with the *Visualize2045* Plan which specifies two managed lanes on I-495 and I-270. For these reasons, ***MDOT SHA dropped Alternative 4 from further consideration.***

4.4.6 Alternative 5: 1-Lane, HOT Managed Lane Network

This alternative consists of adding one HOT managed lane in each direction on I-495 and converting the one existing HOV lane in each direction to a HOT managed lane on I-270 (**Figure 4-6**). Buses would be permitted to use the managed lanes.

Alternative 5 would enhance trip reliability by providing a more dependable travel time because the amount of traffic entering the lane would be controlled. Because of the ability to manage the lane, Alternative 5 is likely to improve the movement of goods and services, accommodate Homeland Security, provide an additional roadway travel choice, and enhance multimodal connectivity. However, additional detailed traffic analyses were necessary to determine if Alternative 5 meets the Purpose and Need. In single-lane, managed lane systems, travel speeds in the managed lanes are sometimes limited by slow moving vehicle(s) and the inability of vehicles to make passing maneuvers over an extended distance between access points. Additionally, there may be potential operational issues in the managed lane if there is an incident or a disabled vehicle, and the system may have to be shut down temporarily until the vehicle(s) are cleared. Also, Alternative 5 is not consistent with the *Visualize2045* Plan which specifies two managed lanes on I-495 and I-270. Finally, while Alternative 5 would provide a revenue source, a financial analysis will need to be completed to determine if this alternative is financially viable. For these reasons, ***MDOT SHA carried Alternative 5 forward for further analysis***.

Figure 4-6: Alternative 5 Typical Sections



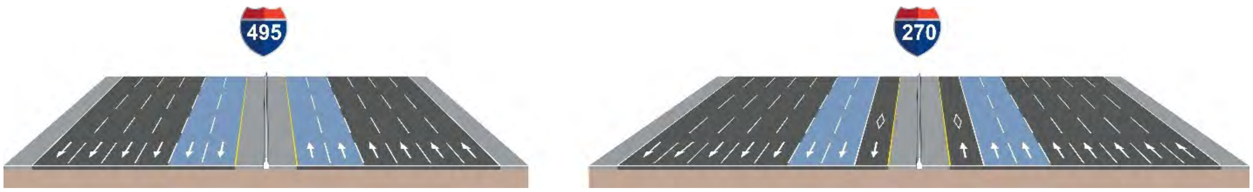
4.4.7 Alternative 6: Adding 2 GP Lanes

This alternative consists of adding two GP lanes in each direction on I-495 and I-270, while maintaining the existing HOV lane on I-270 (**Figure 4-7**). Preliminary traffic analysis[25] of Alternative 6 conducted using HCS and projected year 2040 peak hour volumes, indicated that adding 2 GP lanes in each direction *may* be effective in addressing the existing and long-term traffic growth. The preliminary traffic analysis results indicated that adding 2 GP lanes could result in improved LOS and may be able to accommodate potential induced demand. It should be noted that HCS analysis was a tool that could be used when evaluating this

[25] Data from the MSTM, conducted by the MDOT SHA TFAD, March 2018

alternative because the alternative only involves the addition of GP lanes. (More complex modeling is required for alternatives that have a mix of traffic in managed lanes and GP lanes.) More detailed traffic modeling would be required for this alternative because some of the results using the planning-level HCS analysis tools were inconclusive. Additional modeling was necessary to determine the specific amount of traffic demand anticipated under this alternative, and whether this alternative would consistently and adequately relieve long-term traffic congestion throughout the Study area corridors.

Figure 4-7: Alternative 6 Typical Sections



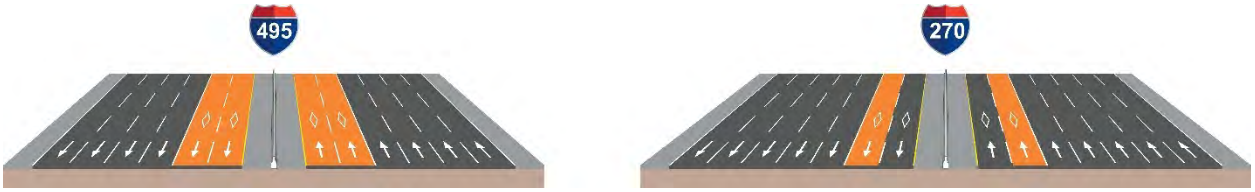
There is no readily available revenue source for development of this alternative. If MDOT SHA were to fund the construction of two GP lanes and re-allocate its entire capital plan expansion budget ($1.4 billion over the next six years), it would take more than 25 years to deliver Alternative 6. This approach would also leave no additional funding available for other MDOT SHA capital projects across the State of Maryland during those 25 years. While MDOT could issue CTBs to finance the construction of two GP lanes, MDOT statute imposes a debt limit on CTBs issued and only $1.1 billion of capacity is expected to remain by the end of FY2019. This amount is not sufficient to construct the two GP lanes on I-495 and I-270, and future MDOT capital funding would be required to pay off the debt as the GP lane alternatives do not generate any revenue.

While Alternative 6 may address existing and long-term traffic growth and accommodate homeland security, it would not provide a revenue source or an additional roadway travel choice. While Alternative 6 may enhance trip reliability and improve the movement of goods and services, it would do so less effectively than alternatives with managed lanes. Without the ability to manage at least some of the lanes, traffic incidents or unexpected demand could result in unanticipated (non-recurring) congestion, which in turn would reduce trip reliability. This would occur even with the additional capacity added as part of Alternative 6. Also, Alternative 6 is not consistent with the *Visualize2045* Plan. For these reasons, ***MDOT SHA dropped Alternative 6 from further consideration.***

4.4.8 Alternative 7: 2-Lane, HOV Managed Lane Network

This alternative consists of adding two HOV lanes in each direction on I-495, retaining one existing HOV lane in each direction on I-270, and adding one HOV lane in each direction on I-270 (**Figure 4-8**). This alternative is similar to Alternative 4, except with double the HOV capacity. While the additional capacity in this alternative compared to Alternative 4 may result in improved traffic operations, the two-lane HOV network would likely be underutilized and the spare capacity could encourage more violators to use it, which would require additional enforcement.

Figure 4-8: Alternative 7 Typical Sections



Additionally, as noted in Alternative 4, relatively recent research from 2016 assessed trends in HOV versus priced managed lanes and indicated agencies nationwide are turning to priced managed lanes instead of HOV lanes to address congestion issues.

While Alternative 7 provides additional capacity, which may result in improved traffic operations, it would likely be underutilized due to not having enough HOV eligible vehicles to fill the lanes leading to more violators and the need for additional enforcement. Alternative 7 would not accommodate long-term traffic growth and would not provide a revenue source for development of this alternative. Even if MDOT SHA were to fund the construction of it by re-allocating its entire capital plan expansion budget ($1.4 billion over the next six years), it would take more than two decades to deliver Alternative 7. Alternative 7 is not consistent with *Visualize2045* Plan. Therefore, ***MDOT SHA dropped Alternative 7 from further consideration.***

4.4.9 Alternative 8: 2-Lane, ETL Managed Lane Network on I-495 and 1-Express Toll Lane and 1-Lane HOV Managed Lane Network on I-270

This alternative consists of adding two ETL managed lanes in each direction on I-495, retaining one existing HOV lane in each direction on I-270, and adding one ETL managed lane in each direction on I-270 (**Figure 4-9**). Buses would be permitted to use the managed lanes.

Figure 4-9: Alternative 8 Typical Sections

Along I-270, as noted in Alternative 4, in the NB direction, the HOV lane currently provides a reliable trip during a typical peak period. However, in the SB direction, the HOV lane is nearly as congested as the adjacent GP lanes during the morning peak period. Alone, the HOV lanes would operate with inconsistent performance and, therefore, would not provide a reliable trip during the typical peak periods; however, with the addition of the managed lanes per direction, Alternative 8 could improve existing traffic and long-term traffic growth and trip reliability, based on the current information available (refer to Section 4.4.4 for additional information on the performance of the existing HOV system on I-270). Along I-270, ease of usage would be compromised by including three operational strategies (HOV, ETL, and GP).

Alternative 8 would provide high trip reliability on I-495, an additional roadway travel choice, accommodate Homeland Security, improve the movement of goods and services, and would enhance multimodal connectivity. Alternative 8 would also provide a revenue source. However, additional analysis is needed to determine the long-term traffic benefits and the financial viability of this alternative. The I-495 element of Alternative 8 is consistent with the *Visualize2045* Plan. For these reasons, ***MDOT SHA carried Alternative 8 forward for further analysis.***

4.4.10 Alternative 9: 2-Lane, HOT Managed Lane Network

This alternative consists of adding two HOT managed lanes in each direction on I-495, converting the one existing HOV lane in each direction to a HOT managed lane on I-270, and adding one HOT managed lane in each direction on I-270, resulting in a two-lane, managed lane network on both highways (**Figure 4-10**). Buses would be permitted to use the managed lanes.

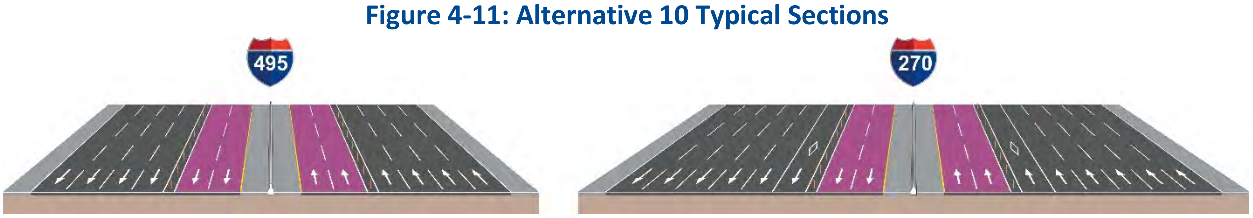
Figure 4-10: Alternative 9 Typical Sections

Detailed traffic analysis was needed to determine the long-term traffic benefits of this alternative; however, it would have high trip reliability by providing a two-lane, HOT managed network on both facilities, would provide an additional roadway travel choice, would accommodate Homeland Security, and would enhance multimodal connectivity. Alternative 9 with two HOT managed lanes provides a revenue source for the development of the alternative; however, a financial analysis was needed on this alternative to determine whether it is financially viable. The I-495 element of Alternative 9 is consistent with the *Visualize2045* Plan. For these reasons, ***MDOT SHA carried Alternative 9 forward for further analysis.***

4.4.11 Alternative 10: 2-Lane, ETL Managed Lane Network plus 1-Lane HOV Managed Lane Network on I-270

This alternative consists of adding two ETL managed lanes in each direction on I-495, retaining one existing HOV lane per direction on I-270, and adding two ETL managed lanes in each direction on I-270 (**Figure 4-11**). Buses would be permitted to use the managed lanes.

Figure 4-11: Alternative 10 Typical Sections



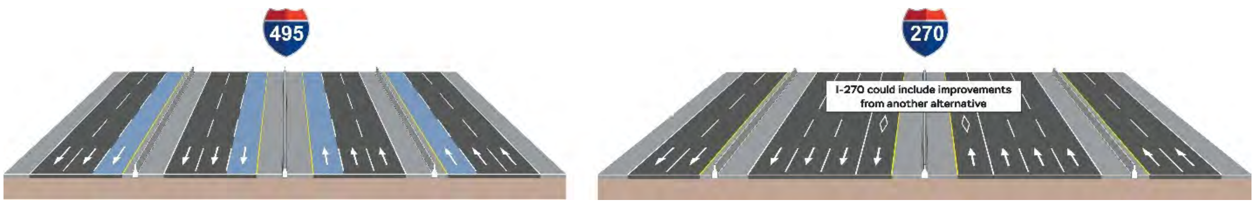
Along I-270, as noted in Alternative 4, in the NB direction, the HOV lane currently provides a reliable trip during a typical peak period. However, in the SB direction, the HOV lane is nearly as congested as the adjacent GP lanes during the morning peak period. Alone, the HOV lanes would operate with inconsistent performance and, therefore, would not provide a reliable trip during the typical peak periods; however, Alternative 10 may improve existing traffic and long-term traffic growth and enhance trip reliability because it includes two ETL managed lanes in addition to the existing HOV lane. However, along I-270, ease of usage would be compromised by including three operational strategies (ETL, HOV, and GP lanes).

While Alternative 10 would provide high trip reliability, an additional roadway travel choice, would accommodate Homeland Security, improve the movement of goods and services and enhance multimodal connectivity, additional traffic analysis was needed to determine the long-term traffic benefits of this alternative. Alternative 10 with two ETL managed lanes would provide a revenue source; however, a financial analysis was needed to determine if this alternative is financially viable. Also, Alternative 10 is consistent with the *Visualize2045* Plan. For these reasons, ***MDOT SHA carried Alternative 10 forward for further analysis.***

4.4.12 Alternative 11: Collector-Distributor Lanes on I-495

This alternative consists of physically separating local and long-distance traffic using C-D lanes on I-495 only (**Figure 4-12**). The new C-D lanes would be physically separated from the GP lanes. The most likely lane configuration would be three C-D lanes to the outside of the existing GP lanes. The existing C-D system (two physically separated C-D lanes) on I-270 would remain.

Figure 4-12: Alternative 11 Typical Sections



The existing interchanges and travel patterns along I-495 are not conducive to a C-D system because:

- The traffic volumes exiting/entering I-495 at each interchange are high which would likely cause congestion in the local lanes; and
- Current origin-destinations include a large mix of long-distance, medium-distance, and short-distance trips.

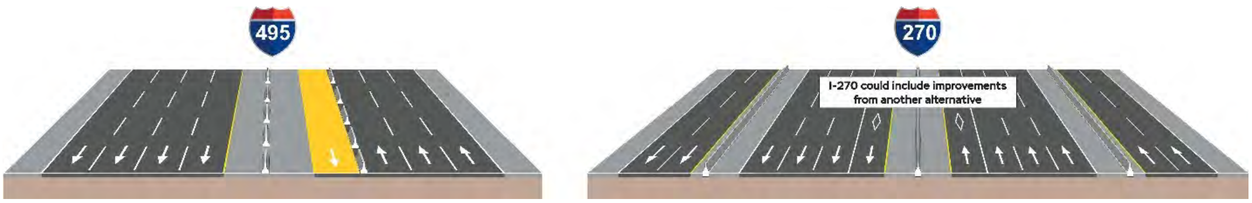
Additionally, C-D lane systems in each direction along I-495 are unfavorable because they have the same additional capacity as provided with a two GP alternative, but would require more widening and associated environmental, land use and cost implications to accommodate the barrier separation between the express and local lanes. In addition, slip ramps to/from the local lanes would require further widening.

While Alternative 11 would add capacity on I-495, a C-D lane system is more appropriate for highways where there is a substantial volume of long-distance trips that could benefit from being separated from local trips to/from interchanges within the corridor. Therefore, a C-D system on I-495 is likely to operate inefficiently with too much traffic using the local lanes and not enough accessing the express lanes to travel longer distances. The corresponding volumes on the express and local lanes would then be imbalanced, creating traffic operational issues even if there is sufficient overall capacity on I-495. Additionally, Alternative 11 would not provide an additional travel choice with an option for a less congested trip through a roadway management strategy and would have complex travel patterns on I-495, which include various origin-destinations and trip lengths that could cause congestion in the local lanes and potential underutilization in the express lanes. Alternative 11 would not provide a readily available revenue source for development of the improvement. Alternative 11 is not consistent with the *Visualize2045* Plan. For these reasons, ***MDOT SHA dropped Alternative 11 from further consideration.***

4.4.13 Alternative 12A: Contraflow Lane on I-495

This alternative consists of converting one I-495 travel lane in the off-peak direction to accommodate traffic in the peak direction of travel (**Figure 4-13**). The lane would be physically separated from the off-peak direction with a moveable barrier[26] and would operate in the peak travel direction.

Figure 4-13: Alternative 12A Typical Sections



Contraflow is only an effective treatment if there is a significant directional split in traffic during the peak hours (i.e., if the majority of traffic is traveling in one direction in the morning and in the opposite direction in the evening). Based on a review conducted by MDOT SHA of recent (2018) traffic count data along I-495 collected by MDOT SHA and available on MDOT SHA's traffic Monitoring System database,[27] directional traffic splits are fairly even during the peak periods throughout the Study area. The Outer Loop generally carries a little more traffic between I-95 and the Virginia Line during the AM and PM peak hours, carrying between 51 percent and 55 percent of the traffic, while the Inner Loop carries between 45 percent and 49 percent of the traffic. East of I-95, the Inner Loop carries more traffic during the AM peak hour (60 percent vs. 40 percent for the Outer Loop), while traffic is split nearly evenly (50-50 percent) during the PM peak, east of I-95. The data indicates that I-495 is not conducive to implementing contraflow or taking away a lane in one direction to provide it to the other direction as there is not a significant directional split during the peak hours.

In the off-peak direction, this alternative would eliminate an existing lane. Because the directional traffic split is relatively even along I-495, there is no clear "off-peak" direction. Capacity needs to be added in both directions during both peak hours. Removing a lane in either direction during the peak periods would remove capacity and result in traffic operations that are worse than the No Build. Even in the peak direction (the direction where a lane is added), Alternative 12A would operate similarly to Alternative 3 – one GP lane per direction and a reliable trip cannot be guaranteed in the future design year (2040) due to latent demand.[28] Therefore, Alternative 12A is rated "Low" in the category of trip reliability.

Contraflow on I-495 is unfavorable for several reasons relative to ease of use:

- Cross-median access points to/from the contraflow would have to be provided. Special signing/striping, and traffic control devices (like movable barrier or gates) would be needed at each crossover.
- The full limits of the contraflow lane would have to be shielded from the adjacent non-peak direction lanes by movable traffic barrier. Issues with a movable barrier system include: a long duration of time and complexity of deploying the movable barrier system; communicating movable barrier operations to travelers (in both directions); location and storage of the movable

[26] In accordance with the Roadside Design Guide, page 6-2, Figure 6.1: Guidelines for Median Barriers on High-Speed Fully-Controlled Access Roadways

[27] Count data collected by MDOT SHA is available at the i-TMS website (http://maps.roads.maryland.gov/itms_public/).

[28] Sensitivity Analysis based on the MSTM, conducted by the MDOT SHA TFAD, March 2018

barrier during un-deployed periods, storage and maintenance of the movable barrier machines; and operations/configurations at interchanges and the numerous crossroads and any new directed access interchanges with median ramps.

- The contraflow lane would end/exit into the existing peak period lane(s). These lanes are likely to be congested since no additional peak period capacity is provided beyond the end of the contraflow lane. As such, the end/exit is likely to create a congested merge point that would affect operations on the contraflow lane and GP lanes upstream.

Overall, the traffic data indicates that I-495 is not conducive to implementing contraflow by taking away a lane in one direction to provide it to the other direction because the split in traffic is nearly equal. Alternative 12A only provides capacity in one direction on I-495 and does not meet the Study's Purpose and Need as it does not address existing and long-term traffic growth, does not improve trip reliability, does not accommodate Homeland Security, does not improve the movement of goods and services, and does not enhance multimodal connectivity. Alternative 12A has no readily available revenue source for development of the alternative and has "low" ease of usage. Alternative 12A is also not consistent with the *Visualize2045* Plan. For these reasons, ***MDOT SHA dropped Alternative 12A from further consideration.***

4.4.14 Alternative 12B: Contraflow Lane on I-270

This alternative considers converting the existing HOV lanes on I-270 to a contraflow lane during peak periods (**Figure 4-14**). The current traffic split on I-270 is 65/35 percent (approximately 65 percent of the traffic traveling SB vs. 35 percent of the traffic traveling NB in the morning, and vice-versa in the afternoon). This could be a large enough difference that contraflow operations could be considered because additional capacity is only needed in one direction at a time. However, similar to Alternative 12A, contraflow on I-270 is unfavorable for several reasons including cross-median access points to the contraflow lane, operational challenges with a moveable barrier system, and congestion at the merge point when no additional capacity improvement is provided. Furthermore, taking away a lane from the off-peak direction would reduce capacity and could introduce congestion for a location that does not have congestion under No Build conditions.

Figure 4-14: Alternative 12B Typical Sections

In addition, a contraflow system on I-270 with the HOV lanes would also be unfavorable for the following reasons:

- Contraflow lane would operate in the peak direction, so non-HOV users would have to merge into/across the existing HOV lanes to access the contraflow lane, potentially impacting the operations and enforcement of these lanes approaching the contraflow access points. It is also illegal for non-HOV users to use HOV lanes even for short merging periods.

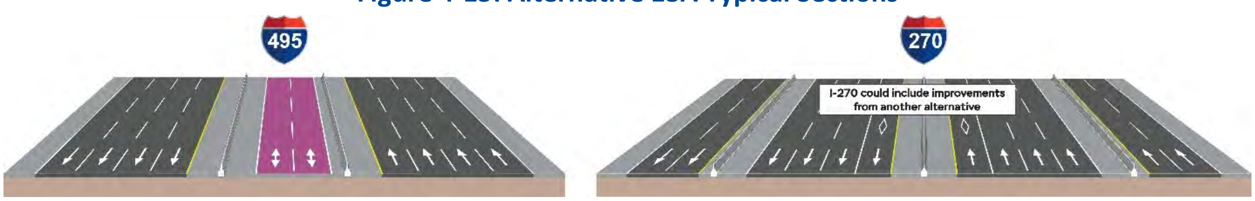
- Similarly, to exit the contraflow lane, non-HOV users would have to merge into/across the existing HOV lanes at the end of the contraflow lane, potentially impacting the operations and enforcement of these lanes approaching the contraflow access points.
- It is most likely that the contraflow lane would be accessed at a single location and the exit from the contraflow lane would be at a single location (or a single location on each spur), effectively operating as an express lane for travelers that would want to travel the full length of the contraflow lane.

Alternative 12B only provides capacity in one direction on I-270 and does not meet the Study's Purpose and Need as it does not address existing and long-term traffic growth, does not improve trip reliability, does not accommodate Homeland Security, does not improve the movement of goods and services, and does not enhance multimodal connectivity. Alternative 12B has no readily available revenue source for development of the alternative and has "low" ease of usage. Alternative 12B is also not consistent with the *Visualize2045* Plan. For these reasons, ***MDOT SHA dropped Alternative 12B from further consideration.***

4.4.15 Alternative 13A: Priced Managed Reversible Lanes on I-495

This alternative considers adding two priced managed (as either HOT or ETL), reversible lanes on I-495 (**Figure 4-15**). Buses would be permitted to use the priced managed reversible lanes.

Figure 4-15: Alternative 13A Typical Sections



Similar to contraflow (Alternatives 12A and 12B), reversible lanes are typically only implemented if there is a significant directional split in traffic during the peak hours. As noted above in the discussion on Alternative 12A, a review conducted by the Study team of recent (2018) traffic count data along I-495 collected by MDOT SHA and available on MDOT SHA's Traffic Monitoring System database indicates that volumes are nearly evenly split between the Inner Loop and Outer Loop within the Study area, and therefore, reversible lanes along I-495 would not address long-term traffic growth in the off-peak direction because additional capacity is needed in both directions during the peak periods on I-495.

Alternative 13A would provide a reliable trip, but only in the peak direction. Because the directional traffic split is relatively even along I-495, there is no clear "off-peak" direction. Therefore, the direction of traffic that is not benefitting from the reversible lanes would experience the same congestion as the No Build, and there would be no improvement in trip reliability in that direction. Also, switching the system and ensuring that vehicles do not enter in the wrong direction (a potential safety hazard) requires extensive, daily maintenance and, therefore, would be rated as having "low" ease of usage.

Overall, the traffic data indicates that I-495 is not conducive to implementing reversible lanes on I-495 because the split in traffic is nearly equal and additional capacity is needed in both directions on I-495 during the peak hours to address existing and long-term traffic growth. Alternative 13A only provides capacity in one direction and does not meet the Study's Purpose and Need as it would not enhance trip reliability outside of the peak hours, would not address long-term traffic growth in the off-peak direction, and would not improve the movement of goods and services outside of the peak hours. Alternative 13A has a "low" ease of usage due to the switching of operational systems on a daily basis. Alternative 13A is not consistent with the *Visualize2045* Plan. For these reasons, ***MDOT SHA dropped Alternative 13A from further consideration.***

4.4.16 Alternative 13B: HOT Managed Reversible Lane on I-270

This alternative considers converting the existing HOV lanes in both directions to two HOT managed, reversible lanes on I-270 (**Figure 4-16**). Buses would be permitted to use the managed lanes.

Figure 4-16: Alternative 13B Typical Sections

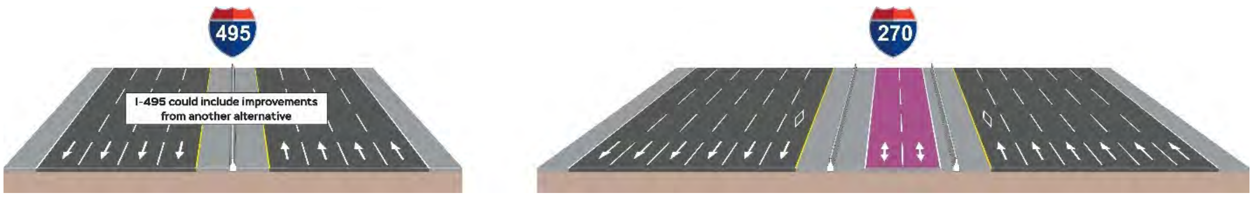
The current traffic split on I-270 is 65/35 percent (approximately 65 percent of the traffic traveling SB vs. 35 percent of the traffic traveling NB in the morning, and vice-versa in the afternoon). This could be a large enough difference that the off-peak direction may not need improvements, pending additional traffic analysis. This peak-period directional flow experienced on I-270, which is not experienced on I-495, is why Alternative 13B could improve existing traffic and long-term traffic growth and trip reliability; however, detailed traffic analysis is needed to confirm this. In addition, with a reversible lane system, there is a lot of "down time" when the lanes cannot be used while they are being cleared and switched to the opposite direction. No operational benefit is experienced in either direction during this time, which can occur for several hours during the middle of the day when traffic demand remains high on I-270. Also, switching the system and ensuring that vehicles do not enter in the wrong direction (a potential safety hazard) requires extensive, daily maintenance. The time-of-day restrictions can also confuse motorists if the lanes are available for use at certain times, but not others, therefore, Alternative 13B would be rated as "low" ease of usage.

While Alternative 13B would accommodate Homeland Security and improve the movement of goods and services by providing two additional lanes of capacity it would be limited by only providing these improvements in one direction. Alternative 13B is not consistent with the *Visualize2045* Plan as it does not include two managed lanes in each direction on I-270. Alternative 13B could improve existing and long-term traffic growth and enhance trip reliability; however, detailed traffic analysis is needed to confirm if this alternative could fully accommodate the long-term growth in the peak direction without deteriorating operations in the off-peak direction. Alternative 13B would have a readily available revenue source but a financial analysis is needed to determine if a reversible system would be financially viable. For these reasons, ***MDOT SHA carried Alternative 13B forward for further analysis.***

4.4.17 Alternative 13C: ETL Managed Reversible Lanes and one HOV Managed Lane Network on I-270

This alternative considers retaining the existing HOV lanes in both directions and adding two ETL managed, reversible lanes on I-270 (**Figure 4-17**). Alternative 13C would maintain the existing roadway network on I-270 with HOV lanes to allow for free travel while adding two managed, reversible lanes. Buses would be permitted to use the managed lanes.

Figure 4-17: Alternative 13C Typical Sections



As noted in Alternative 4, in the NB direction, the HOV lane currently provides a reliable trip during a typical peak period. However, in the SB direction, the HOV lane is nearly as congested as the adjacent GP lanes during the morning peak period. Alone, the HOV lanes would operate with inconsistent performance and therefore, would not provide a reliable trip during the typical peak periods. However, with the addition of the managed reversible lanes, Alternative 13C could improve existing traffic and long-term traffic growth and trip reliability; traffic analysis would be needed to confirm this.

Additionally, as noted in Alternative 13B, the current traffic split on I-270 of 65/35 percent in the peak periods could be a large enough difference that it could improve existing traffic and long-term traffic growth and trip reliability in the peak direction while the off-peak direction may not need improvements. Also, the operational concerns and down time noted in 13B would be the same with this alternative. While Alternative 13C would accommodate Homeland Security and improve the movement of goods and services by providing two additional lanes of capacity it would be limited by only providing these improvements in one direction. Alternative 13C is consistent with the *Visualize2045* Plan.

While Alternative 13C may have operational concerns and 'low' ease of usage as noted with similar reversible lane alternatives, it could improve existing and long-term traffic growth and could enhance trip reliability. Detailed traffic analysis was needed to determine if this alternative can accommodate long-term traffic growth in the peak direction without deteriorating operations in the off-peak direction. Alternative 13C would provide a revenue source but additional financial analysis is needed to determine whether a two-lane, two-directional system would be financially viable. For these reasons, ***MDOT SHA carried Alternative 13C forward for further analysis.***

4.4.18 Alternative 14A: Heavy Rail Alternative

Alternative 14A considers heavy rail transit parallel to the existing I-495 and I-270 right-of-way. Consideration of heavy rail or light rail transit to circle Washington, DC began in the 1990s. In the 2002 *Capital Beltway / Purple Line Study* (2002 Study), a single, 42-mile circumferential rail corridor was analyzed. It included six unique corridors operating as either heavy rail or light rail. The heavy rail transit corridors considered fewer stations, longer station spacing, and higher operating speeds than the light rail alternatives. Heavy rail requires an electrified third rail for power which requires heavy rail to be separated from other traffic for safety reasons.

The conclusions from this study stated, "Congestion on the Beltway itself as well as demand on the other transportation facilities is so great that no single highway or transit improvement will provide significant relief to the long-term demand," (page S-17). It was also recommended that studies of the highway and transit alternatives be conducted separately because transit operates more efficiently if it serves areas where people live and work. Furthermore, the 2002 Capital Beltway / Purple Line Study concluded that the implementation of any potential transit alignment corridor would provide an alternative to driving on adjacent, congested highways. While transit may not significantly improve conditions on the Beltway itself, it would provide additional mobility on a regional scale. The transit model results from this study showed a range of new daily transit trips of 34,000 to 64,000. This study also concluded that fixed guideway transit was not recommended wholly along the Capital Beltway itself. A beltway transit corridor would take advantage of existing transportation right-of-way where available, but it would not effectively connect activity centers. Adding that people do not live and work "on the Beltway," transit would better serve patrons by more directly connecting activity center locations.

The 2002 *Capital Beltway / Purple Line Study* recommended the "inner Purple Line" (inside the Beltway) as the priority transit corridor, rather than within the right-of-way of I-495 or outside the Beltway. The 2002 Study did not recommend a transit mode, but rather recommended more detailed transit planning studies be performed. Other segments, between I-270/Rock Spring Technology Park and New Carrolton and between New Carrolton and Suitland/Branch Avenue, were projected to have lower daily transit demand and were recommended to be implemented "at a later time when conditions change, and the corridors are more attractive for improvements to transit service," (Page S-21).

Heavy rail was considered in the Purple Line EIS project but was dropped from further consideration due to prohibitive capital costs; desired operational conditions that could not be met through the communities; not meeting the goal of cost-effective transit alternative that is rapid, reliable, and environmentally friendly; and the availability of other viable alternatives.

The communities along the I-270 corridor are currently served by the WMATA Metro Red Line and the Maryland Area Regional Commuter (MARC) Brunswick Line. The Red Line Metro alignment follows MD 355 with five stations north of I-495. The Red Line also crosses I-495 at MD 97 with three stations north of I-495. The MARC Brunswick line includes five stations north of I-495 within the Study corridors and continues north into West Virginia. The MARC Brunswick Line is generally parallel to MD 355 to the east.

State planned, heavy rail improvements do not include new heavy rail service, but rather focus on maintenance of existing systems and improvements to the capacity of existing heavy rail service. The 2016 CLRP Amendment document was approved by the National Capital Region TPB at the MWCOG in November 2016, and in the list of major transit projects included, "MARC – Increased trip capacity and frequency along all commuter lines, 2029", (page 24). The MARC Growth and Investment Plan also identified a phased implementation of improvements to the Brunswick Line through 2035, including additional daily seats, and rail service improvements such as reduced headways, expanded service during peak and off-peak periods, extension to northern Virginia, and weekend service.[29]

Heavy rail commuting options currently exist in the I-270 corridor via the DC Metro Red Line and the MARC Brunswick Line and current planning documents do not include new heavy rail service. Alternative 14A

[29] https://mta.maryland.gov/marc-growth-and-investment-plan

does not meet the Study's Purpose and Need as it would not address existing and long-term traffic growth and would not provide an additional roadway travel choice. Also, Alternative 14A is not consistent with the *Visualize2045* Plan. While Alternative 14A may enhance trip reliability for existing or future transit commuters, overall, it would not improve trip reliability along I-495 or I-270. Under this alternative, fares would be collected, but additional analysis would be needed to determine financial feasibility based on ridership and operations and maintenance costs. In addition, improvement of movement of goods and services would be limited to commuter benefits, which would be limited because it would be direct door to door access between residents and employers, and not movement of freight or services that require vehicular movement (i.e., mechanical, electrical, etc.). For these reasons, ***MDOT SHA dropped Alternative 14A from further consideration.***

4.4.19 Alternative 14B: Light Rail Alternative

As described in the previous section, both heavy rail and light rail alternatives were considered in the 2002 *Capital Beltway / Purple Line Study*. The light rail alignment recommended by that study extended from Bethesda to New Carrollton (the Purple Line). This Purple Line alignment moved forward into planning, design, and construction. The FEIS and Draft Section 4(f) Evaluation was signed in 2013 and a ROD was issued in 2014. The 16-mile, two-track light rail system is currently under construction by the MDOT MTA with operation scheduled to begin in 2022. The Purple Line project is addressing the transit demand for a transit alignment inside the Beltway as identified as the transit priority corridor in the 2002 Capital Beltway / Purple Line Study.

The transportation analysis completed in support of the Purple Line FEIS used the 2040 MWCOG travel demand model compared the No Build Alternative with the Purple Line alternative's regional daily vehicle trips. "Under the Purple Line Preferred Alternative in 2040, the number of daily trips would be 16,790 less than under the No Build Alternative. The number of daily vehicle trips in 2040 represents a reduction of 0.06 percent on a regional basis relative to the No Build Alternative. Though regionally small, the change would benefit the corridor roadway system performance, where the reduction would occur."[30]

The Purple Line FEIS and Purple Line Travel Forecasts Results Report also evaluated the impact of transit alternatives on overall automobile usage by presenting the vehicle miles travel (VMT)[31] in the region. In 2040, under the Purple Line, 129,828 less vehicle miles (0.07 percent) would be traveled each day in the region versus the 2040 No Build Alternative.[32] The Purple Line will likely provide additional transportation options connecting activity centers and provide mobility improvements to the region. These improvements may not be evident on the Beltway itself, but on parallel arterials and local streets where trips can be diverted back to major roads. As stated earlier, congestion on I-495 and the demand for other transportation is so great that transit and roadway improvements are needed to address congestion in the region (2002 Capital Beltway / Purple Line Study).

Also described in the previous section, the communities along I-270 are currently served by heavy rail transit via the MARC Brunswick Line and DC Metro Red Line. In addition, the MTA and Montgomery County have current BRT studies underway to provide additional travel choice and relieve congestion in the adjacent roadway networks. Montgomery County is studying BRT on MD 355, US 29, and MD 586.

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[30] *Purple Line FEIS* and *Purple Line Travel Forecasts Results Report*, 2013

[31] Vehicles miles traveled (VMT) represents the total miles traveled during all of the vehicle trips in the region, without regard to the number of passengers in a vehicle, Purple Line FEIS, page 3-12.

[32] Purple Line FEIS, page 3-12 and Purple Line Travel Forecasts Results Report, 2013

The MTA is studying BRT between the Metropolitan Grove MARC Station and the Shady Grove Metro Station. These other BRT studies and the construction of the Purple Line are addressing the transit demand within the Study corridors.

While Alternative 14B may enhance trip reliability for existing and future transit commuters, overall, it would not improve trip reliability along I-495 and I-270. Under this alternative, fares would be collected, but additional analysis would be needed to determine financial feasibility based on ridership and operations and maintenance costs. In addition, improvement in the movement of goods and services would be limited to commuter benefits and not the movement of freight or services that require vehicular movement (i.e., mechanical, electrical, etc. services). Further, Alternative 14B does not meet the Study's Purpose and Need as it would not address existing and long-term traffic growth and would not provide an additional roadway travel choice. Alternative 14B is not consistent with the *Visualize2045* Plan. Lastly, the Purple Line light rail and other planned transit studies are already underway near the Study corridors. For these reasons, ***MDOT SHA dropped Alternative 14B from further consideration***.

4.4.20 Alternative 14C: Fixed Guideway Bus Rapid Transit (Off Alignment)

This alternative assumes fixed guideway BRT along a new alignment separate from the existing roadways. Consideration of this alternative was informed in part by the recent analysis concerning a proposed regional network of BRT routes across the region. The *Visualize2045* and the FY 2019-2024 TIP identifies several BRT projects in the Financially Constrained plan approved on October 17, 2018.

- Randolph Road BRT: US 29 to MD 355
- North Bethesda BRT: Montgomery Mall Transit Center to White Flint Metrorail Station
- MD 355 BRT: Bethesda to Clarksburg
- MD 650 BRT: Colesville Park-and-Ride to Eastern Avenue
- MD 586/Veirs Mill Road BRT: MD 355, Rockville Pike to MD 97, Georgia Avenue

A 2017 study by the National Capital Region TPB, Long-Range Plan Task Force, titled, *An Assessment of Regional Initiatives for the National Capital Region - Draft Technical Report on Phase II of the TPB Long-Range Plan Task Force,* studied a series of regional transportation initiatives compared to the baseline of the CLRP. One of the initiatives studied was a regionwide system of BRT and transitway networks (known as *Initiative 4: Regionwide Bus Rapid Transit and Transitways*). This included new BRT facilities in Montgomery County, Prince George's County, Northern Virginia, DC, and a transitway from Branch Avenue to Waldorf. These lines are in addition to those already in the CLRP.

The Maryland portion of the network included:

- MD 97/Georgia Avenue North / Georgia Avenue South
- MD 355 North / MD-355 South
- Randolph Road (US-29 to White Flint)
- MD 650/New Hampshire Avenue
- North Bethesda Transitway (White Flint Metro - Montgomery Mall)
- MD 193/University Blvd (Wheaton – Takoma/ Langley Transit Center)
- US 29 (Columbia-Silver Spring)

- MD 586/Veirs Mill Rd (Rockville-Wheaton)
- US 1 (Arundel Mills-College Park)
- US 1 (Greenbelt-Konterra)
- MD 5 / US 301 (White Plains-Branch Ave)
- US 50 (Bowie-New Carrollton)
- MD 193/University Blvd/Riggs Rd/MD-410/MD-201/MD-450 (Bladensburg-Takoma-Langley)

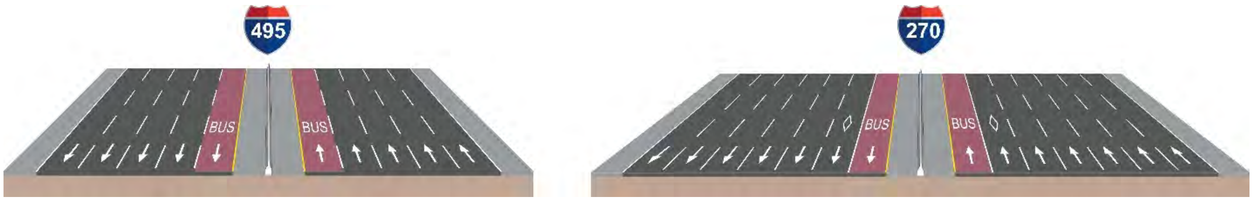
This study showed that an extensive, regionwide network of BRT and transitway facilities would result in a one percent reduction in average travel times for transit, HOV and single-occupancy vehicle commute trips relative to the 2040 CLRP scenario. Daily vehicle hours of delay would be reduced by two percent, and transit commute mode share would increase four percent. Daily VMT and daily VMT per capita would be reduced by less than one percent. Share of passenger miles on reliable modes would increase by six percent.

Given the modest improvements to travel times and vehicle hours of delay expected from an extensive regionwide network of BRT and transitways, dedicated BRT facilities along only I-495 and I-270 would not achieve the Study's Purpose and Need as it would not address existing and long-term traffic growth, would not enhance trip reliability along I-495 or I-270, and would not accommodate Homeland Security. While Alternative 14C may enhance trip reliability for existing and future transit commuters, overall, it would not improve trip reliability along I-495 and I-270. Under this alternative, fares would be collected, but additional analysis would be needed to determine financial feasibility based on ridership and operations and maintenance costs. In addition, improvement in the movement of goods and services would be limited to commuter benefits and not the movement of freight or services that require vehicular movement (i.e., mechanical, electrical, etc. services). Alternative 14C is not consistent with the *Visualize2045* Plan. Based on the analysis in the 2017 previous study mentioned above which concluded that a regional network of BRT and transitway facilities would not substantially improve traffic conditions over the No Build, ***MDOT SHA dropped Alternative 14C from further consideration***.

4.4.21 Alternative 15: Dedicated Bus Managed Lane Network on I-495 and I-270 Roadways

This alternative assumes buses would operate in a managed, dedicated bus lane on I-495 and I-270 between existing park-and-ride facilities and new connections at specified locations. This bus lane could result from constructing a new travel lane and retaining the existing GP lanes. The bus lane could accommodate all bus travel, including express bus service, commuter buses, WMATA local buses, over-the-road coach buses, tourist buses, and inter-city buses. Stations could be located adjacent to the dedicated bus lane or at stations immediately off I-495 at the interchanges. (**Figure 4-18).**

Figure 4-18: Alternative 15 Typical Sections



With this alternative, transit would be enhanced from increased roadway capacity along I-495 and I-270 and would experience the same increased speeds and reliable travel as other managed lane users. A dedicated, managed bus lane would result in higher operating speeds than a bus traveling in a GP lane and could operate during peak periods only or all day. Alternative 15 would require engineering complexity to construct slip ramps or grade-separated entrance and exits ramps.

Alternative 15 does not meet the Study's Purpose and Need as it would not address the existing and long-term traffic growth on the Study corridor roadways. Also, a dedicated bus lane would be underutilized if it is used for buses only and there would be available capacity in this lane for other vehicles. Under this alternative, fares would be collected, but additional analysis would be needed to determine financial feasibility based on ridership and operations and maintenance costs. Alternative 15 is not consistent with the *Visualize2045* Plan. Therefore, as a standalone alternative, ***MDOT SHA dropped Alternative 15 from further consideration***.

Table 4-3: Recommended Screened Alternatives Summary Table

	Alternative #	Name/ Description	Engineering: Existing Traffic and Long-Term Traffic Growth (H/M/L)	Engineering: Trip Reliability: Provides a Dependable Travel Time (H/M/L)	Engineering: Additional Roadway Travel Choice (Y or N)		Engineering: Ease of Usage for Travelers (H/M/L)		Homeland Security: Accommodates a Population Evacuation and Improves Emergency Response (Y or N)	Movement of Goods and Services: Improve Movement of Freight, Services & commuting Employees (H/M/L)	Financial Viability: Provide a Revenue Source (Y or N)	Multimodal Connectivity: Enhances Access to Existing Transit (H/M/L)
					I-495	I-270	I-495	I-270				
	1	No Build (Existing): All projects in CLRP (including I-270 ICM improvements)	○	○	N	N	●	●	N	○	N	○
	2	TSM/TDM: Solutions **along I-495 and I-270**: restriping within existing pavement, peak period shoulder use, ramp metering and ATM	○	○	N	N	◓	◓	N	○	N	○
1 Lane	3	+1 GP Lane: Add one GP lane in each direction **on I-495 and I-270**	○	○	N	N	●	●	N	○	N	◓
1 Lane	4	1-Lane, HOV Managed Lane Network: Add one HOV lane in each direction **on I-495** and retain existing HOV lane in each direction **on I-270**	○	◓	Y	N	◓	●	Y	◓	N	◓
1 Lane	5	1-Lane, HOT Managed Lane Network: Add one HOT managed lane in each direction **on I-495** and convert one existing HOV lane in each direction to a HOT managed lane **on I-270**	♦	●	Y	Y	◓	◓	Y	●	Y	◓
2 Lane	6	+2 GP Lanes: Add two GP lanes in each direction **on I-495 and I-270**	♦	♦	N	N	●	●	Y	♦	N	◓
2 Lane	7	2-Lane, HOV Managed Lane Network: Add two HOV lanes in each direction **on I-495** and retain one existing HOV lane and add one HOV lane in each direction **on I-270**	○	◓	Y	N	◓	●	Y	◓	N	◓
2 Lane	8	2-Lane, ETL Managed Lane Network on I-495 and 1-Lane, ETL and 1-Lane, HOV Managed Lane Network on I-270: Add two ETL managed lanes in each direction **on I-495** and add one ETL managed lane and retain one existing HOV lane in each direction **on I-270**	♦	●	Y	Y	◓	○	Y	●	Y	●
2 Lane	9	2-Lane, HOT Managed Lane Network: Add two HOT managed lanes in each direction **on I-495** and convert one existing HOV lane to a HOT managed lane and add one HOT managed lane in each direction **on I-270**	♦	●	Y	Y	◓	◓	Y	●	Y	●
2 Lane	10	2-Lane, ETL Managed Lane Network on I-495 and 2-Lane ETL and 1-Lane HOV Managed Lane Network on I-270 only: Add two ETL managed lanes in each direction **on I-495 and on I-270** and retain one existing HOV lane in each direction **on I-270** only	♦	●	Y	Y	◓	○	Y	●	Y	●

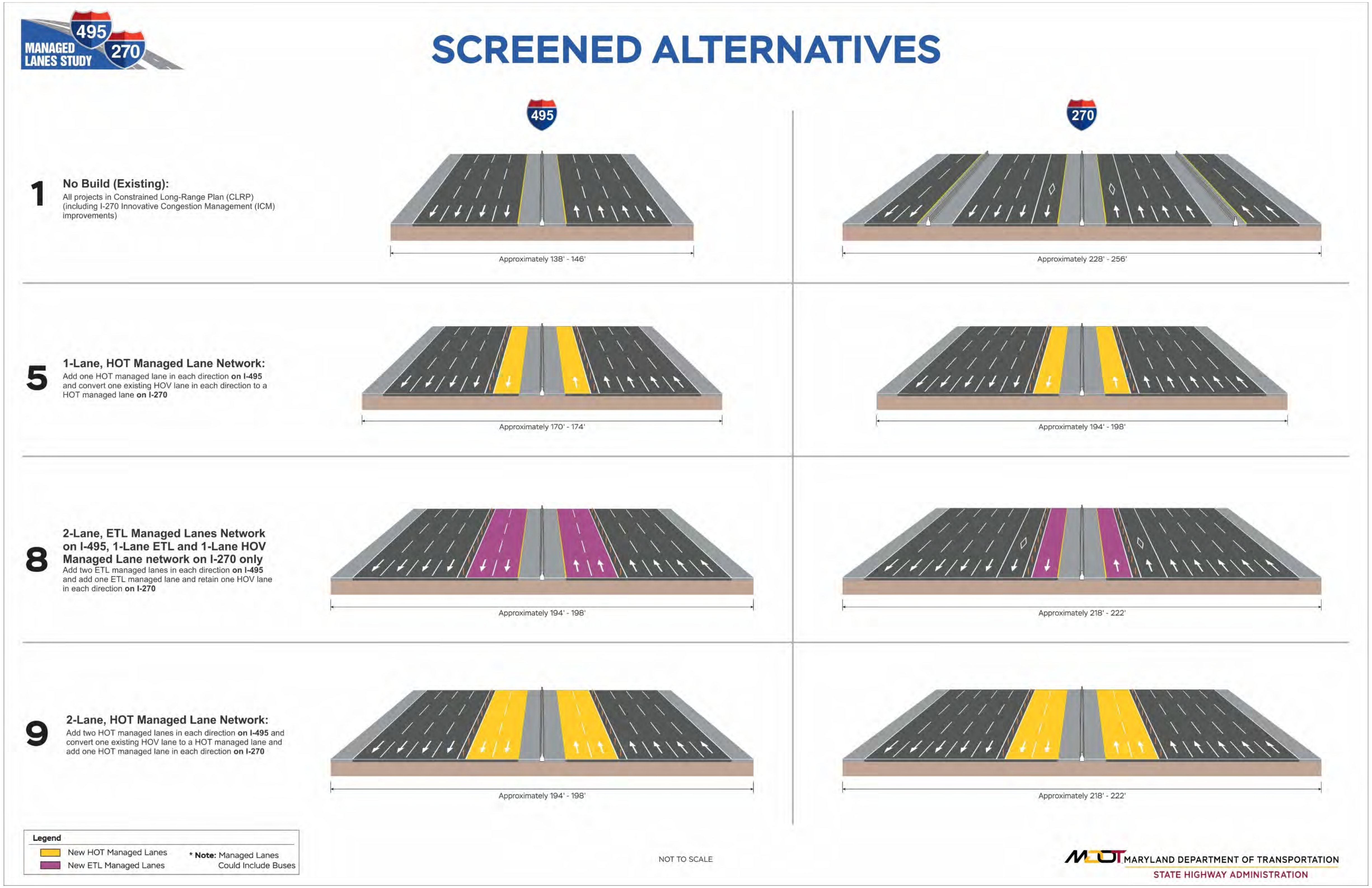
KEY: ○Low ◓Medium ●High Y: Yes N: No ♦ additional information needed

	Alternative #	Name/ Description	Engineering: Existing Traffic and Long-Term Traffic Growth (H/M/L)	Engineering: Trip Reliability: Provides a Dependable Travel Time (H/M/L)	Engineering: Additional Roadway Travel Choice (Y or N) I-495	Engineering: Additional Roadway Travel Choice (Y or N) I-270	Engineering: Ease of Usage for Travelers (H/M/L) I-495	Engineering: Ease of Usage for Travelers (H/M/L) I-270	Homeland Security: Accommodates a Population Evacuation and Improves Emergency Response (Y or N)	Movement of Goods and Services: Improve Movement of Freight, Services & commuting Employees (H/M/L)	Financial Viability: Provide a Revenue Source (Y or N)	Multimodal Connectivity: Enhances Access to Existing Transit (H/M/L)
	11	C-D on I-495: Physically separate traffic using C-D lanes, adding two GP lanes in each direction **on I-495;** retain existing lanes **on I-270**	○	○	N	N/A	○	○	Y	○	N	◓
Reversible	12A	Contraflow Lane on I-495: Convert existing GP lane **on I-495** to contraflow lane during peak periods	○	○	N	N/A	○	○	N	○	N	○
	12B	Contraflow Lane on I-270: Convert existing HOV lane **on I-270** to contraflow lane during peak periods	○	○	N/A	N	○	○	N	○	N	○
	13A	Managed, Reversible Lane Network on I-495: Add two managed reversible lanes **on I-495**	○	○	Y	N/A	○	N/A	Y	◓	Y	◓
	13B	HOT Managed Reversible Lane Network on I-270: Convert existing HOV lanes to two HOT managed reversible lanes **on I-270**	♦	♦	N/A	Y	N/A	○	Y	♦	Y	◓
	13C	ETL Managed Reversible Lanes and HOV Managed Lane Network on I-270: Retains the existing HOV lanes in both directions and adding two ETL managed, reversible lanes on I-270	♦	♦	N/A	Y	N/A	◓	Y	♦	Y	◓
Transit	14A	Heavy Rail	○	●	N	N	N/A	N/A	N	◓	N/A	●
	14B	Light Rail	○	●	N	N	N/A	N/A	N	◓	N/A	●
	14C	Fixed Guideway BRT (Off Alignment)	○	●	Y	Y	N/A	N/A	N	◓	N/A	●
	15	Dedicated Bus Managed Lane on I-495 and I-270 Roadways	○	●	Y	Y	N/A	N/A	Y	◓	N/A	●

Note: the recommended Screened Alternatives are shaded green.

KEY: ○Low ◓Medium ●High Y: Yes N: No ♦ additional information needed

Figure 4-19: Screened Alternatives – Typical Sections



SCREENED ALTERNATIVES

10

2-Lane, ETL Managed Lane Network and 1-Lane HOV Managed Lane Network on I-270 only

Add two ETL managed lanes in each direction **on I-495 and on I-270** and retain one existing HOV lane in each direction **on I-270 only**

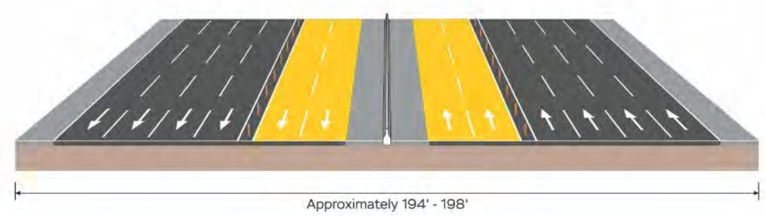
495

270

13B

2-Lane, HOT Managed Lane Network on I-495; HOT Managed, Reversible Lane Network on I-270:

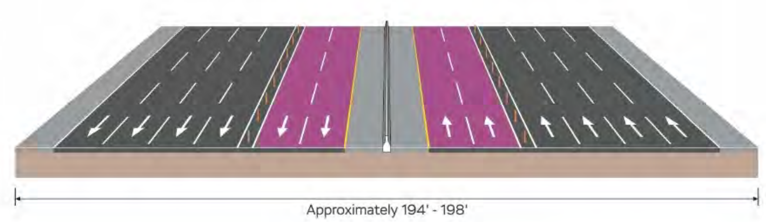
Add two HOT managed lanes in each direction on I-495 and convert existing HOV lanes to two HOT managed reversible lanes **on I-270** while maintaining GP lanes



13C

2-Lane, ETL Managed Lane Network on I-495; ETL Managed, Reversible Lane Network and 1-Lane HOV Managed Lane Network on I-270

Add two ETL managed lanes in each direction on I-495, maintain existing HOV managed lanes on I-270 and add two reversible ETL managed lanes on I-270



Legend

- New HOT Managed Lanes
- New ETL Managed Lanes

* **Note:** Managed Lanes Could Include Buses

NOT TO SCALE

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

4.5 Agency and Public Input on Alternatives

MDOT SHA and FHWA began coordination on the alternatives during the NEPA scoping stage which began in March 2018 when the Notice of Intent to develop an EIS of the I-495 & I-270 Managed Lanes Study was published. During the scoping phase, MDOT SHA and FHWA began seeking agency and public comments on the scope of the Study, the purpose and need as well as potential alternatives. MDOT SHA held monthly Interagency Working Group (IAWG) Meetings to seek input from Federal, State and local agencies. MDOT SHA also held several Scoping Public Open Houses in April 2018 to seek the public's input. The scoping public comment period was open from March 16, 2018 to May 1, 2018 and a total of 620 comments were received.

In July 2018, after developing the Preliminary Range of Alternatives, MDOT SHA held four Alternatives Public Workshops. The purpose of the Workshops was to seek input on the preliminary alternatives as well as the screening criteria. The July Workshops public comment period was open from July 17, 2019 to August 27, 2019 and 2,282 comments were received and considered in the alternatives screening process.

4.5.1 Agency Input

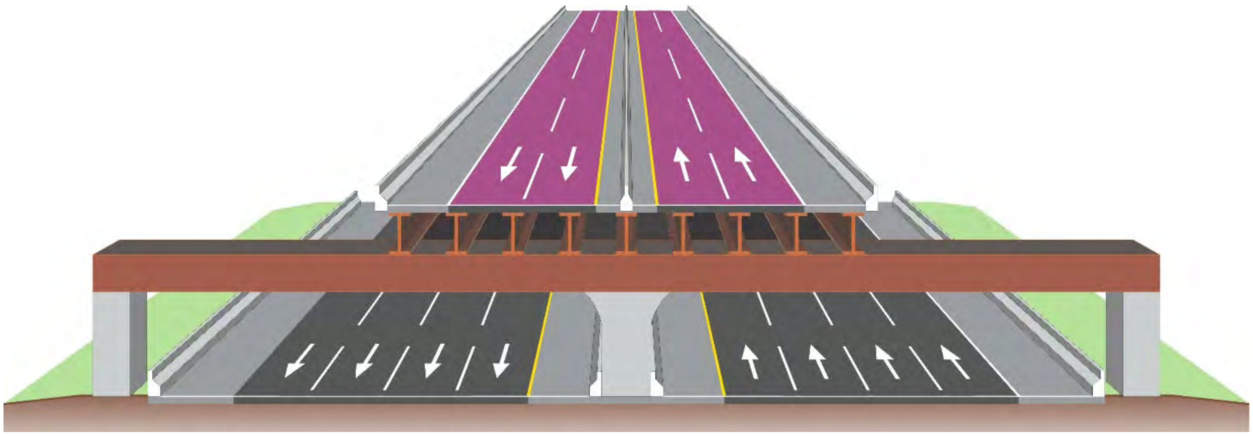
During the IAWG meetings, agency representatives asked if vertical or elevated alignment options were being considered as an option to limit the widening of I-495 and I-270. Vertical options are being considered as a means and methods to adding roadway capacity on I-495 and I-270, but is not being considered as a separate, standalone alternative. However, a vertical alignment would not likely reduce the extent of the LOD as construction cannot occur over moving traffic so temporary lanes would still need to be constructed for maintenance of traffic during construction. Also, this alternative would need to consider and include access to the elevated roadway, interchange reconfigurations, and noise and visual impacts resulting from having an elevated roadway.

The results of this evaluation are summarized below. An elevated alignment would include the managed lanes supported above the at-grade GP lanes. A typical scenario was designed for discussion purposes wherein a proposed elevated structure would be 82 feet wide, consisting of four managed lanes (2 per direction), shoulders, and barrier/parapet. Supporting an elevated structure of this width would require that the support bridge span the at-grade lanes as depicted in **Figure 4-20**. This configuration would consist of the following elements:

- Support pier and cross-highway structural girders spaced every 150 to 200 feet;
- An elevated (bridge) structure with girders that span between the support piers and cross-highway girders; and
- At-grade roadway modified to accommodate the elevated structure.

The support piers along the outside of the highway would be placed outside of the existing roadway edge and spaced approximately every 150 to 200 feet to accommodate construction of the elevated structure and maintenance of traffic during construction. In addition, the at-grade roadway modifications would include widening to support maintenance of traffic during construction, the median support piers, and to meet AASHTO roadway design standards. For example, in the area near MD 97, the existing highway is approximately 130 feet wide total, including the outside shoulders. The elevated roadway would be 176 feet wide from the outside of the support piers on either side of the roadway. The at-grade roadway would be 156 feet wide, representing more than two lanes worth of widening compared to the existing condition.

Figure 4-20: Typical Section of Elevated Option



Design and construction costs with this approach would be high due to the complexity of design of the new elevated structure and the amount of at-grade widening that would likely be needed. The elevated structure could have additional noise and aesthetic impacts than an at-grade alternative as it would be necessary to raise the roadway to a height above the existing roadway where noise and visual barriers existing for portions of the Study corridor. Operational characteristics such as incident response and snow removal would need to be addressed which would further increase the cost of the alternative. In addition, the are many direct access interchanges to/from the managed lanes being considered in the I-495 & I-270 Managed Lanes Study. The impacts and costs of providing these direct access connections would be greater with the proposed elevated structure because the cross-highway supports would limit the interchange/ramp configurations. Interchange ramps connecting to the elevated structure could be over 80 feet high. Higher, long-term maintenance concerns would also include redecking the entire structure every 30 years, cleaning and painting the steel every 10 years, overlaying the concrete deck once between redecking, and overlaying the at-grade roadway underneath. In addition, lighting conditions along the at-grade roadway may be undesirable. Some of the at-grade lanes would be “shadowed” under the elevated structure while other lanes would be “daylighted”. This could result in uneven sight conditions for drivers. The frequent spacing over the overhead cross-highway support members would further add to the shadowed/daylighted effect.

At the interchanges and overpasses, if the crossroad spans I-495 or I-270, then the profile of the elevated roadway would need to span both facilities, effectively providing a three-tiered overpass with a vertical distance of more than 50 feet between the lowest roadway and the deck of the elevated structure.

Maintenance of traffic requirements and the number of lanes that need to remain open during construction would significantly affect the ability to construct an elevated roadway without additional temporary impacts. Stormwater management could also be a major concern due to the amount of new and impervious area that must be managed for water quality and quantity with the addition of four lanes.

As stated earlier, vertical or elevated options are being considered as a means and methods to adding roadway capacity on I-495 and I-270 for the Study. However, it is not being considered as a standalone alternative.

In response to agency and public comments to retain alternatives which maintain the HOV lanes on I-270, MDOT SHA defined priced managed lanes separately as HOT or ETL and added Alternative 13C after the July 2018 Public Workshops. On I-270, Alternative 13C maintains the one existing HOV lane in each direction and adds two reversible ETLs. (Refer to **Section 4.4.16** for additional information on this alternative.) Also, under the HOT alternatives (5, 9, 13C), HOVs would be permitted to use the HOT lanes for free or at a reduced rate.

4.5.2 Public Input

MDOT SHA conducted a series of Public Workshops in July 2018 in Montgomery and Prince George's Counties for the I-495 & I-270 Managed Lanes Study to present the Study status and schedule, Purpose and Need summary, Preliminary Range of Alternatives, and the Screening Criteria used to narrow the range of alternatives. The intent of the workshops was to gather comments and information that would help inform the alternatives development process including determining the ARDS and environmental, traffic, and property analysis.

The Public Workshops provided an opportunity for the public to view, ask questions, and comment on the Study information. During the Workshop comment period (July 17, 2018 – August 27, 2018), MDOT SHA received a total of 2,282 comments through the workshop comment form, online meeting comment form, online general comment form, emailed comments, mailed comments and the toll-free line.

The following list identifies the common themes from the comments:

- Acknowledgement that congestion is a problem;
- Alternatives and existing corridor footprint;
- Alternatives/ Alternatives Development;
- NEPA Study/ Public Outreach/ P3 Processes;
- Environmental considerations;
- High Occupancy Vehicle Lanes/ Tolls; and
- Transit and Bicycle/ Pedestrian

Two frequently heard comments from the public specific to the Preliminary Range of Alternatives were: keep improvements within the existing roadway footprint and support for expanding existing public transit networks.

In response to public comments to keep the improvements within the existing footprint, MDOT SHA would not include the replacement or reconstruction of the C-D lanes currently on I-270 under any of the recommended Screened Alternatives (refer to **Figure 4-19**). Currently, these C-D lanes on I-270 operate with imbalanced traffic utilization. Also, the barriers separating the C-D lanes would be physically impacted during the construction of a build alternative. For these reasons, the C-D lanes would not be reconstructed, thus limiting the amount of roadway widening that would be needed if Alternatives 5, 8, 9, 10, 13B, or 13C were selected.

In response to public comments on transit and regional mobility, MDOT SHA considered Alternatives 14A, 14B, 14C, and 15 in the Preliminary Range of Alternatives. "There is no single project, program or policy solution to the transportation challenges faced in our region," was the conclusion from the 2017 Report by the National Capital Region – Transportation Review Board, Long-Range Plan Task Force. Therefore, the State is focused on a system of systems approach to addressing overall transportation needs in the National Capital Region.

When travelers on I-495 and I-270 experience 7 to 10 hours of congestion, a region-wide transportation system "toolkit" is needed to address congestion. The current I-495 & I-270 Managed Lanes Study is focused on addressing congestion on these interstate roadways, and therefore will not be studying transit alternatives as solutions for this Study. However, the Study will consider accommodating bus usage of a managed lane, coupled with enhancing connectivity to existing transit facilities through reduced congestion on the Study corridors and direct and indirect access to existing park-and-ride facilities, presents the opportunity to incorporate multimodal solutions to the identified transportation needs.

In addition, to address the regional transportation system, the State is considering other transportation improvements, outside the scope of the I-495 & I-270 Managed Lanes Study, to provide additional travel choices for residents, including increased annual funding for WMATA bus and Metro improvements, MARC service and capacity improvements, Smart Signal timing systems, and additional capacity on MD 295. Also, MDOT has committed to working with WMATA to consider the results of the Washington Area Transformation Bus Study in the Managed Lanes Study improvements, allowing bus usage in the managed lanes, and direct and indirect connections to existing transit stations and planned TODs.

Lastly, the 16-mile, two-track light rail system (the Purple Line) is currently under construction by the MDOT MTA with operation scheduled to begin in 2022. The Purple Line project is addressing the transit demand for a transit alignment within the Beltway as identified as the transit priority corridor in the 2002 *Capital Beltway / Purple Line Study*. The Purple Line FEIS and Purple Line Travel Forecasts Results Report evaluated the impact of transit alternatives on overall automobile usage by presenting the VMT in the region. In 2040, under the Purple Line, 129,828 less vehicle miles (0.07 percent) would be traveled each day in the region versus the 2040 No Build Alternative (Purple Line FEIS, page 3-12 and Purple Line Travel Forecasts Results Report, 2013).

Public input also assisted the project team in identifying environmental resources and community concerns in the Study corridors; these resources and concerns were taken into consideration as the alternatives were carried forward for further design development and environmental evaluation.

4.6 Summary

As a result of the initial screening, Alternatives 1, 5, 8, 9, 10, 13B, and 13C were recommended to be advanced for further detailed analysis. As noted previously, Alternative 1: No Build provides a baseline comparison. The recommended Screened Alternatives were advanced for further development and environmental evaluation. Through the screening process and as additional design progressed, the environmental impacts and cost implications resulting from the Screened Alternatives were considered as part of the more detailed evaluations which are documented in **Chapter 6** of this Technical Report.

5

5 ENGINEERING DETAILS OF SCREENED ALTERNATIVES

5.1 Design Criteria

The screened alternatives were developed based on the AASHTO *Policy on the Geometric Design of Highways and Streets* (AASHTO, 2011), MDOT SHA *Highway Location Reference*, *Roadside Design Guide* (AASHTO, 2011), *A Policy on Design Standards Interstate System* (AASHTO, 2016), and *Guidelines for Implementing Managed Lanes* (National Cooperative Highway Research Program (NCHRP), 2016). Mainline and interchange geometric design guidelines used in the development of alternatives are presented in **Table 5-1** and **Table 5-2**. The geometric design criteria were informed by the existing alignment of I-495 and I-270 within the Study limits. Existing sub-standard geometric elements including horizontal curve radius, superelevation rate, and stopping sight distance were identified; however, correction of geometric deficiencies is outside of the scope of the Purpose and Need for this Study. Design exceptions will be explored during final design.

A typical section is a graphical representation of the work to be performed within the Study limits and includes the major highway, standard design elements, and roadside grading. For each Screened Alternative, the roadway typical section was applied along the Study limits on I-495 and I-270 and served as the basis for development of the LOD. The roadway typical sections of the Screened Alternatives are shown in **Figure 4-19**.

The method of separation between the managed lanes and the GP lanes was considered during the development of the alternatives. The three approaches for separation evaluated as a part of this Study were barrier separation;[33] buffer separation[34] and pylon separation.[35] Pylon separation was selected because it has the smallest footprint while still providing physical separation between the managed lanes and the GP lanes. The pylons add physical and visual separation to the typical buffer separation, while improving sight distance compared to barrier separation. Pylons are easy to remove and are flexible enough to provide access for vehicles to and from the managed lanes during incidents and emergencies. The pylons will be placed within a four-foot buffer. The width of four feet is consistent with managed

[33] **Barrier separation** employs concrete barriers to physically separate the managed lanes from the general purpose lanes (NCHRP, 2016).

[34] **Buffer separation** is a physical space defined by pavement markings with no barrier between the managed lanes and the general purpose lanes (NCHRP, 2016).

[35] **Pylon separation** uses pylons (i.e., flexible delineators or tubular markers) in addition to a physical buffer to separate the managed lanes from the general purpose lanes (NCHRP, 2016).

lanes separation provided on I-495 in Virginia and is consistent with the desired buffer width presented in FHWA's *Priced Managed Lanes Guide* (2012, Chapter 6. Design).

Table 5-1: Mainline Design Criteria

Design Element		I-495	I-270
Functional Classification		Urban Interstate	Urban Interstate
% Trucks (2040)		7%	7%
Design Vehicle		WB-67	WB-67
Posted Speed Limit		55 MPH	55 MPH
Design Speed		60 MPH	60 MPH
Lane Width		12 feet	12 feet
Shoulder Width		Right: 10 feet; 12 feet with concrete barrier Left: 10 feet; 12 feet where needed for sight distance	Right: 10 feet; 12 feet with concrete barrier Left: 10 feet
Bridge Width		Match approach roadway width	Match approach roadway width
Maximum Superelevation		8%	6%
Horizontal Alignment – Minimum Curve Radius		1,200 feet	1,330 feet
Minimum Horizontal Curve Length		200 feet	200 feet
Vertical Alignment	Crest (K)/DS	151/60 MPH	151/60 MPH
	Sag (K)/DS	136/60 MPH	136/60 MPH
Maximum Vertical Grade		5.0%	4.0%
Minimum Vertical Grade		0.5%	0.5%
Minimum Stopping Sight Distance		570 feet	570 feet
Normal Pavement Cross Slope		1.5 – 2.0%	1.5 – 2.0%
Normal Shoulder Cross Slope		2.0 – 6.0%	2.0 – 6.0%
Vertical Clearance		16.5 feet	16.5 feet
Clear Zone		30 feet	30 feet

Table 5-2: Interchange Design Criteria

Design Element	General Purpose and Managed Lanes	
	Directional Ramps	Loop Ramps
Design Vehicle	WB-67	WB-67
Posted Speed Limit	Varies	Varies
Design Speed	Desired: 50 MPH Minimum: 35 MPH	Desired: 30 MPH Minimum: 20 MPH
Lane Width	Single lane: 15 feet Two lanes: 12 feet per lane	Single lane: 15 feet Two lanes: 12 feet per lane

Design Element		General Purpose and Managed Lanes	
		Directional Ramps	Loop Ramps
Shoulder Width		Right: 10 feet; 12 feet with concrete barrier Left: 4 feet	Right: 10 feet; 12 feet with concrete barrier Left: 4 feet
Bridge Width		Match approach roadway width	Match approach roadway width
Maximum Superelevation		8%	8%
Horizontal Alignment – Minimum Curve Radius		758 feet (50 MPH) 314 feet (35 MPH)	214 feet (30 MPH) 76 feet (20 MPH)
Vertical Alignment	Crest (K)/DS	84/50 MPH 29/35 MPH	19/30 MPH 7/20 MPH
	Sag (K)/DS	96/50 MPH 49/35 MPH	37/30 MPH 17/20 MPH
Maximum Vertical Grade		5.0%	4.0%
Minimum Vertical Grade		0.5%	0.5%
Minimum Stopping Sight Distance		425 feet (50 MPH) 250 feet (35 MPH)	200 feet (30 MPH) 115 feet (20 MPH)
Normal Pavement Cross Slope		1.5 – 2.0%	1.5 – 2.0%
Normal Shoulder Cross Slope		2.0 – 6.0%	2.0 – 6.0%
Vertical Clearance		16.5 feet	16.5 feet
Clear Zone		30 feet	30 feet

5.2 Limits of Disturbance

The Screened Alternatives include a variety of elements that contributed to the typical section and the LOD to create the complete end-to-end alternatives. The LOD is the proposed boundary within which all construction, staging, materials storage, grading, clearing, erosion and sediment control, landscaping, drainage, stormwater management, noise barrier replacement/construction, and related activities would occur. The methodology and assumptions for establishing the LOD are explained in detail below.

5.2.1 Methodology and Assumptions for Establishing Limits of Disturbance

The LOD for each Screened Alternative were determined from the proposed roadway typical sections, interchange configuration, and roadside design elements. Bentley Power InRoads V8i (SELECTseries 4) civil design software was used to model the proposed roadway typical section and roadside design features to the available topography and terrain information. The software models produced cut and fill lines that represented the point where the proposed slope intersected with existing ground or the back of retaining wall. Generally, the cut and fill lines were offset by ten feet to create the LOD. The proposed options for roadside typical sections are described in Section 5.2.3.

The preliminary design for on-site stormwater management, including ponds, large facilities and bio-swales along the roadside and within interchanges, was developed to a preliminary level of detail and was included within the LOD. Existing streams that were impacted by roadside grading were relocated where feasible. The LOD associated with the stormwater management ponds and relocated streams is described further in the *Stormwater Management Report*.

Improvements that required profile adjustments and roadway shifts for roads that cross over I-495 and I-270 due to mainline widening were designed at a preliminary level. The LOD incorporates the modifications along these crossroads. It was assumed that any required noise barriers along I-495 and I-270 would be located within the LOD. A 30-foot offset to the proposed LOD was established beyond the edge of I-495 and I-270 mainline bridges over water and roadways to accommodate potential reconstruction. It should be noted that all Screened Alternatives consider the full replacement of the American Legion Bridge generally in the centerline of the current crossing.

Major utility relocations were identified. A preliminary assessment of potential impacts and necessary utility relocations was conducted and an offset of between 10 feet and 50 feet to the proposed LOD was established beyond the cut and fill lines for these potential utility relocations.

The proposed LOD was compared to existing right-of-way and adjusted as follows: where the distance between the cut and fill lines and the existing right-of-way was greater than ten feet, the available distance was evaluated and the LOD was set between the ten-foot offset and the right-of-way line or at the existing right-of-way line. Adjacent land use was considered in the development of the LOD as described in the following sections.

5.2.2 Consideration of Adjacent Land Use

There are various regulated and sensitive resources adjacent to the roadway along I-495 and I-270, such as natural resources including streams and high-quality wetlands; historic communities; and national and local parks. Private business and residential properties were also considered during the development of the LOD and efforts were taken to avoid relocation of these properties, where possible. Similarly, while developing the engineering layouts and LOD for the Screened Alternatives, MDOT SHA used a process to limit or avoid impacts to sensitive environmental features. This included the application of five progressively narrower roadside typical sections, as described in **Section 5.2.3**, to minimize or avoid impacts to these environmental and community resources. A resource was considered impacted based on the conditions described in **Table 5-3**.

Table 5-3: Conditions Where Resources were Considered Impacted

Land Use Category	Condition
Natural resource	Proposed grading cut or fill line physically intersected or overlapped the resource boundary
Section 4(f) / Section 106 regulated resource	Proposed LOD intersected or overlapped the resource boundary
Private properties	Relocation if the LOD was less than 20 feet from the primary structure on the property; however, if the LOD was set along the existing right-of-way and the primary structure was less than 20 feet from the LOD/right-of-way, the property was not counted as a displacement since work would occur within the State's right-of-way and not directly impact the adjacent property.

5.2.3 LOD Minimization Approach

The five roadside typical sections are described below:

- An open section with a full-width bioswale for stormwater management;
- An open section with a reduced-width bioswale for stormwater management;
- An open section with no surface stormwater management;
- A closed section with concrete barrier; and
- A closed section with retaining wall.

The roadside typical sections were applied to the Build Alternatives using a step-by-step process, from widest to narrowest to the greatest extent necessary to avoid impacts, based on the existing roadside conditions and land use constraints.

The LOD used to quantify environmental impacts served as the proposed right-of-way line where it was located outside of the existing right-of-way line. All roadside design values met MDOT SHA and AASHTO design standards. Existing roadways were widened into the median wherever possible to minimize impacts.

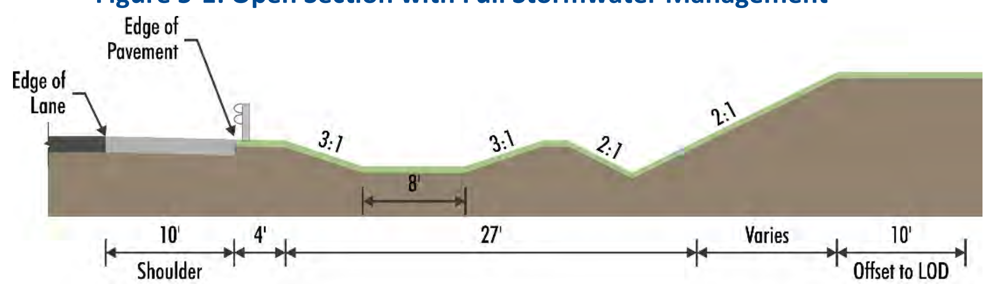
The design and costs of the Build Alternatives assumed application of the various roadside typical section steps. These engineering modifications were applied to demonstrate that environmental impacts could be minimized or avoided. Ongoing discussions with the regulatory agencies will result in further minimization, avoidance, and mitigation.

In areas where regulated environmental and sensitive resources and private properties were impacted by the widest roadside typical section (Step 1), the second widest roadside typical section, Step 2, was applied to modify and narrow the LOD. This process continued by applying the increasingly narrower roadside typical sections, Steps 3, 4, and 5, consecutively, as necessary, to avoid or minimize impacts to the adjacent resource. If a private property was still considered to be a displacement after application of the LOD minimization process, it was assumed that the entire parcel would be impacted and was encompassed in the LOD. At natural resource locations, the LOD was set based on the offset from the cut and fill lines. At Section 4(f) and Section 106 regulated resource locations, the LOD was offset from the cut and fill lines or was set at the resource boundary if the distance between the cut/fill line and the resource boundary is greater than ten feet.

A. Step 1: Open Section with Full Stormwater Management

The widest roadside typical section with surface stormwater management is shown in **Figure 5-1**. It provides an open section without curb and gutter that would allow stormwater sheet flow off the road into a drainage ditch. The typical section would include W-beam guardrail at the edge of pavement; an eight-foot wide flat bottom Environmental Site Design (ESD) swale with 3-to-1 side slopes; a V-ditch with 2-to-1 side slopes that ties to existing ground; and a ten-foot offset to the LOD to accommodate erosion and sediment control, noise barrier construction, and construction easements. This typical section was used as the widest typical section because it provided the greatest flexibility for roadside grading and linear stormwater management.

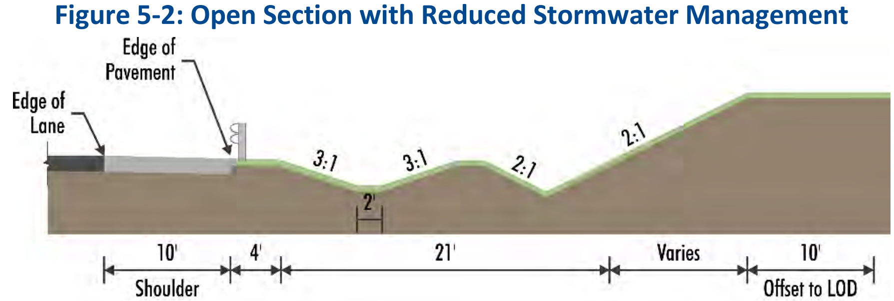
Figure 5-1: Open Section with Full Stormwater Management



B. Step 2: Open Section with Reduced Stormwater Management

A second roadside typical section with surface stormwater management is shown in **Figure 5-2**. It provides an open section that would include W-beam guardrail at the edge of pavement; a two-foot wide flat bottom ESD swale with 3-to-1 side slopes; a V-ditch with 2-to-1 side slopes that ties to existing ground; and a ten-foot offset to the LOD to accommodate erosion and sediment control, noise barrier construction, and construction easements. This section would maintain linear stormwater management, but at a reduced water storage capacity compared to Step 1.

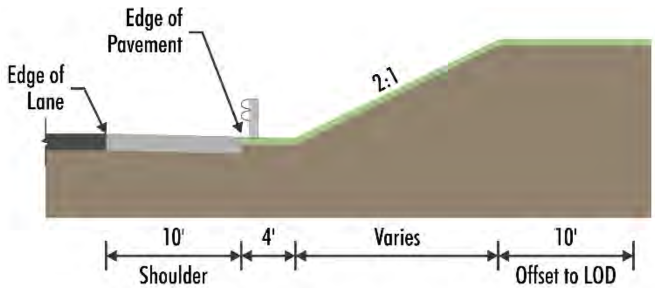
Figure 5-2: Open Section with Reduced Stormwater Management



C. Step 3: Open Section with No Stormwater Management

The roadside typical section shown in **Figure 5-3** is an open section with no surface stormwater management facilities. It would include W-beam guardrail at the edge of pavement; a 2-to-1 slope to tie to existing ground; and a ten-foot offset to the LOD to accommodate erosion and sediment control, noise barrier construction, and construction easements. This section would maintain an open section without linear stormwater management.

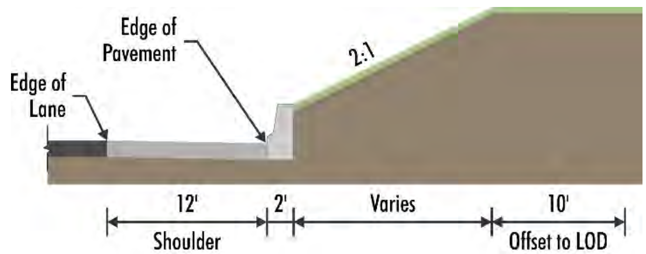
Figure 5-3: Open Section with No Stormwater Management



D. Step 4: Closed Section with Concrete Barrier

A closed roadside typical section (**Figure 5-4**) that would include a single-face concrete barrier at the edge of pavement with no surface stormwater management facilities; a 2-to-1 slope behind the barrier to tie to existing ground; and a ten-foot offset to the LOD to accommodate erosion and sediment control, noise barrier construction, and construction easements. The paved outside shoulder would be 12 feet wide to provide a two-foot offset to the barrier.

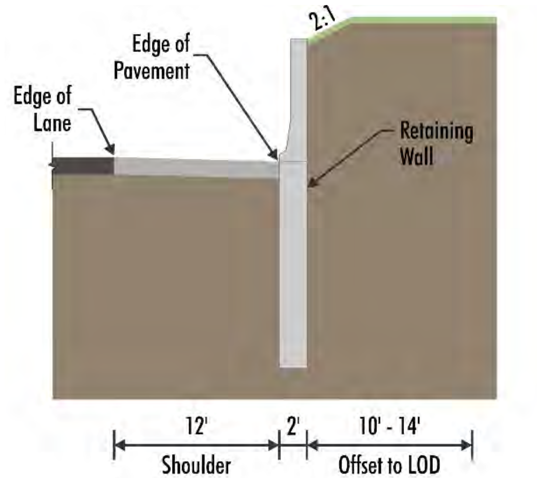
Figure 5-4: Closed Section with Concrete Barrier



E. Step 5: Closed Section with Retaining Wall

A closed roadside typical section (**Figure 5-5**) that would include a retaining wall at the edge of pavement, no surface stormwater management facilities, and a ten- to 14-foot offset from the back of the wall to the LOD to accommodate erosion and sediment control, noise barrier construction, and construction easements. In general, the LOD was offset 14 feet behind the back of the retaining wall; however, in constrained areas, further evaluation was performed to determine where the offset could be reduced to ten feet. The paved outside shoulder would be 12 feet wide to provide a two-foot offset to the retaining wall. This step would be the narrowest typical section.

Figure 5-5: Closed Section with Retaining Wall



5.2.4 Targeted Areas of Impact Reduction

The regulatory agencies, including U.S. Fish and Wildlife Service, U. S. Army Corps of Engineers, Maryland Department of the Environment, Maryland Department of Natural Resources (MDNR), Maryland-National Capital Park and Planning Commission, and National Park Service requested a series of coordination meetings through the Summer and Fall 2019 to focus on areas along the corridor to ensure further avoidance and minimization measures beyond the 5-step LOD minimization process were applied to the maximum reasonable extent while still meeting the purpose and need. The specific resources or focus areas where further analysis of avoidance and minimization efforts occurred included: Potomac River; Chesapeake and Ohio Canal National Historic Park; Clara Barton Parkway; Thomas Branch; Rock Creek and Rock Creek Stream Valley Park; National Park Seminary Historic District; Metropolitan Branch, Baltimore and Ohio Railroad; Sligo Creek Parkway; Northwest Branch of the Anacostia River; Paint Branch; Cherry Hill Road Park; Greenbelt Park; and a tributary of the Southwest Branch of the Western Branch of the Patuxent River. Approaches that were evaluated to minimize the LOD for the Build Alternatives included elimination/relocation of managed lane access points, shifting the centerline alignment (asymmetrical widening), reduction in number of lanes, and interchange configuration changes. The approaches that were studied and, where possible, incorporated into the LOD for the Build Alternatives at these focus areas are described in the *Avoidance, Minimization, and Impacts Report* and the *Section 4(f) Evaluation*.

5.3 Interchanges and Managed Lanes Access

There are 34 existing interchanges within the Study limits. For the Build Alternatives, all interchanges would be modified to accommodate the mainline widening of I-495 and I-270.

As described in Section 5.1, the managed lanes would be separated from the GP lanes by a buffer and pylons. Access for the managed lanes would be provided by direct access ramps at select interchanges, at specific at-grade auxiliary lanes (also termed 'slip ramps') where ingress to the managed lanes from the GP lanes or egress from the managed lanes to the GP lanes would be provided, and at the end points of the Study. In total, access to and from the managed lanes would occur at 27 locations, as well as at the start of the system along the I-495 inner loop west of MD 5 and SB I-270 north of I-370. The proposed managed lane access points were based on preliminary traffic and revenue analyses and may change as more detailed analyses are completed. The preliminary access locations were identified using the following considerations:

- Providing system-to-system connections between major interstates and freeways (e.g., I-495/I-95, I-495/I-270 spurs, I-495/US 50).
- Providing access at interchanges with high traffic demand (e.g., US 29, MD 5).
- Providing access throughout the Study area to maximize the number of users and adjacent communities that could use the managed lanes (e.g., MD 187, Ritchie Marlboro Road).
- Providing access at major transit facilities (e.g., Cherrywood Lane at Greenbelt Metro, Pennsy Drive at New Carrollton Metro).
- Providing access at interchanges of interest to the counties and agencies (e.g., Wootton Parkway, MD 650) based on input provided after the Spring 2019 Public Workshops.
- Potential community, property, and environmental impacts resulting from providing access.
- Geometric considerations such as interchange and ramp spacing.

The proposed managed lane access locations would include three new interchanges where access does not currently exist: on I-495 at Cherrywood Lane, and on I-270 at Wootton Parkway and Gude Drive. The proposed access locations are shown in **Figure 5-6** and listed in **Table 5-4**. The interchange modifications and access locations identified in **Table 5-4** would be the same for all the Build Alternatives and were used to establish the LODs. Generic examples showing general configurations for direct access interchange ramps and at-grade slip ramps are provided in **Figure 5-7** and **Figure 5-8**. The specific number of lanes and ramp configurations at the I-495 and I-270 interface interchanges and the I-270 Y-split are shown for each Build Alternative in **Figure 5-9** through **Figure 5-14.**

The managed lane access locations were presented at the Public Workshops held in March and April 2019. Following the Workshops, MDOT SHA received feedback from Montgomery County, Prince George's County, and local agencies on the proposed access locations and expressed interest in potential new or changed locations. Using this input, the proposed access locations to/from the managed lanes were re-evaluated based on the potential for additional traffic volume in the managed lanes with consideration for additional impacts to environmental resources and private properties. The managed lane access points were revised as summarized below:

- Provide access to and from both directions of the managed lanes on I-495 at MD 650 (previously no managed lane access proposed).
- Provide access to and from both directions of the managed lanes near Largo (between MD 202 and MD 214) (previously no managed lane access proposed).
- Provide access to and from both directions of the managed lanes on I-270 at Gude Drive (previously managed lanes access proposed to/from the south only).
- Provide access to and from both directions of the managed lanes on I-270 at Wootton Parkway (previously no managed lane access proposed).
- Eliminate access to/from the managed lanes on I-270 at Montrose Road while maintaining access for the GP lanes (previously full managed lane access proposed).

- Provide access to and from both directions of the managed lanes on I-270 West Spur at Westlake Terrace (previously managed lanes access proposed to/from the north only).
- Eliminate access to/from the managed lanes on I-270 West Spur at Democracy Boulevard while maintaining access for the GP lanes (previously managed lane access to/from the south).

These locations could be changed by the developers and there is the potential that multiple developers could ultimately operate different phases within the limits of the overall I-495 & I-270 Managed Lanes Study. If so, exchange ramps between the phase limits may be needed to accommodate different tolling approaches and rates within each phase. However, given that future operations are unknown at this time, no exchange ramps between phases have been included in this analysis. Should future developers propose additional access locations or exchanges, those locations will be studied for their potential impacts consistent with Federal and state law.

Figure 5-6: Proposed Managed Lanes Access Locations

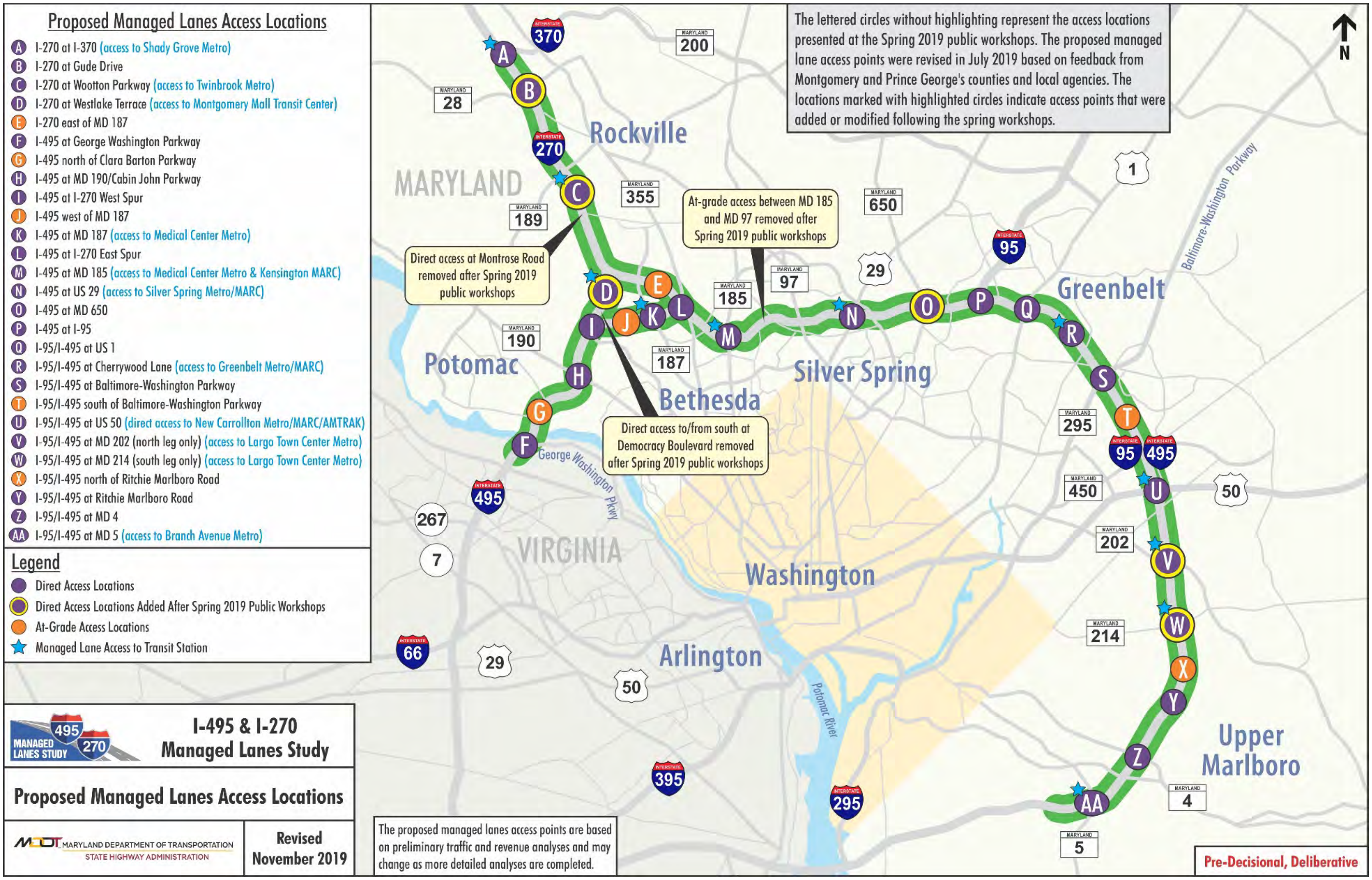


Table 5-4: Proposed Interchange Modifications and Managed Lanes Access Locations[36]

Location	Modification/Configuration	Access
Interface with Virginia I-495 HOT Lanes	• A managed lane entrance ramp would be provided along the inner loop in Virginia north of the Dulles Toll Road to allow users headed to Maryland to access the managed lanes. • A managed lane exit ramp would be provided along the outer loop in Virginia north of the Dulles Toll Road to allow users from Maryland to exit the managed lanes. • An at-grade auxiliary lane would be provided along the inner loop in Maryland north of the Clara Barton Parkway to allow users from Virginia to exit the managed lanes. • An at-grade auxiliary lane would be provided along the outer loop in Maryland north of the Clara Barton Parkway to allow users headed to Virginia to enter the managed lanes.	• Exchange between VA and MD managed lanes (see location 'G' on **Figure 5-6**).
I-495/George Washington Memorial Parkway Interchange	• Direct access flyover ramps, formed in the median of both the inner and outer loops of I-495, would allow I-495 outer loop managed lane users to exit to George Washington Parkway eastbound and westbound George Washington Parkway users to enter the I-495 inner loop managed lanes. The managed lanes in the median of I-495 would continue south through the interchange at George Washington Parkway to connect with the I-495 Express Lanes in Virginia as part of the I-495 Express Lanes Northern Extension Study (NEXT) being implemented by VDOT. • The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access • Direct access to managed lanes in Maryland (see location 'F' on **Figure 5-6**).
I-495/MD 190/Cabin John Parkway Interchange	• Direct access flyover ramps would connect the managed lanes to Cabin John Parkway and MD 190. A flyover ramp from the I-495 inner loop managed lanes would connect with an existing exit from the GP lanes, allowing users to exit onto both directions of MD 190. Similarly, users entering from both directions of MD 190 would enter the I-495 outer loop managed lanes via an existing entrance ramp and separate flyover ramp. Another flyover ramp would allow users from both directions of MD 190 to enter the I-495 inner loop managed lanes and allow users from the I-495 outer loop managed lanes to exit onto both directions of MD 190. • Two additional flyover ramps would allow users on NB Cabin John Parkway to enter the I-495 inner loop managed lanes and users of the I-495 outer loop managed lanes to exit onto SB Cabin John Parkway. • The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access • Direct access to managed lanes (see location 'H' on **Figure 5-6**).
I-495/I-270 West Spur Interchange	• The I-495/I-270 West Spur interchange would be reconstructed to accommodate GP and managed lanes movements between I-495 and the I-270 West Spur. • All managed lane and GP lane ramps that connect the I-270 West Spur to I-495 would cross under bridges on I-495. A new structure would develop in the median to carry through movements of the outer loop managed lanes located on I-495. In addition, the inner loop managed lanes and GP lanes on I-495 would be located on one structure that crosses over the I-270 NB GP lanes. To allow the GP lanes on the inner loop of I-495 to diverge to the I-270 West Spur, the GP lanes would separate from the through GP lanes on the outside and cross under the new I-495 inner loop bridge. The SB I-270 managed lanes would be located adjacent to the SB I-270 GP lanes and would merge with the I-495 outer loop managed lanes. The inner loop managed lanes on I-495 would diverge and cross under the I-495 outer loop managed lane bridge to continue on I-270 NB.	• GP lane access • Direct access to managed lanes (see location 'I' on **Figure 5-6**).
At-grade auxiliary lanes along I-495 between I-270 West Spur and MD 187	• At grade auxiliary lanes would provide access to and from the managed lanes. • Along the inner loop an at-grade auxiliary lane would provide ingress to the managed lanes. • Along the outer loop an at-grade auxiliary lane would provide egress from the managed lanes.	• At-grade access for managed lanes (see location 'J' on **Figure 5-6**).
I-495/MD 187 Interchange	• The MD 187 interchange would be reconfigured as a single point urban interchange (SPUI) to provide direct access to and from the managed and GP lanes. • Right side entrance and exit ramps from both directions of the managed lanes along I-495 and left side entrance and exit ramps from both directions of the GP lanes along I-495 would connect to form two entrance ramps and two exit ramps to and from MD 187. • The SPUI intersection would be located at-grade on MD 187, under I-495. The managed lanes and GP lanes on I-495 would cross over MD 187 on three separate bridges. • The direct access ramps would provide connectivity with the nearby Medical Center Metro station.	• GP lane access • Direct access to managed lanes (see location 'K' on **Figure 5-6**).
I-495/I-270 East Spur/MD 355 Interchange	• The I-495/I-270 East Spur interchange would be reconstructed to accommodate GP and managed lanes movements between I-495 and the I-270 East Spur. • Direct access would be provided to and from the I-270 East Spur managed lanes and the I-495 managed lanes. The SB managed lanes on the I-270 East Spur would cross over the I-495 outer loop managed and GP lanes to merge with the I-495 inner loop managed lanes. The managed lanes on the I-495 outer loop diverge and would cross under the I-495 outer loop managed and GP lanes to merge with the I-270 NB GP lanes. In addition to providing new ramps for direct access, two existing ramps would be reconfigured to accommodate the roadway widening and direct access movements. • The entrance ramp from NB MD 355 to the I-495 outer loop GP lanes would exit MD 355 on the left side and fly over the interchange movements to merge with the I-495 outer loop GP lanes on the right side, just east of the Bethesda Trolley Trail bridge over I-495. The existing left side exit ramp from the SB I-270 East Spur GP lanes to SB MD 355 would be replaced with a right-side exit ramp that crosses over I-495 and merges with the existing exit ramp from the I-495 inner loop GP lanes to SB MD 355. • The existing Red Line Metro bridge would not be impacted by the interchange modifications or mainline widening.	• GP lane access for I-270 East Spur and MD 355 • Direct access to managed lanes for I-270 East Spur (see location 'L' on **Figure 5-6**).
I-495/MD 185 Interchange	• Direct access exit and entrance ramps to/from the I-495 managed lanes at MD 185 would be in the median. The entrance and exit ramps would merge and diverge on the left side of the managed lanes on I-495. The ramps would meet MD 185, which crosses under I-495, at a new intersection. Direct access movements to/from both directions of the I-495 managed lanes and both directions on MD 185 would be provided by way of the intersection. • The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline. • The direct access ramps would provide connectivity with the nearby Medical Center Metro station and the Kensington MARC station.	• GP lane access • Direct access to managed lanes (see location 'M' on **Figure 5-6**).

[36] The proposed managed lane access points are based on preliminary traffic and revenue analyses and agencies' input. The locations may change based on public and agencies' comments on the DEIS and as more detailed analyses are completed, and the Interstate Access Point Approval request is reviewed by FHWA.

Location	Modification/Configuration	Access
I-495/MD 97 Interchange	• Due to the roadway widening along I-495, the interchange at MD 97 would need to be reconfigured since the existing loop ramps could not be maintained with tighter radii. • The existing loop ramps would be eliminated, and the loop ramp movements would be accommodated via left turns to and from modified directional ramps at existing signalized intersections on MD 97. • MD 97 would be widened to accommodate two new left turn lanes in each direction.	• GP lane access
I-495/US 29 Interchange	• The US 29 interchange would be reconfigured to accommodate direct access to and from the managed lanes and NB and SB US 29. Direct access to and from the managed lanes on I-495 would be provided via a new four-leg signalized intersection on US 29. The exit and entrance ramps along the I-495 managed lanes would be in the median. • All existing loop ramps would be demolished, and the loop ramp movements would be accommodated via left turns to and from modified directional ramps at two new signalized intersections on US 29. • The direct access ramps would provide connectivity with the nearby Silver Spring Metro and MARC stations and the Paul Sarbanes (Silver Spring) Transit Center.	• GP lane access • Direct access to managed lanes (see location 'N' on **Figure 5-6**).
I-495/MD 193 Interchange	• The interchange at MD 193 would need to be reconfigured due to mainline widening along I-495. The existing loop ramps would be eliminated, and the loop ramp movements would be accommodated via left turns to and from new and modified directional ramps at signalized intersections on MD 193. • MD 193 would be widened to accommodate new left turn lanes in each direction. • In the northwest quadrant, a new directional entrance ramp would be constructed to allow NB users on MD 193 to enter the I-495 outer loop via a left turn. Similarly, in the southeast quadrant of the interchange, a new spur to the existing entrance ramp would be constructed to allow SB users on MD 193 to enter the I-495 inner loop via a left turn. A new signalized intersection would be constructed on MD 193 at this location south of I-495 to signalize the left turn movement.	• GP lane access
I-495/MD 650 Interchange	• A direct access exit ramp from the EB I-495 managed lanes and entrance ramps to/from the I-495 managed lanes at MD 650 would be in the median. The entrance and exit ramps would merge and diverge on the left side of the managed lanes on I-495. The ramps would meet MD 650, which crosses under I-495, at a new intersection. Direct access movements to both directions of the I-495 managed lanes and from the EB I-495 managed lanes would be provided by way of the intersection. A right-side exit ramp from the WB I-495 managed lanes west of the I-95 interchange would fly over the I-495 outer loop GP lanes and merge with the existing exit from the GP lanes, allowing users to exit onto both directions of MD 650. • The MD 650 interchange would be partially reconfigured to accommodate direct access to and from the managed lanes and NB and SB MD 650. The existing loop ramp in the southwest quadrant could not be maintained with a tighter radius. The existing loop ramps in the southeast and southwest quadrants would be eliminated, and the loop ramp movements would be accommodated via left turns to and from modified directional ramps at a new intersection on MD 650. The GP interchange ramps in the northeast and northwest quadrants would be adjusted to accommodate the widened I-495 mainline.	• GP lane access • Direct access to managed lanes (see location 'O' on **Figure 5-6).**
I-95/I-495 Interchange	• Several flyover ramps would be constructed to provide direct access between the I-495 managed lanes and I-95. Along the inner loop, a right-side exit ramp from the I-495 managed lanes would cross over the GP lanes on the I-495 inner loop and merge with the existing exit ramp from I-495 to NB I-95. Direct access from SB I-95 would be accomplished via an exit ramp in the median of I-95 and two separate flyover ramps that connect with the outer loop and inner loop managed lanes on I-495. Along the outer loop, a flyover exit ramp on the right side would connect the I-495 managed lanes with NB I-95. • The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access • Direct access to managed lanes (see location 'P' on **Figure 5-6**).
I-495/US 1 Interchange	• Direct access exit and entrance ramps to/from the I-495 managed lanes at US 1 would be in the median. The entrance and exit ramps would merge and diverge on the left side of the managed lanes on I-495. The ramps would meet US 1, which crosses over I-495, at a new intersection. Direct access movements to/from both directions of the I-495 managed lanes and both directions on US 1 would be provided by way of the intersection. • The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access • Direct access to managed lanes (see location 'Q' on **Figure 5-6**).
I-495/Greenbelt Metro Interchange	• The Greenbelt Metro interchange would be modified to provide all movements, adding the currently missing ramps to/from the south. • The existing GP interchange ramps to/from the north would be adjusted to accommodate the widened I-495 mainline.	• GP lane access
I-495/Cherrywood Lane Interchange ***(new interchange)***	• A new interchange would be constructed at the existing Cherrywood Lane overpass to provide direct access to and from the I-495 managed lanes only. • Direct access would be provided via a grade-separated four-leg signalized intersection on Cherrywood Lane. The exit and entrance ramps along the I-495 managed lanes would be in the median. • The direct access ramps would provide direct access to the Greenbelt Metro and MARC stations.	• Direct access to managed lanes (see location 'R' on **Figure 5-6**).
I-495/MD 201 Interchange	• The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access
I-495/Baltimore-Washington Parkway Interchange	• Direct access would be provided at the Baltimore-Washington Parkway by constructing several flyover ramps. Baltimore-Washington Parkway crosses over I-495 at the interchange and a series of new flyover ramps would cross over the Baltimore-Washington Parkway. • Direct access would be provided from NB Baltimore-Washington Parkway to the I-495 outer loop managed lanes and from SB Baltimore-Washington Parkway to the I-495 inner loop and outer loop managed lanes via directional flyover ramps on structure directly over the Baltimore-Washington Parkway. • Direct access from the I-495 inner loop managed lanes to NB and SB Baltimore-Washington Parkway and from the I-495 outer loop managed lanes to NB Baltimore-Washington Parkway would be provided via directional flyover ramps on structure. • The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access • Direct access to managed lanes (see location 'S' on **Figure 5-6**).
At-grade auxiliary lanes along I-495 between the Baltimore-	• At-grade auxiliary lanes would provide access for the MD 450, MD 202, Arena Drive, and MD 214 interchanges to/from the north. • Along the inner loop an at-grade auxiliary lane would provide egress from the managed lanes.	• At-grade access for managed lanes (see location 'T' on **Figure 5-6**).

Location	Modification/Configuration	Access
Washington Parkway and MD 450	• Along the outer loop an at-grade auxiliary lane would provide ingress to the managed lanes.	
I-495/MD 450 Interchange	• The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access
I-495/US 50 Interchange	• Direct access would be provided at US 50 by constructing new flyover ramps. US 50 crosses over I-495 at the interchange. New flyover ramps would cross over I-495, US 50, and the GP ramps. • Direct access would be provided from the I-495 inner loop managed lanes to eastbound and westbound US 50 and from the I-495 outer loop managed lanes to eastbound and westbound US 50 on new flyover structures directly above US 50. • Direct access would be provided from eastbound US 50 to the I-495 inner loop and outer loop managed lanes and from westbound US 50 to the I-495 inner and outer loop managed lanes via new flyover ramp structures at the highest elevation level at the interchange. • Direct access to/from the New Carrollton Transit Center would be provided via a grade-separated three-leg intersection on Pennsy Drive, west of I-495. The exit and entrance ramps would connect with the managed lane ramps located in the median along US 50. • The GP interchange ramps would be adjusted to accommodate the widened I-495 and US 50 mainlines.	• GP lane access • Direct access to managed lanes (see location 'U' on **Figure 5-6**).
I-495/MD 202 Interchange	• Direct access to/from the north would be provided via a grade-separated three-leg signalized intersection on MD 202. The exit and entrance ramps along the I-495 managed lanes would be in the median. • The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access • Direct access to managed lanes (to/from north only) (see location 'V' on **Figure 5-6**).
I-495/Arena Drive Interchange	• The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access
I-495/MD 214 Interchange	• Direct access to/from the south would be provided via a grade-separated three-leg signalized intersection on MD 214. The exit and entrance ramps along the I-495 managed lanes would be in the median. • The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access • Direct access to managed lanes (to/from south only) (see location 'W' on **Figure 5-6**).
At-grade auxiliary lanes along I-495 between MD 214 and Ritchie Marlboro Road	• At-grade auxiliary lanes would provide access for the MD 450, MD 202, Arena Drive, and MD 214 interchanges to/from the south. • Along the inner loop an at-grade auxiliary lane would provide ingress to the managed lanes. • Along the outer loop an at-grade auxiliary lane would provide egress from the managed lanes.	• At-grade access for managed lanes (see location 'X' on **Figure 5-6**).
I-495/Ritchie Marlboro Interchange	• Direct access exit and entrance ramps to/from the I-495 managed lanes at Ritchie Marlboro Road would be in the median. The entrance and exit ramps would merge and diverge on the left side of the managed lanes on I-495. The ramps would meet Ritchie Marlboro Road, which crosses under I-495, at a new roundabout. • Direct access movements to/from both directions of the I-495 managed lanes and both directions on Ritchie Marlboro Road would be provided by way of the roundabout. • The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access • Direct access to managed lanes (see location 'Y' on **Figure 5-6**).
I-495/MD 4 Interchange	• Direct access exit and entrance ramps to/from the I-495 managed lanes at MD 4 would be in the median. The entrance and exit ramps would merge and diverge on the left side of the managed lanes on I-495. The ramps would meet MD 4, which crosses under I-495, at a new intersection. • Direct access movements to/from both directions of the I-495 managed lanes and both directions on MD 4 would be provided by way of the intersection. • The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access • Direct access to managed lanes (see location 'Z' on **Figure 5-6**).
I-495/MD 337/Suitland Road Interchange	• The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline.	• GP lane access
I-495/MD 5 Interchange	• There would be four new ramps constructed at the MD 5 interchange to provide direct access to the I-495 outer loop managed lanes from NB and SB MD 5 and from the I-495 inner loop managed lanes to NB and SB MD 5. • The I-495 inner loop managed lanes would connect to NB MD 5 via a new exit ramp located in the median of I-495 that would cross under the I-495 inner loop. Access from the inner loop managed lanes to SB MD 5 would be provided via a new flyover ramp on the left side of the managed lanes that would cross over the inner loop and merge with the existing GP exit to SB MD 5. Access to the I-495 outer loop managed lanes from NB and SB MD 5 would be provided via new flyover ramps along MD 5. • Because the managed lane system terminus along I-495 is located west of MD 5, direct access from MD 5 to the inner loop managed lanes and from the outer loop managed lanes to MD 5 would not be provided. • The GP interchange ramps would be adjusted to accommodate the widened I-495 mainline. • The direct access ramps would provide direct access to the nearby Branch Avenue Metro station.	• GP lane access • Direct access to managed lanes (see location 'AA' on **Figure 5-6**).
I-270 West Spur/Democracy Boulevard Interchange	• The GP interchange ramps would be adjusted to accommodate the widened I-270 West Spur mainline.	• GP lane access •
I-270 West Spur/Westlake Terrace Interchange	• Direct access to the NB managed lanes and from the SB managed lanes on the I-270 West Spur would be provided at Westlake Terrace by repurposing the existing HOV entrance and exit ramps. The existing intersection at Westlake Terrace would be converted to a four-leg intersection with new exit and entrance ramps to/from the south to provide direct access for all directions on the managed lanes. The entrance and exit ramps would merge and diverge on the left side of the managed lanes on I-270.	• GP lane access • Direct access to managed lanes (see location 'D' on **Figure 5-6**).

Location	Modification/Configuration	Access
	• The direct access ramps would provide access to the adjacent Westlake Terrace transit center.	
I-270 Y-Split Interchange	• The existing Y-Split interchange would be reconstructed to provide ramps between the managed lanes on the I-270 mainline with the managed lanes on both I-270 spurs and maintain all GP lane movements.	• GP lane access • Managed lanes access
I-270/Montrose Road Interchange	• The existing GP interchange ramps would be adjusted to accommodate the widened I-270 mainline.	• GP lane access
I-270/Wootton Parkway Interchange ***(new interchange)***	• A new interchange would be constructed at the existing Wootton Parkway overpass to provide direct access to and from the I-270 managed lanes only. • Direct access would be provided via a grade-separated four-leg signalized intersection on Wootton Parkway. The exit and entrance ramps along the I-270 managed lanes would be in the median. • The direct access ramps would provide access to the nearby Twinbrook Metro station.	• Direct access to managed lanes (see location 'C' on **Figure 5-6**).
I-270/MD 189 Interchange	• The GP interchange ramps would be adjusted to accommodate the widened I-270 mainline.	• GP lane access
I-270/MD 28 Interchange	• The GP interchange ramps would be adjusted to accommodate the widened I-270 mainline.	• GP lane access
I-270/Gude Drive Interchange ***(new interchange)***	• A new interchange would be constructed at Gude Drive to provide direct access to and from the I-270 managed lanes only. • Direct access would be provided via a grade-separated four-leg signalized intersection on Gude Drive. The exit and entrance ramps along the I-270 managed lanes would be in the median.	• Direct access to managed lanes (see location 'B' on **Figure 5-6**).
I-270/Shady Grove Road Interchange	• The GP interchange ramps would be adjusted to accommodate the widened I-270 mainline.	• GP lane access
I-270/I-370 Interchange	• Several new flyover ramps would be constructed to provide direct access for the I-270 managed lanes at I-370. Flyover ramps from the NB I-270 managed lanes to eastbound and westbound I-370 and from eastbound and westbound I-370 to the I-270 SB managed lanes would be constructed. • Because the managed lane system terminus along I-270 is located just north of I-370, direct access from I-370 to the NB managed lanes and from the SB managed lanes on I-270 to I-370 would not be provided. • The GP interchange ramps would be adjusted to accommodate the widened I-270 mainline. • The direct access ramps would provide connectivity with the nearby Shady Grove Road Metro station.	• GP lane access • Direct access to managed lanes to/from the south (see location 'A' on **Figure 5-6**).
At-grade auxiliary lanes along I-270 East Spur north of I-495	• At-grade auxiliary lanes would provide access for MD 355 and I-270 East Spur to I-270 mainline direct access interchanges. • Along the NB I-270 East Spur an at-grade auxiliary lane would provide ingress to the managed lanes. • Along the SB I-270 East Spur an at-grade auxiliary lane would provide egress from the managed lanes.	• At-grade access for managed lanes (see location 'E' on **Figure 5-6**).
I-270 East Spur/MD 187/Rockledge Drive Interchange	• The GP interchange ramps would be adjusted to accommodate the widened I-270 East Spur mainline.	• GP lane access

Figure 5-7: Example Direct Access Interchange

Figure 5-8: Example At-Grade Access Slip Ramp Configuration

Figure 5-9: Alternative 5 I-495 / I-270 Interchange Interface

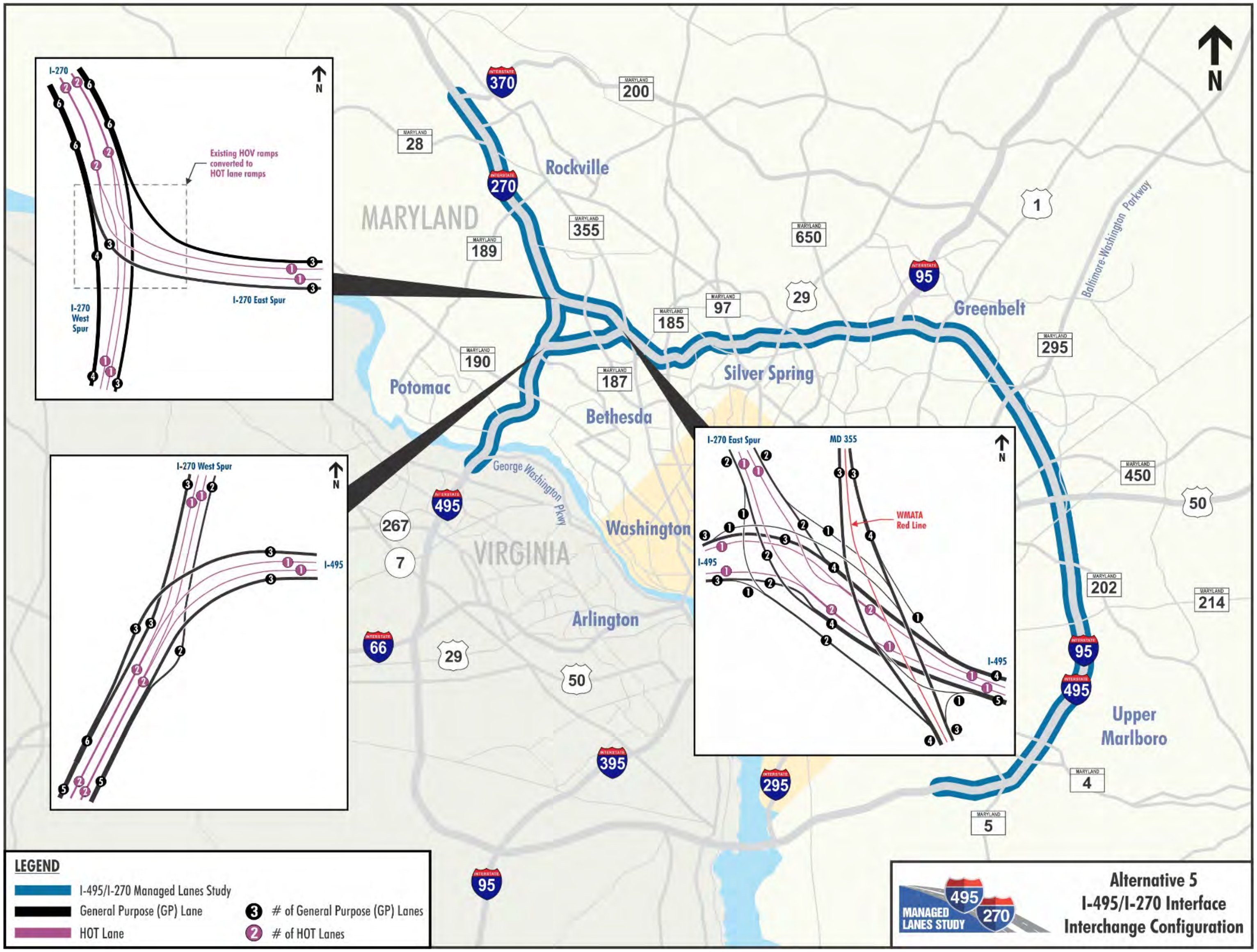


Figure 5-10: Alternative 8 I-495 / I-270 Interchange Interface

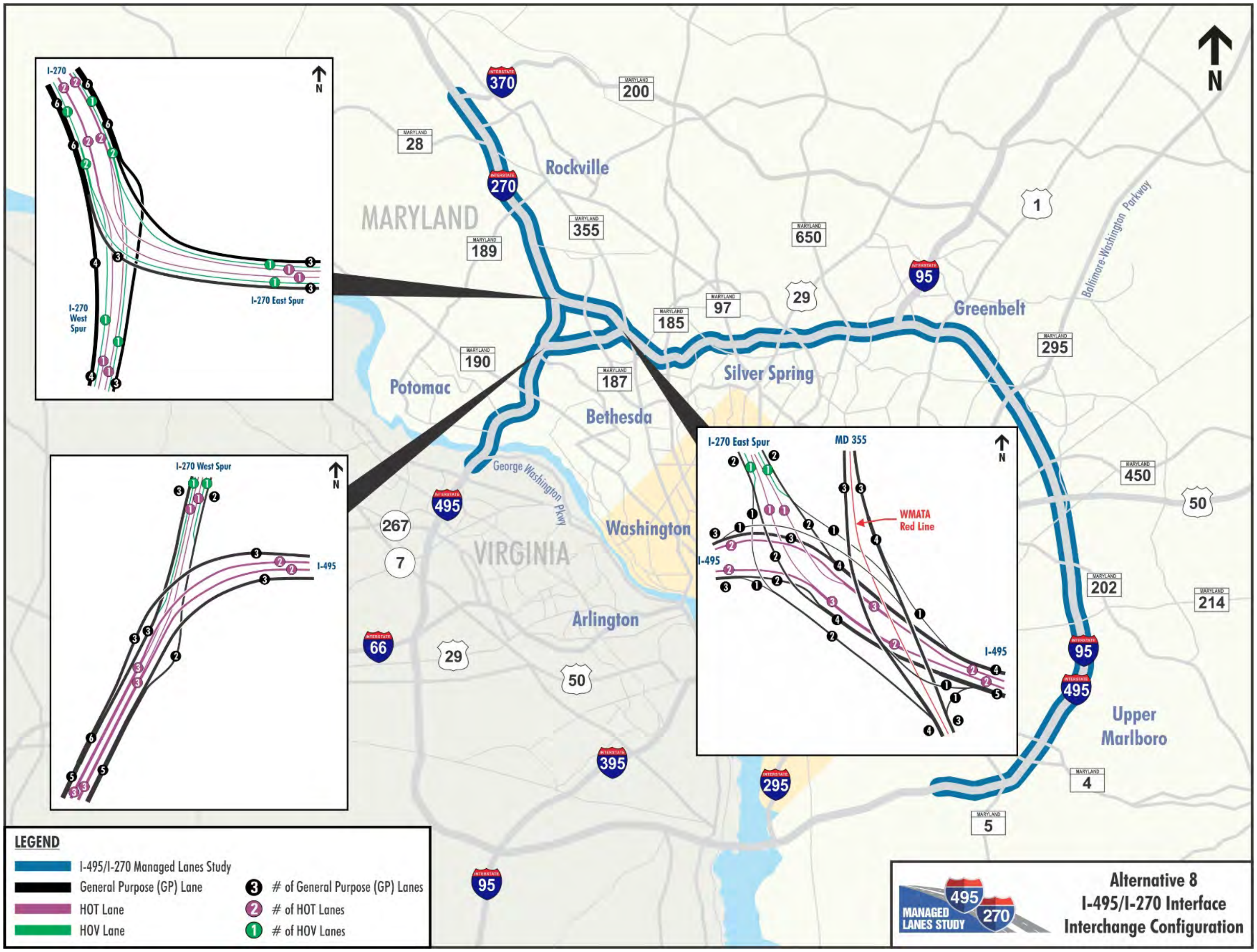


Figure 5-11: Alternative 9 I-495 / I-270 Interchange Interface

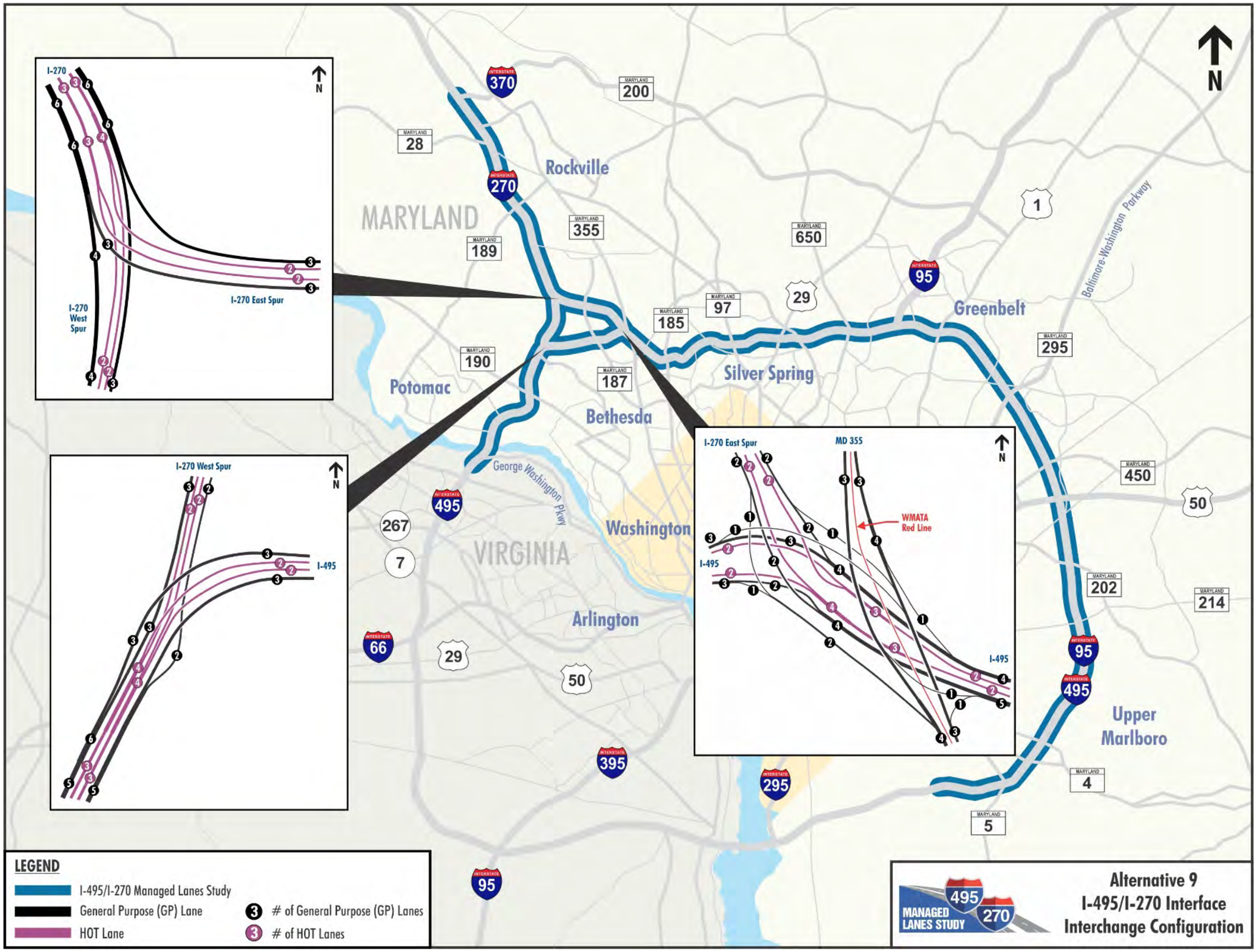


Figure 5-12: Alternative 10 I-495 / I-270 Interchange Interface

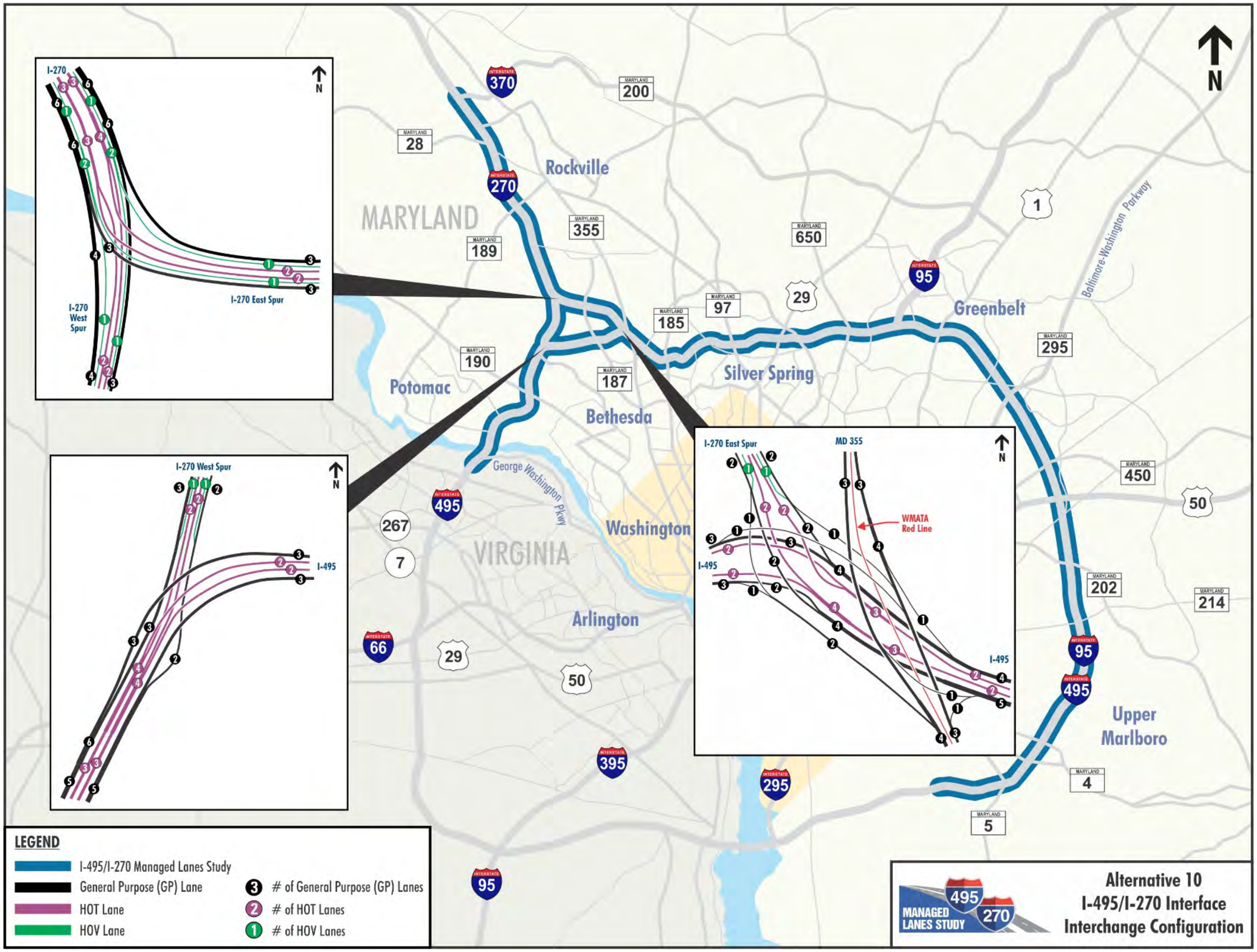


Figure 5-13: Alternative 13B I-495 / I-270 Interchange Interface

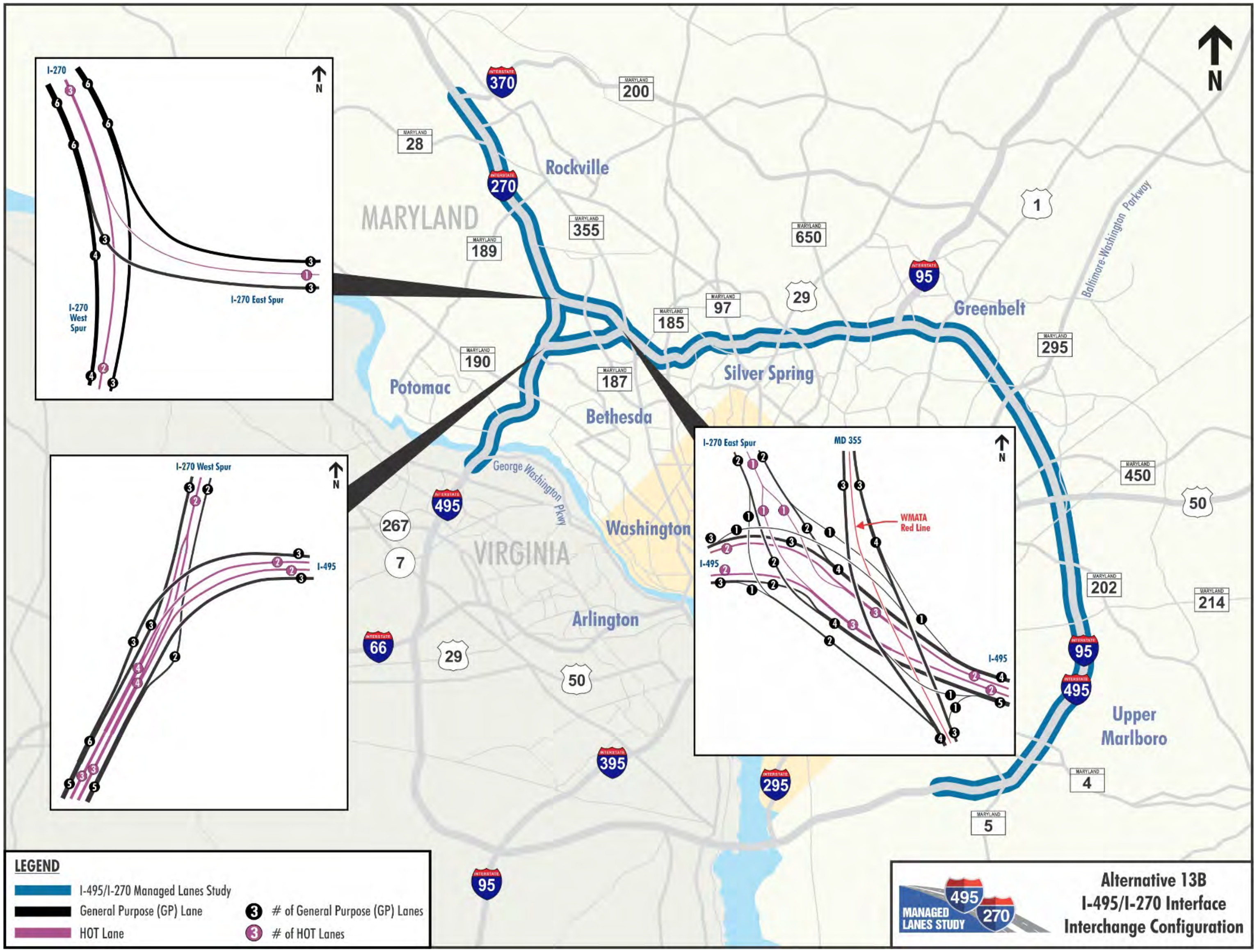
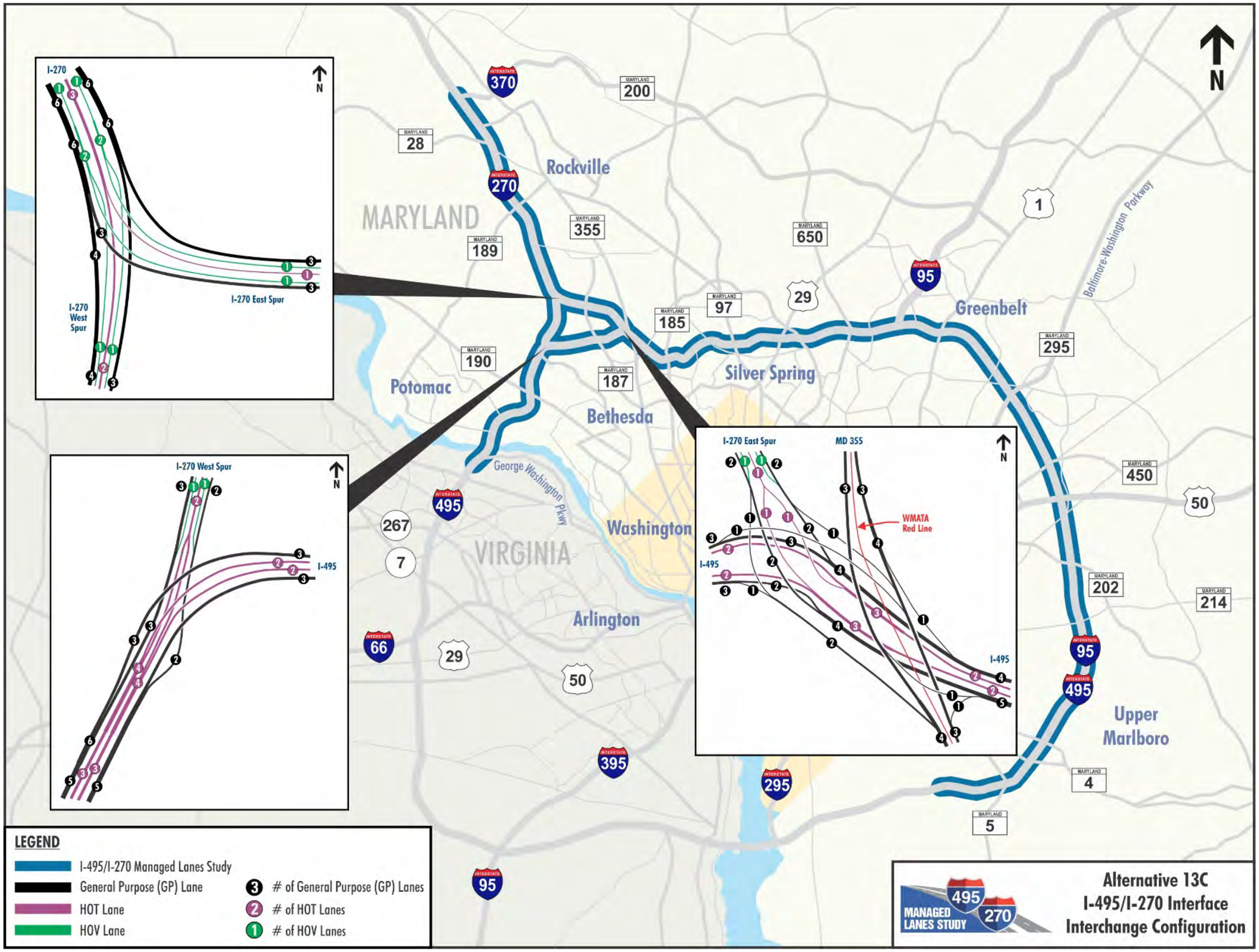


Figure 5-14: Alternative 13C I-495 / I-270 Interchange Interface



5.4 I-270 Mainline Changes

Along the I-270 mainline there are C-D roadways that separate express and local traffic in both directions from Montrose Road to north of the Study limits north of I-370. All the Build Alternatives would include the removal of the C-D roadways, replacing the separated express and local lanes with unseparated GP lanes. The same number of total GP lanes that currently exist are provided in the ARDS. This modification has two primary reasons. First, the existing separated express and local lanes operate inefficiently in that throughout the peak periods there are locations where either the express lanes operate over capacity while the adjacent local lanes operate below capacity or vice versa. This imbalance in portions of the express and local lanes is partially the result of the existing configuration of interchanges and slip ramps between the express and local lanes does not allow for the optimal use of the express and local lanes during periods of highest demand. This issue would be alleviated by eliminating the C-D roadways. Second, eliminating the C-D roadways would reduce the extent of impacts to environmental features, community resources, and private properties resulting from adding managed lanes along the I-270 mainline. The No Build Alternative (Alternative 1) would not include removal of the C-D roadways on I-270.

5.5 Structures

Structures include all existing bridges in the Study corridors that would be affected due to widening as part of the Build Alternatives. This includes 54 mainline and ramp bridges along I-495 that would be replaced or widened, as well as 60 bridges that cross over I-495 or cross roads, including two pedestrian bridges east of MD 187 (Bethesda Trolley Trail) and at MD 97 (Forest Glen Pedestrian Path). Seven mainline and ramp bridges along I-270 would be replaced and 15 bridges that cross over I-270 would be impacted, including two pedestrian bridges north of Grosvenor Lane (Bethesda Trolley Trail) and at MD 28. Existing overpass bridges would be replaced if impacted due to mainline widening. The American Legion Memorial Bridge on I-495 spanning the Potomac River is anticipated to be replaced with a new, wider bridge on the existing centerline (no widening of the existing bridge). The existing bridge is nearly 60 years old and would need to be replaced regardless of this Study. The new bridge would be constructed in phases to maintain the same number of existing lanes at all times, and therefore the new bridge will be replaced in the same existing location.

Existing bridges crossing I-495 and I-270 that were not impacted by mainline widening and were constructed before 1970 that have not undergone a superstructure replacement would be replaced. For existing overpass bridges constructed before 1970 that have undergone a major rehabilitation, the current condition, bridge sufficiency rating, and extent of work needed to accommodate mainline widening were considered to determine if the bridge would be replaced or repaired.[37] For existing bridges crossing I-495 and I-270 constructed after 1970 with a superstructure rated six or lower, the superstructure would be replaced, and substructure repairs would be needed. For existing bridges crossing I-495 and I-270 constructed after 1990, deck replacement or overlay and substructure repairs

[37] The bridge sufficiency rating, which is a result of an in-depth hands-on bridge inspection, is an early warning sign for engineers to initiate the rehabilitation or replacement process and to use when prioritizing funding. The rating applies to three main elements of a bridge: 1) the deck (riding surface); 2) the superstructure (main supporting element of the deck, usually beams, girders, trusses, etc.); and 3) the substructure (supports to hold up the superstructure and deck, usually abutments and piers). These elements are rated on a scale from zero (closed to traffic) to nine (relatively new). https://www.roads.maryland.gov/Index.aspx?PageId=148

would be needed. Detailed vertical clearance was not investigated to determine if the widened roadway would be feasible under existing conditions.

Three overpass bridges that cross over I-495 at Greentree Road, Linden Lane, and D'Arcy Road would be replaced on a new alignment adjacent to the existing bridge because they are not wide enough to accommodate phased reconstruction. The CSXT rail bridge that crosses over I-495 west of Seminary Road would be impacted by mainline widening and, due to the complexity of railroad operations, would be replaced on a new alignment to the west of the existing bridge. Forty-two new bridges would be constructed along I-495 and up to 11 new bridges would be constructed along the I-270 corridor as part of the proposed improvements.

As described in **Section 5.2**, new retaining walls were identified as part of the Build Alternatives. The type of retaining wall was not assessed but would be identified during the design phase. An analysis was performed to assess the hydrologic and hydraulic properties of the culvert crossings along the I-495 and I-270 corridors to determine the replacement, extension and/or augmentation needs of each crossing due to widening of the roadway. The analysis included all hydraulic structures and culverts with a diameter greater than three feet. For cost estimating purposes, existing noise barriers were assumed to be replaced if within the LOD and therefore potentially impacted by the proposed work. The type of noise barrier was not assessed but would be identified during the design phase. The modeling and analysis performed to determine the need for new noise barriers is documented in the *Noise Technical Report*.

6

6 ALTERNATIVES RETAINED FOR DETAILED STUDY

6.1 Refined Screening Criteria for ARDS

The screening of the Preliminary Range of Alternatives included an evaluation based on 15 metrics, under six major elements related to the Study's Purpose and Need using a "high, medium, low" or "yes and no" approach. The evaluation of the Screened Alternatives involved a detailed assessment of each alternative including preliminary engineering, traffic, financial viability, and environmental impacts. The screening criteria for the Screened Alternatives were the same used for the initial screening but were refined where the additional data would further differentiate between an alternative's ability to meet the Study's Purpose and Need, as described in Section 6.1.1 to 6.1.7 below. The results of the evaluation of the Screened Alternatives (**Section 6.2**) and rationale for the ARDS (**Section 6.3**) culminate in recommendations for alternatives to be carried forward for evaluation in the Draft EIS.

6.1.1 Engineering Considerations

A. Existing Traffic and Long-Term Traffic Growth

This criterion evaluated whether an alternative could accommodate existing traffic and long-term traffic growth. Three metrics were identified for this screening criterion based on the traffic analysis: 1) system-wide delay, 2) corridor travel times and speeds, and 3) density and LOS. This additional traffic analysis included projecting future traffic volumes for the AM peak period (6:00 AM to 10:00 AM) and PM peak period (3:00 PM to 7:00 PM) in the design year of 2040 using the MWCOG regional forecasting model and coding the volumes and proposed geometric changes for each alternative into a VISSIM simulation model.

During the evaluation of the Screened Alternatives, this criterion was presented with a rating of "low," "medium," or "high" based on the average rating for three individual metrics from the traffic analysis results (system-wide delay, corridor travel time/speed, and density/LOS), as described in the following three sections. This screening criteria was refined because additional data was available to further differentiate between an alternative's ability to meet the Study's Purpose and Need.

It should be noted that operations on I-495 may vary between alternatives, even for options with the same number of lanes on I-495, based on the different conditions along I-270. For example, there may be less utilization in the managed lanes on I-495 for alternatives with only one managed lane on I-270 (Alternative 5 and Alternative 8). This may cause the GP lanes on I-495 to be more crowded. Additional information is provided in Section **6.3** for each alternative.

1. System-wide Delay

System-wide delay reflects the average amount of time each vehicle in the VISSIM simulation model is delayed while trying to reach its destination. System-wide delay includes the entire Study area included in the model, not just the corridor Study limits. Delay can be caused by slow travel due to congestion or when vehicles must yield at stop-controlled or signalized intersections. System-wide delay is reported in the unit of seconds per vehicle and minutes per vehicle. Therefore, the lower the number, the less delay a vehicle would experience, reflecting a reduction in congestion. This data is also presented as a percent improvement over the projected future No Build conditions and is used to refine the definitions of the "low," "medium," and "high" ratings. This screening criterion was refined because additional data was available to further differentiate between an alternative's ability to meet the Study's Purpose and Need.

A rating of "low" for reducing system-wide delay was given for alternatives that would:

- Not reduce system-wide delay along Study area roadways; or
- Result in a 30 percent[38] or less improvement in system-wide average delay compared to the projected No Build conditions during both the AM peak period and the PM peak period.

A rating of "medium" was given for alternatives that would:

- Result in a greater than 30 percent improvement in system-wide average delay compared to the projected No Build conditions during one peak period, but a 30 percent or less improvement in system-wide average delay compared to the projected No Build conditions during the other peak period.

A rating of "high" was given for alternatives that would:

- Result in a greater than 30 percent improvement in system-wide average delay compared to the projected No Build conditions during both the AM peak period and the PM peak period.

System-wide delay is an effective metric because it provides a comparison between alternatives using a single number. However, the numbers can be skewed by vehicles that make short, unimpeded trips with little or no delay. For example, some vehicles on US 50 enter and exit the simulation model only for a brief time and have a delay of zero. This reduces the average delay per vehicle in the network. Therefore, more specific metrics were also examined, including corridor travel time and speed.

2. Corridor Travel Time and Speeds

Corridor travel time represents the amount of time it would take a vehicle to travel from one end of the corridor to the other along either I-495 or I-270 during the peak hour in the design year of 2040. Similarly, corridor speed represents the average speed during the trip. For travel times, lower numbers are better, reflecting more efficient travel. For speeds, higher numbers are better. For the Build Alternatives, travel time and speed were calculated separately for travel in the GP lanes and the HOT/ETLs based on the

[38] There is no standard metric for ranking system-wide delay. These cutoff values were determined by the study team using engineering judgment to define logical breakpoints to help differentiate between alternatives.

results of the VISSIM simulation model. This screening criteria was refined because additional data was available to further differentiate between an alternative's ability to meet the Study's Purpose and Need.

A rating of "low" for improving corridor travel time and speeds was given for alternatives that would:

- Not improve or minimally improve corridor travel times and corridor speed along the Study limits.

A rating of "medium" was given for alternatives that would:

- Relieve long-term traffic congestion by reducing average corridor travel times and increasing speeds during *some* peak hours along the majority of the Study limits in the future design year (2040), including most of the HOT/ETL lanes and some of the GP lanes. However, some locations would continue to experience congestion during certain future peak hours.

A rating of "high" was given for alternatives that would:

- Relieve long-term traffic congestion by reducing average corridor travel times and increasing travel speeds along the Study limits during *all* peak hours in the future design year (2040), including travel in both the HOT/ETL lanes and the GP lanes.

3. Density and Level of Service (LOS)

Density is the number of vehicles occupying a given length of a roadway at a particular instant. Density is averaged over time and is expressed in passenger cars per mile per lane (pc/mi/ln). Higher density values are indicative of more friction in the system and more congestion. LOS is a letter grade assigned to a section of roadway that measures the quality of traffic flow, ranging from LOS A to LOS F. LOS A represents optimal, free-flow conditions, while LOS F represents failing conditions where demand exceeds capacity. For highway segments, the Highway Capacity Manual assigns LOS grades based on density. Urban freeway segments, such as I-495 and I-270, reach failing (LOS F) conditions when the density exceeds 45 pc/mi/ln.

For this metric, the percentage of lane-miles operating at LOS F were calculated within the Study area during the AM and PM peak periods. The analysis included all highway lanes on I-495 and I-270, including GP lanes and managed lanes, where provided. Lower percentages are better, reflecting fewer failing roadway segments. This screening criteria was refined because additional data was available to further differentiate between an alternative's ability to meet the Study's Purpose and Need.

A rating of "low" for reducing density and improving LOS was given for alternatives that would:

- Result in 20 percent or more of the Study Area lane miles experiencing failing LOS conditions during the peak periods in the design year of 2040. [39]

[39] There is no standard metric for ranking percent of lane-miles operating at LOS F. These cutoff values were determined by the study team using engineering judgment to define logical breakpoints to help differentiate between alternatives.

A rating of "medium" was given for alternatives that would:

- Result in less than 20 percent of the Study Area lane miles experiencing failing LOS conditions during the peak period in the design year of 2040, but more than 12 percent of the Study area experiencing failing LOS conditions during at least one peak period.

A rating of "high" was given for alternatives that would:

- Result in 12 percent or less of the Study Area lane miles experiencing failing LOS conditions during the peak periods in the design year of 2040.

B. Trip Reliability

MDOT SHA evaluates trip reliability using the Planning Time Index (PTI). PTI reflects the 95th percentile travel time for a section of roadway and represents the total time motorists should allow to ensure they arrive at their destination on time. Non-recurring events that affect PTI, such as incidents, weather, increased demand for special events, and reduced capacity due to work zones, make it difficult to predict future travel times and calculate a future PTI value. However, in general, trip reliability can be enhanced by providing additional roadway capacity and/or managing demand on the system.

Although PTI cannot be calculated directly for future travel times, a similar metric known as Travel Time Index (TTI) was determined for each of the Screened Alternatives to help quantify the future reliability of the network. TTI is a metric used by MDOT SHA to quantify congestion levels on freeways and expressways. It is defined as the average (50^{th} percentile) travel time on a segment of freeway/expressway for a particular hour compared to the travel time of the same trip during free-flow or uncongested conditions. The higher the TTI, the longer the travel times. Most roadway segments that have a high TTI value also experience high PTI values because they are more likely to be impacted by minor incidents. Roadways with lower TTI values have some reserve capacity to absorb the disruption caused by non-recurring congestion and are typically more reliable.

Ratings of "low," "medium," or "high" for the GP lanes were refined based on the additional traffic analysis related to the TTI metrics on levels of congestion for trip reliability.

A rating of "low" was given for the GP lanes on alternatives that would:

- Not improve trip reliability on the Study corridors;
- Only improve trip reliability in one direction on the Study corridors; and
- Experience a severe level of congestion in both the AM and PM peak periods along multiple roadway segments (where severe congestion is defined as having a TTI value greater than 2.0) and poor average TTI values in both the AM and PM peak periods.

A rating of "medium" was given for the GP lanes on alternatives that would:

- Provide an option that enhances trip reliability in both directions in the near-term (i.e., existing traffic demand), but not at all times and not in the long-term term (i.e., design year 2040 traffic demand). These alternatives reflect an improvement in trip reliability compared to the No Build condition but would not consistently provide trip reliability in the long-term.

- Experience a moderate or heavy level of congestion in the AM, PM, or both peak periods along the majority of the roadway segments (where moderate congestion is defined as having a TTI value between 1.15 and 1.3 and heavy congestion is defined as having a TTI value between 1.3 and 2.0) and good average TTI values in one peak period but poor average TTI values in the other peak period.

A rating of “high” was given for the GP lanes on alternatives that would:

- Provide an option that enhances trip reliability consistently, in both directions in the near-term and long-term.
- Experience an uncongested condition during both the AM and PM peak periods along multiple roadway segments (where uncongested conditions are defined as having a TTI value less than 1.15) with good average TTI values in both peak periods.

For the managed lanes, the trip reliability was based on the type of managed lane system provided:

A rating of “low” was given for the managed lanes on alternatives that would:

- Not provide a managed lane, and therefore not provide a reliable trip option.

A rating of “medium” was given for the managed lanes on alternatives that would:

- Provide a one-lane managed lane system along portions of the Study Area, which offers a reliable trip option most of the time, but trip reliability could be influenced by slow-moving vehicles or incidents.

A rating of “high” was given for the managed lanes on alternatives that would:

- Provide a two-lane managed lane system in the peak direction, which offers a reliable trip option even if slow-moving vehicles or incidents block a single lane.
- It should be noted that the reversible lane alternatives were not penalized in this metric for not providing a managed lane in the off-peak direction, but other metrics (such as travel time/speed, density/LOS, and GP lane TTI) account for the increased congestion in the GP lanes resulting from this condition.

C. Additional Roadway Travel Choice

Along I-495, motorists have one choice for travel, the GP lanes. Therefore, they must either plan for recurring delays during peak periods, attempt to bypass high-volume ramps/locations using arterial streets, or adjust their travel schedule to avoid these typical daily delays. Along I-270, both the local and express lanes within the C-D Road system operate as GP lanes. The C-D Road system does not provide a choice for users to avoid the routing congestion experienced in both the local and express lanes. This criterion evaluated if an alternative would provide an additional roadway travel choice (e.g., HOV, HOT lanes) for users (single-occupancy vehicle, truck, bus, carpool, and vanpool) other than the GP lanes on I-495 and I-270. The managed lanes, whether HOT or ETL, would operate with congestion pricing where toll rates would be adjusted dynamically over short time intervals based on real-time traffic demand to maintain traffic operations at a rate above minimum requirements, such as a 45 mph speed.

During the screening of the Preliminary Range of Alternatives, a response of "Yes" indicated that an alternative would provide motorists with an option for a less congested trip via a roadway management strategy, and a response of "No" meant an alternative would not provide motorists with an option for a less congested trip.

The detailed analysis has not changed the response to this screening criteria. Therefore, a response of "yes" indicates the alternative's ability to meet this need.

D. Ease of Usage for Travelers

Ease of usage for travelers is indicated by factors such as safety, enforcement, signing, and decision points/access. This criterion was used to determine if an alternative would likely require complex traffic and highway operating configurations that could lead to driver confusion. This screening criterion was refined because additional data was available to further differentiate between an alternative's ability to meet the Study's Purpose and Need.

- A rating of "low" was given for alternatives that include multiple types of lane operations and include lanes where operations change throughout the day.
- A rating of "medium" was given for alternatives that would have a more complex operating configuration such as including two or three types of lane operations at one access point (e.g., GP, HOV, and ETL, or GP and HOT).
- A rating of "high" was given for alternatives that would enable efficient and safe operations more easily by having one type of lane operations (e.g., GP only).

The "medium" rating included alternatives with GP, HOV, and ETL lanes because the decision for drivers when approaching the highway consists of accessing one of two systems: the GP/HOV lanes via the GP ramps or the ETL lanes via the direct access ramps. This is the same driver decision that is needed when a driver is approaching a highway with only GP and HOT lanes with direct access ramps. A rating of "low" was given when the lane use required drivers to make that same decision when approaching access ramps, but also understand how operations change during the day, such as the direction of traffic on reversible lanes.

6.1.2 Homeland Security

Quick, unobstructed roadway access is needed during a homeland security threat causing populations to evacuate. This criterion evaluated whether an alternative would provide additional capacity that would assist in accommodating a population evacuation and improving emergency response. With a response of "Yes or No," each alternative was assessed considering whether the alternative provides additional capacity to assist in accommodating population evacuation and emergency response

The detailed analysis has not changed the response to this screening criteria. Therefore, a response of "yes" indicates the alternative's ability to meet this need.

6.1.3 Movement of Goods and Services

The ability to move freight, services, and commuting employees efficiently through the Study corridors is heavily influenced by the performance of I-495 and I-270. This criterion evaluated whether an alternative would improve the movement of freight, services, and commuters. It is closely tied to TTI, vehicle throughput, and effects on the local roadway network. These screening criteria were refined because additional data was available to further differentiate between an alternative's ability to meet the Study's Purpose and Need.

A. Vehicle Throughput

For each of the Screened Alternatives, the metric of vehicle throughput was calculated to quantify how efficiently goods and services could be moved through the Study area. Throughput includes all vehicles traveling in both directions in the GP lanes and the managed lanes, where provided. Throughput represents the number of vehicles and/or people that pass by a given point in the roadway network in a set amount of time. Throughput quantifies the efficiency of the roadway network in getting people, goods, and services to their destinations. Results are reported in terms of percent increase in vehicle throughput for each Screened Alternative compared to the No Build conditions, rounded to the nearest five percent. Higher values indicate more efficient movement of goods and services. Ratings of "low," "medium," or "high" were given for alternatives based on the anticipated benefit compared to the No Build conditions. Throughput measurements were taken at four key locations: I-495 at the American Legion Bridge, I-495west of I-95, I-495 at MD 5, and I-270 at Montrose Road.

- A rating of "low" was given for alternatives that would have no improvement in throughput compared to the No Build alternative at one or more key locations.
- A rating of "medium" was given for alternatives that had the greatest increase in throughput at some key locations but the lowest increase in throughput at other key locations.
- A rating of "high" was given for alternatives that had the greatest increase in throughput at two or more key locations in both the AM peak and the PM peak.

B. Local Road Network

The traffic analysis also included the effect each alternative would have on traffic operations on the surrounding local road network. Daily delay data from the local arterials was collected from the MWCOG model to determine the impact each of the Screened Alternatives would have on the delay experienced by motorists on the surrounding local roadway network. This impact was quantified by calculating the projected reduction in delay on the local road network. Values are presented in terms of total vehicle hours of delay each day on all arterials in Montgomery County, Prince George's County, and Washington, DC. Other regions in Maryland and Virginia showed negligible change in the local delay. Lower values are better, representing less delay for local travelers. These numbers were also converted to the percent reduction in delay versus the No Build condition to help compare the relative merit of each of the Screened Alternatives for this metric. Higher values are better, reflecting greater benefit.

- A rating of "low" was given for alternatives that would have the smallest reduction (less than one percent) in delay on the surrounding local roadway network compared to the No Build conditions.
- A rating of "medium" was given for alternatives that would have moderate reduction (one to five percent) in delay on the surrounding local roadway network compared to the No Build conditions.
- A rating of "high" was given for alternatives that would have the greatest reduction (greater than five percent) in delay on the surrounding local roadway network compared to the No Build conditions.

6.1.4 Multimodal Connectivity

The existing congestion on the I-495 and I-270 corridors adversely affects the roadway network and has negative effects on access to and usage of other transportation modes, such as transit. Besides enhanced performance on I-495 and I-270 themselves, improvements to provide congestion relief on these corridors will also enhance existing and proposed multimodal network connectivity and mobility through enhancing trip reliability and providing additional travel choices for efficient travel during times of extensive congestion. Improved connections to park-and-ride lots, Metrorail, bus, MARC, Purple Line, and Transit Oriented Development are anticipated to occur as a result of addressing congestion on these regional roadways, thus providing the foundation for sustainable transportation land use connections and expanding the opportunity within the National Capital Region through multimodal connections. Since the screening of the Preliminary Range of Alternatives, new direct access ramps between managed lanes and existing transit stations and the ability of buses to use the managed lanes was further developed (for additional details refer to **Section 5.3**).

This criterion attributed a rating of "low," medium," or "high" based on the ability of an alternative to enhance connectivity to and between existing transit facilities and whether the alternative could provide opportunities for more reliable and efficient transit service. A rating of "high" would both enhance connectivity to and between existing transit facilities near the corridor and provide opportunities for new or modified transit service. A "medium" rating would provide for one or the other, and a "low" rating would minimally or not provide either enhanced connectivity nor provide opportunities for new or modified transit.

6.1.5 Financial Viability

Maryland's traditional funding sources, including the Transportation Trust Fund, are unable to effectively finance, construct, operate, and maintain a highway system of the magnitude that may be needed to enhance trip reliability in these Study corridors due to fiscal constraints of the program and the other State-wide transportation needs. Revenue sources that provide adequate funding are needed to support the more immediate capacity improvements in the I-495 and I-270 corridors. The use of alternative funding approaches, such as tolling or fares, would provide the potential to address large-scale improvements and makes the Screened Alternatives financially viable.

Detailed financial analysis for the Screened Alternatives was not available during the initial evaluation in Spring 2019. Financial viability was originally based on preliminary capital cost estimates which were used as a proxy for overall program costs. The more significant the initial build cost, the higher the long-term operations and maintenance costs that are needed to maintain the infrastructure. However, other data was used as a proxy to allow a comparison of the Screened Alternatives to identify those that would have a greater or lesser likelihood of being financially viable. Potential traffic volumes, or annual daily traffic (ADT) in the managed lanes would roughly equate to revenue. The higher the traffic volume or ADT that is in the managed lanes, the more travelers that would be paying tolls and therefore, the greater the potential revenue. Following this approach, alternatives with more lanes would result in higher revenue and those with only toll users (ETL) would have higher revenue than those with a mix of toll and reduced toll users (HOT).

In June 2019, additional financial analysis was completed for all the recommended ARDS to assess the potential of each alternative to be financially viable. This analysis considered the preliminary capital costs, initial revenue projections, and preliminary operations and maintenance costs. Estimates were developed for net cashflows to the state from delivery as a toll revenue concession (costs and revenues adjusted for inflation and financing modeled based on market precedents for similar transactions) over the course of a 50-year Public-Private Partnership (P3) agreement to indicate the comparative financial viability of each of the recommended ARDS. The assumptions made to enable a comparison of the alternative's financial viability for the entire study corridor included the following:

- The entire project is delivered as a single design, build, finance, operate, and maintain package with a five-year construction period and a 50-year concession term
- Positive and negative cashflows are addressed at financial close (For negative cashflows it assumes that the state or a public subsidy provides funds)

Subsequently, a more detailed assessment of the financial viability of all the Build Alternatives to assess the potential of each to be financially self-sufficient was completed in November 2019 and updated in January 2020. This analysis considered the preliminary capital costs (10% range between the high and the low capital costs), initial revenue projections, preliminary operations and maintenance costs, interest rates (Mid is mean interest rates over preceding five-year period; High/Low are interest rates 0.50% above/below the Mid rate) and the likely methods for how construction phases would be financed.

The financial analysis is preliminary, and it is possible that the inputs used to compute the financial viability of the alternatives could change. This includes capital, operations and maintenance costs, revenue, and the financing assumptions. However, if any of the inputs change it is anticipated that it would result in a consistent change for all the Build Alternatives. For example, capital costs for all alternatives would go up or down proportionally since the same base assumptions were used to develop the capital costs. Similarly, consistent methodology was used to compute the revenue and for the financial assumptions. Therefore, any changes in the inputs (i.e. interest rates) would result in a consistent change in the financial viability for all Build Alternatives, resulting in the same comparative difference between the alternatives.

6.1.6 Environmental Considerations

While it is acknowledged that the Preliminary Range of Alternatives could have a varying degree of potential environmental impacts, it was not a differentiating factor during the initial screening. The environmental screening criterion used during the initial screening considered whether the preliminary alternative would require additional right-of-way or impact parkland, historic resources, and/or wetlands and waterways, with a "Yes" or "No" response. Because the Build Alternatives are located along the existing I-495 and I-270 corridors within highly urban and environmentally constrained areas, the answer was affirmative for each alternative aside from the No Build. Therefore, as the main purpose of the initial screening was to determine whether the preliminary alternatives met the transportation purpose and need, the consideration of the potential for varying degrees of environmental impacts was not a differentiator in whether the alternative should be retained or dismissed.

In support of the detailed analysis for the Screened Alternatives, existing environmental conditions were further identified through an inventory of readily available public records and resource data, field identification, and agency consultation. Environmental conditions and a preliminary assessment of impacts that could result from the Screened Alternatives were documented by resource type including right-of-way and properties, parks and recreation area, historic properties, 100-year floodplains, unique and sensitive areas and habitat, forest canopy, wetlands, waters, and noise receptors. The overall difference in environmental impacts between the Screened Alternatives was not significant, as further described in **Section 6.2.4**.

Coordination between MDOT SHA and State and Federal agencies is ongoing and will continue as the Study progresses. This included and will continue to include a review of potential avoidance and minimization of environmental impacts and identification of any needed compensatory mitigation.

6.1.7 Section 404(b)(1) Considerations

The evaluation criteria described in the preceding sections addresses each alternative's ability to meet the Study's Purpose and Need, and thus the reasonableness of each alternative. The evaluation supports requirements of FHWA and other Cooperating Federal Agencies for establishing the reasonable range of alternatives (i.e., the ARDS) under NEPA.

However, because the EIS will be consistent with the One Federal Decision policy, the alternatives evaluation should also consider the requirements of any Federal agencies that may ultimately issue a NEPA or permitting decision for the Study.[40] As part of the U.S. Department of the Army Individual Permit process for the United States Army Corps of Engineers (USACE), the I-495 & I-270 Managed Lanes Study is also being evaluated under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. The USACE's evaluation of a Section 404 permit application is a two-part test, which involves determining whether the project complies with the Clean Water Act Section 404(b)(1) Guidelines (Guidelines) and USACE's public interest review. For USACE to issue a 404 permit, the proposed project must comply with the Guidelines and found to be not contrary to the public interest.

The fundamental precept of the Guidelines is that dredged or fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystem of concern [40 CFR 230.1(c)]. In addition, one of the primary requirements of the Guidelines is that no discharge can be permitted if there is a practicable alternative with less adverse impact on the aquatic environment provided the alternative does not have other significant adverse environmental consequences [40 CFR 230.10(a)]. The alternatives test is applied more rigorously (i.e., alternatives are presumed to exist) for projects that are proposed to be in special aquatic sites when the project is not water dependent. Under Section 404, USACE may only approve the least environmentally damaging practicable alternative. Note that an alternative is practicable if it is available and implementable after taking into consideration cost, logistics, and existing technology considering the overall project purpose.

[40] Executive Order (E.O.) 13807: Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure Projects, was issued on August 15, 2017. It requires Federal agencies to process environmental reviews and authorization decisions for "major infrastructure projects" as One Federal Decision and sets a government-wide goal of reducing, to two years, the average time for each agency to complete the required environmental reviews and authorization decisions for major infrastructure projects, as measured from the date of publication of a notice of intent to prepare an EIS. https://www.environment.fhwa.dot.gov/nepa/oneFederal_decision.aspx

The decision whether to issue a 404 permit is also based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity and its intended uses on the public interest. This is known as the public interest review [33 CFR Part 320.4.] The evaluation of the probable impacts which the proposed activity may have on the public interest requires a careful weighing and balancing of the benefits which are reasonably expected to accrue from the project, balanced against the reasonably foreseeable detriments. Among the factors that must be evaluated as part of the public interest review include: conservation, economics, aesthetics, general environmental concerns, wetlands and streams, historic and cultural resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply and conservation, energy needs, safety, food and fiber production, mineral needs, water quality, consideration of property ownership, and in general, the needs and welfare of the people.

Based on the One Federal Decision policy, as well as long-standing efforts by MDOT SHA and the USACE Baltimore District to merge the NEPA and Section 404 alternatives evaluation processes, it is desirable to have a single set of ARDS that satisfies both NEPA and Section 404(b)(1) Guidelines. Thus, evaluating the reasonableness and practicability of the Screened Alternatives is appropriate when identifying the ARDS.

The Section 404(b)(1) guidelines play a major role in decision-making during the NEPA process. However, unlike determination of the reasonableness of an alternative, which rests with FHWA as the lead NEPA agency, USACE holds the decision-making responsibility for determining practicability under Section 404(b)(1) guidelines. MDOT SHA will therefore request concurrence from USACE on the ARDS prior to their inclusion in the DEIS. That said, USACE will not make a final decision regarding the Study's compliance with the Section 404(b)(1) guidelines until a permit decision is rendered.

6.2 Detailed Analysis of Screened Alternatives

The following sections discuss the results of the detailed analysis of the Screened Alternatives on engineering, traffic, financial viability, and environmental impacts.

6.2.1 Engineering Analysis

As described in Chapter 5, for each Screened Alternative, the roadway typical section was applied along the Study limits on I-495 and I-270 and served as the basis for development of the LOD. The typical sections of the Screened Alternatives are shown in **Figure 4-19**. The LOD for each Build Alternative was used to evaluate potential impacts.

6.2.2 Traffic Operational Analyses

Detailed traffic operational analyses were performed on each of the Screened Alternatives to assist in evaluating the alternatives' ability to meet the Study's Purpose and Need. The methodology included a three-step process.

First, regional forecasting models for the No Build Alternative and each of the Screened Alternatives were developed with the assistance of the MWCOG using the MWCOG model, version 2.3.71, based on land use projections from Round 9.0 Cooperative Forecasts, adopted in October 2017. The Build Alternatives forecasts account for latent demand (trips that would otherwise use the local network or travel outside of the peak periods) and induced demand (i.e., new trips) that would be expected because of the additional capacity provided.

Next, the outputs from the MWCOG models were used to develop balanced traffic volume projections for the design year of 2040 for each roadway segment and ramp movement within the Study limits for each hour of the peak period. The morning peak period included the four hours between 6:00 AM and 10:00 AM, while the afternoon peak period included the four hours between 3:00 PM and 7:00 PM.

It should be noted that toll rates are unknown at this point, but they will be dynamic to manage traffic demand in the managed lanes. For the purposes of this analysis, volumes in the managed lanes were assigned to provide the maximum throughput while maintaining speeds of at least 45 mph in the managed lanes (the Federal requirement). This threshold occurs at approximately 1,500 vehicles per hour per lane in the highest demand segment, which equates to a maximum of approximately 3,000 vehicles per hour in the two-lane managed lane alternatives. Based on this assumption, the projected volume using the managed lanes is approximately the same for ETL and HOT alternatives; the toll rate would be higher for single-occupant vehicles in the HOT alternatives to offset the high occupancy vehicles that could use the HOT lanes at a reduced rate.

Finally, traffic simulation models for each of the Screened Alternatives were developed using VISSIM software, Version 10.00-09. Existing conditions models were calibrated to match observed speeds per MDOT SHA guidelines and were used as a base for future year models. The VISSIM models included the proposed geometric configurations of each alternative and were populated with the traffic volumes developed during the previous step. A map of the VISSIM model limits is shown in **Figure 6-1**.

Separate models for the AM peak period and the PM peak period were developed. Model runs included a one-hour seeding period, with output data recorded for the entire four-hour peak period. Outputs included speed, delay, travel time, density, and vehicle throughput.

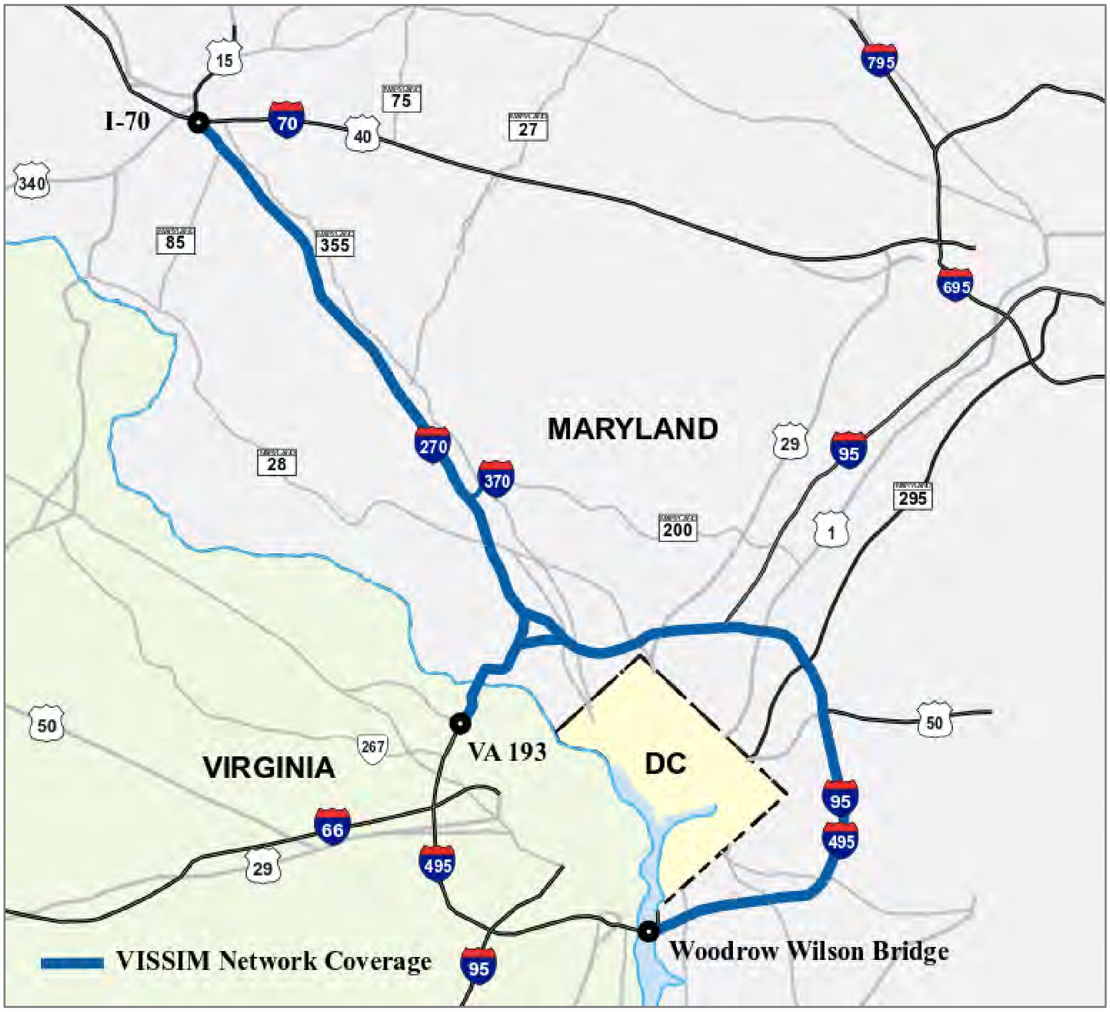
As noted in **Section 5.4**, the existing C-D lane system was removed on all I-270 alternatives to minimize the footprint and associated impacts. The removal of the C-D lanes affects traffic operations in several ways. It eliminates conflict points at the slip ramps and helps to balance volumes evenly across the GP lanes, which helps traffic flow. However, there is some tradeoff as this change causes additional merging and weaving in the GP lanes, which can negatively impact operations. The net result of removing the C-D lane system is reflected in the Build VISSIM results presented in this document.

Additional details regarding the traffic analysis methodology are available in the *Traffic Technical Report*.

These results discuss the detailed traffic evaluation, summarized for the following key metrics:

- System-Wide Delay;
- Corridor Travel Time and Speed;
- Density and LOS;
- TTI;
- Vehicle Throughput; and
- Effect on Local Roadway Network.

Figure 6-1: VISSIM Network Coverage



A. System-Wide Delay

This metric was used to assist in evaluating the criterion of Existing Traffic and Long-Term Traffic Growth. System-wide delay reflects the average amount of time each vehicle in the VISSIM simulation model is delayed while trying to reach their destination. Delay can be caused by slow travel due to congestion or when vehicles must yield right-of-way at a stop-controlled or signalized intersection. System-wide delay is reported in the unit of seconds per vehicle and minutes per vehicle. The results are shown in **Table 6-1** and were generated from the VISSIM outputs. For the raw delay values, lower numbers are better, reflecting a reduction in congestion. For the percent improvement compared to the No Build Alternative, higher numbers are better, reflecting a greater benefit.

For this metric, Alternative 9 and Alternative 10 perform the best and were given a rating of "high." Both alternatives result in a delay savings of more than 30 percent during the AM and PM peak periods compared to the No Build Alternative, which is the baseline. Alternative 8 and Alternative 13C also perform well during the PM peak period but provide less benefit during the AM peak period than Alternative 9 and Alternative 10. These alternatives were given a rating of "medium." Alternative 5 and Alternative 13B perform the worst in this category and were given a rating of "low." While both alternatives are better than the No Build Alternative, they lag behind the other Screened Alternatives in terms of delay savings, particularly during the PM peak, although Alternative 13B does outperform Alternative 8 and Alternative 13C during the AM peak period. Alternative 5 has the least delay savings in both the AM and PM peak periods.

B. Corridor Travel Time and Speed

This metric was also used to assist in the evaluation of the criterion of Existing Traffic and Long-Term Traffic Growth. Corridor travel time represents the amount of time it would take a vehicle to travel from one end of the Study limits to the other along either I-495 or I-270 during the peak hour in the design year of 2040. Similarly, corridor speed represents the average speed during the trip. Results were generated for the I-495 Outer Loop from MD 5 to George Washington Memorial Parkway, the I-495 Inner Loop from George Washington Memorial Parkway to MD 5, I-270 NB from I-495 to I-370, and I-270 SB from I-370 to I-495. Results were also generated separately for travel in the GP lanes and the HOT or ETL lanes. For alternatives that maintained the existing HOV lanes on I-270 in addition to buffer-separated, limited access ETL lanes, the corridor travel time and speed results for the GP lanes included the non-tolled HOV lanes. The results are shown in **Table 6-2** and were generated from the VISSIM outputs. For travel times, lower numbers are better, reflecting more efficient travel. For speeds, higher numbers are better.

During the AM peak, all the Screened Alternatives are projected to provide significant travel time savings along the I-495 Outer Loop compared to the No Build Alternative, where it would take over 100 minutes (1 hour and 40 minutes) to travel less than 40 miles at average speeds less than 25 mph. For travel in the GP lanes, travel times under the Screened Alternatives would improve to between 63 minutes (for Alternative 10, best among the Screened Alternatives) and 74 minutes (for Alternative 5, worst among the Screened Alternatives). In the HOT/ETL lanes, free-flow speeds of over 60 mph would be maintained along the I-495 Outer Loop during the AM peak. More modest improvements would be expected along the I-495 Inner Loop during the AM peak period. Travel times in the GP lanes would improve from 68 minutes under No Build Alternative to between 56 minutes (for Alternative 9, best among the Screened Alternatives) and 61 minutes (for Alternative 5, worst among the Screened Alternatives), with average speeds in the HOT/ETL lanes between 50 mph and 55 mph. Along I-270 during the AM peak, all Screened Alternatives would be projected to improve travel times in the peak SB direction from 16 minutes under No Build Alternative to 10 minutes for vehicles using the HOT/ETL lanes, while no changes from the No Build would be expected in the NB direction during the AM peak period.

During the PM peak, even worse operations than existing conditions are projected under the No Build Alternative. Along the I-495 Outer Loop, the projected travel time to travel from MD 5 to George Washington Memorial Parkway would be over two hours (123 minutes) with average speeds of less than 20 mph under the No Build Alternative. Significant improvements would be expected under each of the Screened Alternatives. For travel in the GP lanes, travel times under the Screened Alternatives would improve to between 45 minutes (for Alternatives 8, 9, and 13B, tied for best among the Screened Alternatives) to 50 minutes (for Alternative 5, worst among the Screened Alternatives). In the HOT/ETL lanes, free-flow speeds of over 60 mph would be maintained along the I-495 Outer Loop in the PM peak for all Screened Alternatives. Along the I-495 Inner Loop, the projected travel time from the George Washington Memorial Parkway to MD 5 would be over 2.5 hours (156 minutes) with average speeds of approximately 15 mph for the No Build Alternative. For travel in the GP lanes, travel times under the

Screened Alternatives would improve to between 60 minutes (for Alternative 10, best among the Screened Alternatives) to 93 minutes (for Alternative 8, worst among the Screened Alternatives). In the HOT/ETL lanes, speeds of over 45 mph would be maintained along the I-495 Inner Loop in the PM peak for all Screened Alternatives. Along I-270, conditions are generally projected to be acceptable under the No Build Alternative in the NB and SB directions due to the CLRP programmed improvements, including the ICM project, with average speeds over 50 mph, except for congestion along the I-270 SB East Spur due to spillback from I-495. In some cases, the Screened Alternatives are projected to operate worse than the No Build along I-270 during the PM peak period due to increased volumes in the system and/or reduced capacity in the off-peak direction from the removal of the HOV lanes.

Because all Screened Alternatives provide significant savings over the No Build Alternative, particularly in the HOT/ETL lanes, only No Build was given a rating of “low” in this category. Alternative 9 and Alternative 10 performed the best on most sections and peak periods, and therefore received a “high” rating, while the other alternatives received a “medium” rating.

C. Density and Level of Service (LOS)

This metric was used to assist in the evaluation of the criterion of Existing Traffic and Long-Term Traffic Growth. Density is the number of vehicles occupying a given length of a roadway at a particular instant. Density is averaged over time and is expressed in passenger cars per mile per lane (pc/mi/ln). Higher density values are indicative of more friction in the system and more congestion. LOS is a letter grade assigned to a section of roadway that measures the quality of traffic flow, ranging from LOS A to LOS F. LOS A represents optimal, free-flow conditions, while LOS F represents failing conditions where demand exceeds capacity. For freeway segments, the Highway Capacity Manual assigns LOS grades based on density. Urban freeway segments reach failing (LOS F) conditions when the density exceeds 45 pc/mi/ln.

For this metric, the percentage of lane-miles operating at LOS F was calculated within the Study limits during the AM peak period and the PM peak period. The results are shown in **Table 6-3** and were generated from the VISSIM outputs. Lower percentages are better, reflecting fewer failing roadway segments.

Alternative 9 was given a rating of “high” because it performed the best in this category, resulting in the least number of failing segments in both the AM and PM peak periods, with only 12 percent of the lane-miles projected to operate at LOS F during the peak hours in the design year of 2040. Alternative 5 performed the worst in this category, with more than 20 percent of the lane-miles projected to fail during the peak hours in 2040 and was therefore given a rating of “low.” However, all the Screened Alternatives performed significantly better than the No Build Alternative, in which 28 percent of the system is projected to fail during the AM peak hour and over half of the system (53 percent) is projected to fail during the PM peak hour.

D. Travel Time Index

While corridor travel time and speed provide another good way to compare alternatives, few vehicles will travel from one end to the other during their trip, particularly along I-495. Therefore, the metric of TTI was also evaluated along shorter trip segments. This metric was used to assist in the evaluation of the criterion of Trip Reliability. TTI is a metric used by MDOT SHA to quantify congestion levels on freeways and expressways. It is defined as the average (50^{th} percentile) travel time on a segment of freeway/expressway for a particular hour compared to the travel time of the same trip during free-flow or uncongested conditions. The higher the TTI, the longer the travel times. For example, a TTI of 2.0 indicates that a trip that would take 15 minutes in light traffic would take 30 minutes in the peak hour due to congestion. TTI values were calculated for the GP lanes of eight total highway segments, including four segments in each direction: I-495 from Virginia 193 to I-270, I-495 from I-270 to I-95, I-495 from I-95 to MD 5, and I-270 from I-495 to I-370. The results are shown in **Table 6-4** and were generated from the VISSIM outputs. (Note: A few of the traffic results have been updated because the 2040 No Build Model results now reflect conditions between Virginia 193 and George Washington Parkway to account for congestion that extends south of the George Washington Parkway.) MDOT SHA defines various levels of congestion in four categories based on TTI as follows:

- Uncongested (TTI < 1.15)
- Moderate Congestion (1.15 < TTI < 1.3)
- Heavy Congestion (1.3 < TTI < 2.0)
- Severe Congestion (TTI > 2.0)

For this metric, Alternative 9 performed the best during the AM peak. Three of the eight segments had a TTI value in the “uncongested” category for Alternative 9, with two others in the “moderate” category, and the remaining three in the “heavy” category. Alternative 13C performed the poorest during the AM peak, with the segment of I-270 SB experiencing a TTI value of 2.2 (in the “severe” category). None of the segments operated in the “severe” category for Alternatives 5, 8, 9, or 10 during the AM peak period.

Alternative 10 and 13C performed the best in terms of TTI during the PM peak. Although the segment of the I-495 Inner Loop from I-270 to I-95 was in the “severe” category, Alternative 10 experienced the lowest TTI of the Screened Alternatives for this segment. Additionally, the other seven segments had TTI values of 1.6 or less for Alternative 10 and Alternative 13C. Alternative 5 performed the poorest during the PM peak, with three segments in the “severe” category.

Alternative 10 was given a rating of “high” because it performs the best during the PM peak and performs well during the AM peak. Alternative 5 was given a rating of “low” because it performs poorest during the PM peak and poorly during the AM peak. The other Screened Alternatives received a “medium” rating.

For the majority of the segments, the No Build has the worst TTI value. Therefore, the No Build Alternative was also given a rating of “low.”

It should be noted that all HOT/ETL segments were projected to operate at uncongested levels, and therefore the results above only compared operations in the GP lanes. However, according to the NCHRP Report 03-96, *Analysis of Managed Lanes on Freeway Facilities*, “For a single managed lane facility, a slow-moving vehicle drags down the speed of vehicles following it, much like it would on a two-lane highway or a single-lane tunnel. On the contrary, multi-lane managed lane facilities allow opportunities for passing, and the impact of slow-moving vehicles is expected to be lower, at least until higher flow levels are reached.” This report documented a case Study (I-880 in San Francisco) where the operating speed at capacity was lower than the expected speed because the speed on the HOV lane was governed by the slowest moving vehicle. Since the studied facility was a single HOV lane facility, “the HOV speed reduction was contributed to a 'snail' effect, meaning that the speed on the HOV lane was governed by the slowest moving vehicle. Since passing was constrained on the single HOV lane, vehicles were trapped behind the 'snail' when GP lanes are heavily congested. As the traffic flow increased, so did the number of slow drivers." Based on this research, a separate metric was applied to differentiate the TTI in the HOT/ETLs for each alternative. The two lane HOT/ETL segments were all rated as "high" for this metric, while the one lane alternatives were rated as "medium." These ratings are included in several tables later in this Chapter.

E. Vehicle Throughput

This metric was used to assist in the evaluation of the criterion for Movement of Goods and Services. Throughput represents the number of vehicles and/or people that pass by a given point in the roadway network in a set amount of time. Throughput quantifies the efficiency of the roadway network in getting people, goods, and services to their destinations. Benefits of increased throughput on the highway include reduced peak spreading (i.e., less congestion in the off-peak hours) and reduced burden on the surrounding roadway network.

The results are shown in **Table 6-5** and were generated from the VISSIM outputs. While the VISSIM model can calculate the vehicle throughput at every single location in the model, this evaluation focused on throughput at four key locations: I-495 crossing the American Legion Bridge, I-495 west of I-95, I-495 at MD 5, and I-270 at Montrose Road. Results are reported in terms of percent increase in vehicle-throughput for each Screened Alternative compared to the No Build Alternative, rounded to the nearest 5 percent.

Most of the Screened Alternatives provided significant throughput benefits during the AM peak period compared to the No Build Alternative. The exception is Alternative 5, which provided no additional throughput on I-495 at MD 5 during the AM peak period compared to the No Build and provided the smallest throughput benefit at the other three key locations studied.

Alternative 10 performed the best during the PM peak period. Of the Screened Alternatives, Alternative 10 provided the highest amount of throughput during the PM peak period at all four key locations studied. Conversely, some alternatives provided no benefit compared to No Build Alternative at certain locations during the PM peak. For example, Alternative 8 did not provide any throughput benefit on I-495 at MD 5, while Alternative 5 and Alternative 13B did not provide any throughput benefits on I-270 at Montrose Road.

For this metric, Alternative 9, Alternative 10, and Alternative 13C were given a rating of "high" because each of these alternatives results in the greatest increase in vehicle throughput at multiple key locations during both the AM peak and the PM peak periods. Although Alternative 8 also provided throughput benefits during the AM peak period, it did not provide as significant increases in throughput during the PM peak period as Alternative 9, Alternative 10, and Alternative 13C. Alternative 8 was given a rating of "medium". Alternative 5 and Alternative 13B performed the worst in this category providing the smallest increase in throughput than all the other Screened Alternatives and were given a rating of "low."

Benefits of increased throughput on the highway include reduced peak spreading (i.e., less congestion in the off-peak hours) and reduced burden on the surrounding roadway network.

F. Effect on Local Roadway Network

This metric was used to assist in the evaluation of the criterion for Movement of Goods and Services. While the focus of the Study is to provide benefits to travelers using I-495 and I-270, the Study will also have impacts on the surrounding roadway network. This impact was quantified to assist in the evaluation of the Screened Alternatives by calculating the projected reduction in delay on the local road network. The results are shown in **Table 6-6** and were generated from the MWCOG regional model outputs. Values are presented in terms of total vehicle hours of delay each day on all arterials in Montgomery County, Maryland, Prince George's County, Maryland and the District of Columbia. Other regions in Maryland and Virginia showed negligible change in local delay. Lower values are better, representing less delay for local travelers. **Table 6-6** also shows the percent reduction in delay versus the No Build Alternative to help compare the relative merit of each of the Screened Alternatives for this metric. Higher values are better, reflecting greater benefit.

Because each of the Screened Alternatives were projected to reduce delay on the surrounding roadway network compared to the No Build Alternative, only the No Build was given a rating of "low" in this category. Most of the Screened Alternatives would reduce delay between 6 percent and 7 percent compared to No Build, except Alternative 5, which had approximately half the benefits of the other alternatives, with a reduction of approximately 3 percent in daily delay versus No Build. For this reason, Alternative 5 was given a "medium" rating and the other Screened Alternatives received a "high" rating.

Table 6-1: Summary of System-Wide Delay Results from VISSIM Model

CRITERIA	PEAK PERIOD	METRIC	EXISTING	ALTERNATIVE 1	ALTERNATIVE 5	ALTERNATIVE 8	ALTERNATIVE 9	ALTERNATIVE 10	ALTERNATIVE 13B	ALTERNATIVE 13C
Accommodate Long-Term Traffic Growth	AM Peak	Average Delay (sec/veh)	267	526	421	404	346	341	384	389
		Average Delay (min/veh)	4.45	8.77	7.02	6.73	5.77	5.68	6.40	6.48
		Percent Improvement vs. No Build	N/A	N/A	20%	23%	34%	35%	27%	26%
	PM Peak	Average Delay (sec/veh)	240	707	549	474	472	464	550	464
		Average Delay (min/veh)	4.00	11.78	9.15	7.90	7.87	7.73	9.17	7.73
		Percent Improvement vs. No Build	N/A	N/A	22%	33%	33%	34%	22%	34%
		RELATIVE RATING*	**N/A**	**Low**	**Low**	**Medium**	**High**	**High**	**Low**	**Medium**

* See Section 6.2.2.A for a description of relative ratings of “low”, “medium”, and “high” as they apply to this table.

Table 6-2: Summary of Corridor Travel Time Results from VISSIM Model

CRITERIA	METRIC	PEAK PERIOD	CORRIDOR	TRAVEL LANES	EXISTING	ALTERNATIVE 1	ALTERNATIVE 5	ALTERNATIVE 8	ALTERNATIVE 9	ALTERNATIVE 10	ALTERNATIVE 13B	ALTERNATIVE 13C
Accommodate Long-Term Traffic Growth	Average Travel Time (minutes)	AM Peak	I-495 Outer Loop from MD 5 to George Washington Memorial Parkway	GP	65	101	74	64	64	63	71	73
				HOT/ETL	N/A	N/A	38	37	38	38	38	38
			I-495 Inner Loop from George Washington Memorial Parkway to MD 5	GP	44	68	61	58	56	58	57	57
				HOT/ETL	N/A	N/A	43	43	43	44	43	46
			I-270 NB from I-495 to I-370	GP	9	9	9	9	9	9	9	9
				HOT/ETL	N/A	N/A	9	9	9	9	N/A	N/A
			I-270 SB from I-370 to I-495	GP	29	16	16	15	12	19	12	24
				HOT/ETL	N/A	N/A	10	10	10	10	10	10
		PM Peak	I-495 Outer Loop from MD 5 to George Washington Memorial Parkway	GP	76	123	50	45	45	48	45	47
				HOT/ETL	N/A	N/A	38	38	38	38	38	38
			I-495 Inner Loop from George Washington Memorial Parkway to MD 5	GP	89	156	89	93	80	60	75	62
				HOT/ETL	N/A	N/A	38	45	42	49	42	42
			I-270 NB from I-495 to I-370	GP	15	10	14	11	12	16	13	12
				HOT/ETL	N/A	N/A	10	10	12	9	14	9
			I-270 SB from I-370 to I-495	GP	11	12	40	22	15	14	28	15
				HOT/ETL	N/A	N/A	10	10	10	9	N/A	N/A
	Average Speed (mph)	AM Peak	I-495 Outer Loop from MD 5 to George Washington Memorial Parkway	GP	36	23	31	36	37	37	33	32
				HOT/ETL	N/A	N/A	62	62	62	62	62	62
			I-495 Inner Loop from George Washington Memorial Parkway to MD 5	GP	53	34	38	40	41	40	41	41
				HOT/ETL	N/A	N/A	54	54	54	52	54	50
			I-270 NB from I-495 to I-370	GP	63	63	61	61	61	61	61	61
				HOT/ETL	N/A	N/A	63	60	63	64	N/A	N/A
			I-270 SB from I-370 to I-495	GP	21	38	37	41	50	32	51	25
				HOT/ETL	N/A	N/A	61	58	59	60	61	60
		PM Peak	I-495 Outer Loop from MD 5 to George Washington Memorial Parkway	GP	31	19	46	52	52	49	52	50
				HOT/ETL	N/A	N/A	62	62	62	61	62	62
			I-495 Inner Loop from George Washington Memorial Parkway to MD 5	GP	26	15	26	25	29	38	31	37
				HOT/ETL	N/A	N/A	62	52	55	47	55	55
			I-270 NB from I-495 to I-370	GP	36	53	39	51	44	35	43	45
				HOT/ETL	N/A	N/A	53	56	50	61	40	58
			I-270 SB from I-370 to I-495	GP	54	50	15	27	41	42	21	40
				HOT/ETL	N/A	N/A	63	63	63	64	N/A	N/A
RELATIVE RATING*						Low	Medium	Medium	High	High	Medium	Medium

* See Section 6.2.2.B for a description of relative ratings of "low", "medium", and "high" as they apply to this table.

Table 6-3: Summary of Density and Level of Service (LOS) Results from VISSIM Model

CRITERIA	PEAK PERIOD	METRIC	EXISTING	ALTERNATIVE 1	ALTERNATIVE 5	ALTERNATIVE 8	ALTERNATIVE 9	ALTERNATIVE 10	ALTERNATIVE 13B	ALTERNATIVE 13C
Accommodate Long-Term Traffic Growth	AM Peak	Total Lane-Miles	465	475	560	660	660	675	630	650
		Lane-Miles Operating at LOS F based on Density*	100	133	116	94	81	99	89	115
		Percent of Lane-Miles Operating at LOS F based on Density*	22%	28%	21%	14%	12%	15%	14%	18%
	PM Peak	Total Lane-Miles	465	475	560	660	660	675	630	650
		Lane-Miles Operating at LOS F based on Density*	177	252	111	93	82	94	74	77
		Percent of Lane-Miles Operating at LOS F based on Density*	38%	53%	20%	14%	12%	14%	12%	12%
		RELATIVE RATING**	**N/A**	**Low**	**Low**	**Medium**	**High**	**Medium**	**Medium**	**Medium**

* LOS F is reached at a density of 45.0 passenger cars per mile per lane (pc/mi/ln)

** See Section 6.2.2C for a description of relative ratings of “low”, “medium”, and “high” as they apply to this table.

Table 6-4: Summary of Travel Time Index (TTI) Results for General Purpose (GP) Lanes from VISSIM Model

CRITERIA	METRIC	PEAK PERIOD	CORRIDOR	EXISTING	ALTERNATIVE 1	ALTERNATIVE 5	ALTERNATIVE 8	ALTERNATIVE 9	ALTERNATIVE 10	ALTERNATIVE 13B	ALTERNATIVE 13C
Provide a Reliable Travel Time	Travel Time Index (TTI)* in GP Lanes**	AM Peak	I-495 Inner Loop from Virginia 193 to I-270	1.4	2.1	1.6	1.6	1.3	1.3	1.8	1.6
			I-495 Outer Loop from I-270 to Virginia 193	1.2	1.2	1.7	1.3	1.7	1.7	1.7	1.6
			I-495 Inner Loop from I-270 to I-95	1.0	1.0	1.5	1.2	1.3	1.2	1.2	1.2
			I-495 Outer Loop from I-95 to I-270	2.8	4.3	1.6	1.5	1.6	1.3	2.1	1.8
			I-495 Inner Loop from I-95 to MD 5	1.0	1.8	1.5	1.5	1.4	1.5	1.3	1.4
			I-495 Outer Loop from MD 5 to I-95	1.2	1.5	1.2	1.0	1.0	1.0	1.0	1.0
			I-270 NB from I-495 to I-370	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			I-270 SB from I-370 to I-495	2.6	1.5	1.5	1.4	1.1	1.7	1.1	2.2
		PM Peak	I-495 Inner Loop from Virginia 193 to I-270	3.7	5.5	2.7	4.5	2.6	1.2	1.6	1.6
			I-495 Outer Loop from I-270 to Virginia 193	2.8	2.4	1.4	1.0	1.0	1.0	1.0	1.0
			I-495 Inner Loop from I-270 to I-95	2.7	5.0	3.2	2.5	2.6	2.4	2.4	2.6
			I-495 Outer Loop from I-95 to I-270	1.1	2.7	1.2	1.1	1.1	1.4	1.1	1.3
			I-495 Inner Loop from I-95 to MD 5	1.5	1.8	1.0	1.0	1.0	1.0	1.0	1.0
			I-495 Outer Loop from MD 5 to I-95	1.9	2.5	1.2	1.0	1.0	1.0	1.0	1.0
			I-270 NB from I-495 to I-370	1.5	1.0	1.4	1.1	1.3	1.6	1.3	1.2
			I-270 SB from I-370 to I-495	1.0	1.1	3.7	2.0	1.3	1.3	2.6	1.4
RELATIVE RATING* **				**N/A**	**Low**	**Low**	**Medium**	**Medium**	**High**	**Medium**	**Medium**

* Note: MDOT SHA defines various levels of congestion based on TTI: Uncongested (green) – TTI ≤ 1.15; Moderate Congestion (yellow) – 1.15 < TTI ≤ 1.3; Heavy Congestion (orange) – 1.3 < TTI < 2.0; and, Severe Congestion (red) – TTI ≥ 2.0.
**Note: This table summarizes TTI in the GP lanes. All HOT/ETLs would have TTI values in the uncongested range (TTI less than 1.15).
*** See Section 6.2.2.D for a description of relative ratings of "low", "medium", and "high" as they apply to this table.

Table 6-5: Summary of Vehicle-Throughput Results from VISSIM Model

CRITERIA	METRIC	PEAK PERIOD	LOCATION	EXISTING	ALTERNATIVE 1	ALTERNATIVE 5	ALTERNATIVE 8	ALTERNATIVE 9	ALTERNATIVE 10	ALTERNATIVE 13B	ALTERNATIVE 13C
Improve Movement of Goods and Services	Vehicle-Throughput (veh/hr)	AM Peak	I-495 at American Legion Bridge	17,105	17,405	20,113	22,240	22,343	22,770	21,788	22,442
			I-495 west of I-95	14,591	13,910	15,977	18,994	19,189	19,052	19,000	19,679
			I-495 at MD 5	12,377	12,606	12,789	15,640	14,002	14,145	14,525	15,258
			I-270 at Montrose Rd	16,225	17,087	17,985	20,951	18,975	21,374	18,310	19,675
		PM Peak	I-495 at American Legion Bridge	16,299	15,421	18,776	18,817	20,906	20,801	20,035	20,288
			I-495 west of I-95	15,561	15,420	19,101	21,524	21,312	21,489	20,170	21,474
			I-495 at MD 5	13,609	13,916	15,132	13,868	15,715	15,725	15,652	15,853
			I-270 at Montrose Rd	18,375	17,972	16,098	18,540	20,156	22,305	16,946	19,989
	Percent Change in Vehicle-Throughput vs. 2040 No Build	AM Peak	I-495 at American Legion Bridge	N/A	N/A	15%	30%	30%	30%	25%	30%
			I-495 west of I-95	N/A	N/A	15%	35%	40%	35%	35%	40%
			I-495 at MD 5	N/A	N/A	0%	25%	10%	10%	15%	20%
			I-270 at Montrose Rd	N/A	N/A	5%	25%	10%	25%	5%	15%
		PM Peak	I-495 at American Legion Bridge	N/A	N/A	20%	20%	35%	35%	30%	30%
			I-495 west of I-95	N/A	N/A	25%	40%	40%	40%	30%	40%
			I-495 at MD 5	N/A	N/A	10%	< 0%	15%	15%	10%	15%
			I-270 at Montrose Rd	N/A	N/A	< 0%	5%	10%	25%	< 0%	10%
			RELATIVE RATING*	**N/A**	**Low**	**Low**	**Medium**	**High**	**High**	**Low**	**High**

* See Section 6.2.2.E for a description of relative ratings of "low", "medium", and "high" as they apply to this table.

Table 6-6: Summary of the Effects on the Local Roadway Network from MWCOG Model

CRITERIA	PERIOD	METRIC	EXISTING	ALTERNATIVE 1	ALTERNATIVE 5	ALTERNATIVE 8	ALTERNATIVE 9	ALTERNATIVE 10	ALTERNATIVE 13B	ALTERNATIVE 13C
Improve Movement of Goods and Services	Daily	Daily Delay (vehicle-hours) for All Arterials in Montgomery County	144,028	247,462	241,601	233,725	231,608	233,139	233,448	234,352
		Percent Reduction vs. No Build (Montgomery County)	**N/A**	0%	2.4%	5.6%	6.4%	5.8%	5.7%	5.3%
		Daily Delay (vehicle-hours) for All Arterials in Prince George’s County	98,421	171,265	163,660	158,725	158,606	158,831	158,798	158,505
		Percent Reduction vs. No Build (Prince George’s County)	**N/A**	0%	4.4%	7.3%	7.4%	7.3%	7.3%	7.5%
		Daily Delay (vehicle-hours) for All Arterials in District of Columbia (DC)	105,257	178,074	169,630	165,184	164,571	165,931	163,978	165,851
		Percent Reduction vs. No Build (Total – Maryland)	**N/A**	0%	4.7%	7.2%	7.6%	6.8%	7.9%	6.9%
		Total Daily Delay (vehicle-hours) for All Arterials in Montgomery County, Prince George’s County, and District of Columbia (DC)	347,706	596,801	574,891	557,634	554,785	557,901	556,224	558,708
		Percent Reduction vs. No Build (District of Columbia)	**N/A**	**0%**	**3.7%**	**6.6%**	**7.0%**	**6.5%**	**6.8%**	**6.4%**

* Note: All other Counties in Maryland and Virginia are expected to experience negligible changes in daily delay (less than 3% for all alternatives).

** See Section 6.2.2.F for a description of relative ratings of “low”, “medium”, and “high” as they apply to this table.

6.2.3 Financial Viability

The initial evaluation of the Screened Alternatives to assess financial viability was done using proxies as detailed financial data was not available. This consisted of using ADT in the managed lanes and preliminary capital costs to compare the potential financial viability of the Screened Alternatives. The results of the ADTs, preliminary capital cost estimates, and financial viability using proxies are presented in **Table 6-7**. The ADT values would roughly correspond to the number of users paying a toll and therefore the total revenue. Alternative 9 has the highest managed lanes ADT at 77,000, followed closely by Alternative 10 at 76,000, 99 percent of the Alternative 9 total. Alternatives 13B, 8, and 13C have the next highest ADTs in the managed lanes with 63,000 (82% of Alternative 9 total), 62,000 (81% of the Alternative 9 total), and 59,000 (77% of the Alternative 9 total), respectively. Alternative 5 has the lowest ADT at 50,000, 65 percent of the Alternative 9 total.

Alternatives 5, 9, and 13B would provide HOT lanes while Alternatives 8, 10, and 13C would provide ETLs. It is likely that the revenue for the HOT lane alternatives would be slightly less compared to the ETL alternatives because the HOV vehicles in the HOT lanes would either have a reduced toll or travel for free. This policy would mean fewer users in these lanes would pay tolls, thus reducing the potential revenue. However, the lower revenue may be offset somewhat by the potential for higher toll rates to be paid by the toll-paying users in the HOT lanes. Toll rates would likely be higher in HOT lanes since there would be less available capacity, necessitating higher toll rates to adequately manage the toll-paying demand.

These results of this initial analysis indicated that Alternative 9 and 10 would have the highest revenue potential, followed by Alternatives 8, 13B, and 13C, with Alternative 5 having the lowest revenue potential.

Preliminary capital costs would roughly correspond to the overall program cost for each alternative. Higher capital costs result in higher long-term operations and maintenance costs, and therefore higher total life-cycle costs. Alternative 10 was chosen as a basis of comparison for all the alternatives within the financial viability criterion because it has the highest estimated preliminary capital cost. Alternative 5 would have the lowest capital cost. Alternative 9 would have the median cost of the Screened Alternatives. Alternative 13B would have the second highest capital cost, slightly less than Alternative 9. Alternatives 8 and 9 would have nearly the same capital cost. Alternative 13C would have a capital cost higher than Alternative 9.

In June 2019, additional financial analysis was completed for all the recommended ARDS to assess the potential of each alternative to be financially viable. This analysis considered the preliminary capital costs, initial revenue projections, and preliminary operations and maintenance costs. Estimates were developed for net cashflows to the state from delivery as a toll revenue concession (costs and revenues adjusted for inflation and financing modeled based on market precedents for similar transactions) over the course of a 50-year P3 agreement to indicate the comparative financial viability of each of the recommended ARDS. The net cashflow results are shown in **Table 6-7**.

Table 6-7: Summary of System-Wide Managed Lanes Traffic and Preliminary Capital Costs

METRIC	ALTERNATIVE 1	ALTERNATIVE 5	ALTERNATIVE 8	ALTERNATIVE 9	ALTERNATIVE 10	ALTERNATIVE 13B	ALTERNATIVE 13C
Managed Lanes ADT – I-495[1]	0	26,000	40,000	40,000	40,000	40,000	40,000
Managed Lanes ADT – I-270[2]	0	24,000	22,000	37,000	36,000	23,000	19,000
Managed Lanes ADT – Total	**0**	**50,000**	**62,000**	**77,000**	**76,000**	**63,000**	**59,000**
Managed Lanes ADT as a Percentage of Alternative 9[3]	0%	65%	81%	100%	99%	82%	77%
Preliminary Capital Cost (in billions of dollars)	**$0**	**$7.7 – $8.6**	**$8.8 – $9.7**	**$8.7 – $9.6**	**$9.0 – $10.0**	**$8.6 – $9.5**	**$8.9 – $9.9**
Capital Cost as a Percentage of Alternative 10[4]	0%	86%	97%	97%	100%	96%	100%
Estimated Positive / (Negative) Cashflows[5] at Financial Close (YOE millions dollars)	N/A	(580)	310	320	120	(240)	(190)

[1] Managed Lanes ADT on I-495 is an average value of the ADT along each segment of the I-495 managed lanes between managed lane access points. This corresponds to the estimated number of users per day paying a toll on I-495.

[2] Managed Lanes ADT on I-270 is an average value of the ADT along each segment of the I-270 managed lanes between managed lane access points. This corresponds to the estimated number of users per day paying a toll on I-270.

[3] Alternative 9 was chosen as a basis of comparison for all the alternatives because it has the highest managed lanes ADT.

[4] Alternative 10 was chosen as a basis of comparison for all the alternatives within the financial viability criterion because it was the highest cost.

[5] Cashflows are indicative of comparative viability of alternatives related to level of detail in cost and traffic and revenue estimates; actual cashflows will depend on details of solicitation, phasing, technical scope along with many other factors that would impact each alternative similarly

The results indicated that Alternatives 8 and 9 would be the most financially viable in that both would provide a net payment to the state of more than $300 million. Alternative 10 is also projected to provide a net revenue to the state, but less than Alternatives 8 and 9. Alternatives 5, 13B, and 13C would require a payment from the state or public subsidy to complete the construction. The shortfall for Alternative 5 would be approximately $580 million, while 13B and 13C would be approximately $240 million and $190 million, respectively.

The revenue shortfall for Alternative 5 would be the largest of any of the Build Alternatives, and therefore it is the least financially viable. The financial analysis is preliminary, and it is possible that the inputs used to compute the financial viability of Alternative 5 could change. However, if any of the inputs change it is anticipated that it would result in a consistent change for all the Build Alternatives. Therefore, any changes in the inputs would result in a consistent change in the financial viability for all alternatives, resulting in the same comparative difference between the alternatives. The conclusion is that Alternative 5 would always be the least financially viable. Based on the June 2019 financial analysis and the deficiencies in addressing the existing traffic and long-term traffic growth and trip reliability, MDOT SHA and FHWA determined Alternative 5 is not a reasonable alternative, as it does not meet the Study's Purpose and Need, and it is not financially viable. Alternative 5 is included in the following detailed assessment of financial viability for comparison purposes only.

As noted in **Section 6.1.5**, a more detailed assessment of the financial viability of all the Build Alternatives to assess the potential of each to be financially self-sufficient was completed in November 2019 and updated in January 2020. This analysis considered multiple factors and a range of key inputs including: preliminary capital costs including mitigation costs (a high and low range of ±5 percent of the base cost), initial revenue projections, preliminary operations and maintenance costs, and the likely methods for how construction would be financed. The key input of interest rates considered a high and low range of ± 0.50 percent from the base assumption

The financial analysis is preliminary because the value of numerous input assumptions used to compute the financial viability of the Build Alternatives could change. Key input factors include capital costs, operations and maintenance costs, revenue forecasts, and financing assumptions, as noted above. If any of the inputs change, however, it is anticipated that the results of the financial analyses would change in a consistent direction for all Build Alternatives. For example, capital costs for all alternatives would generally go up or down proportionally since the same baseline assumptions were used to develop the capital costs. Similarly, a consistent methodology was used to estimate the revenue and consistent financial assumptions were used for all Build Alternatives. Therefore, any changes in the inputs (i.e., interest rates), are expected to result in a similar comparative difference between the alternatives. The results of the financial analysis are shown in **Table 6-8** through **Table 6-13**.

Alternative 9 cashflow estimates indicate that it would be the most likely to be financially self-sufficient. In the baseline scenario, positive excess cashflows would be approximately $960 million. Under a lower construction price and lower interest rate scenario, the positive cashflows would be estimated at $2,762 million. Conversely, a higher construction cost and higher interest rate scenario would result in a negative cashflow estimate where the State may be required to provide a subsidy of approximately $482 million (lowest of the potential subsidies estimated from the financial analysis). See **Table 6-8** for reference.

Alternative 8 cashflow estimates indicate a more positive financial self-sufficient position (requiring no public subsidy) than several other Build Alternatives. Results for the baseline scenario indicated positive excess cashflows of approximately $833 million. Under a lower construction price and lower interest rate scenario, the positive cashflows would be estimated at $2,627 million. Conversely, a higher construction cost and higher interest rate scenario would result in a negative cashflow estimate where the state may be required to provide a subsidy of approximately $584 million. See **Table 6-9** for reference.

Alternative 10 cashflow estimates indicate a more positive financial self-sufficient position requiring no public subsidy than several other Build Alternatives. Results for the baseline scenario indicated positive excess cashflows of approximately $866 million. Under a lower construction price and lower interest rate scenario, the positive cashflows would be estimated at $2,711 million. Conversely, a higher construction cost and higher interest rate scenario would result in a negative cashflow estimate where the State may be required to provide a subsidy of approximately $604 million. See **Table 6-10** for reference**.**

Alternative 13B cashflow estimates indicate that it would be the least likely to be financially self-sufficient among the Build Alternatives. Results for the baseline scenario indicated positive excess cashflows of approximately $196 million. Under a lower construction price and lower interest rate scenario, the positive cashflows would be estimated at $1,907 million. Conversely, a higher construction cost and higher interest rate scenario would result in a negative cashflow estimate where the State may be required to provide a subsidy of approximately $1,088 million. See **Table 6-11** for reference**.**

Alternative 13C cashflow estimates would be less likely to be financially self-sufficient than Alternatives 8, 9, and 10. In the base case scenario, positive excess cashflows would be approximately $328 million. Under a lower construction price and lower interest rate scenario, the positive excess cashflows would be estimated at $2,065 million, compared to the result for a higher construction price and higher interest rate scenario which indicate negative cashflows where the State may be required to provide a subsidy of approximately $998 million. See **Table 6-12** for reference**.**

Alternative 5 ranges between being not be financially self-sufficient in a high cost and high interest rate scenario to potentially being financially viable in a low cost and low interest rate scenario. In the former, the State may be required to pay a subsidy in the order of $900 million, while in the latter that State may receive a concession payment in the order of $1,800 million. See **Table 6-13** for reference.

Table 6-8: Range of Cashflows at Financial Close for Alternative 9 (in millions)

Cashflows		Capital Cost Range (in millions)		
		Low (-5%)	Mid	High (+5%)
Interest Rate Range	Low (-50 basis points)	$2,762	$2,288	$1,812
	Mid	$1,433	$960	$484
	High (+50 basis points)	$406	-$59	-$482

Table 6-9: Range of Cashflows at Financial Close for Alternative 8 (in millions)

Cashflows		Capital Cost Range (in millions)		
		Low (-5%)	Mid	High (+5%)
Interest Rate Range	Low (-50 basis points)	$2,627	$2,153	$1,676
	Mid	$1,308	$833	$357
	High (+50 basis points)	$293	-$160	-$584

Table 6-10: Range of Cashflows at Financial Close for Alternative 10 (in millions)

Cashflows		Capital Cost Range (in millions)		
		Low (-5%)	Mid	High (+5%)
Interest Rate Range	Low (-50 basis points)	$2,711	$2,221	$1,728
	Mid	$1,356	$866	$375
	High (+50 basis points)	$303	-$166	-$604

Table 6-11: Range of Cashflows at Financial Close for Alternative 13B (in millions)

Cashflows		Capital Cost Range (in millions)		
		Low (-5%)	Mid	High (+5%)
Interest Rate Range	Low (-50 basis points)	$1,907	$1,433	$958
	Mid	$670	$196	-$238
	High (+50 basis points)	-$245	-$666	-$1,088

Table 6-12: Range of Cashflows at Financial Close for Alternative 13C (in millions)

Cashflows		Capital Cost Range (in millions)		
		Low (-5%)	Mid	High (+5%)
Interest Rate Range	Low (-50 basis points)	$2,065	$1,588	$1,110
	Mid	$806	$328	-$130
	High (+50 basis points)	-$148	-$573	-$998

Table 6-13: Range of Cashflows at Financial Close for Alternative 5 (in millions)

Cashflows		Capital Cost Range (in millions)		
		Low (-5%)	Mid	High (+5%)
Interest Rate Range	Low (-50 basis points)	$1,799	$1,376	$952
	Mid	$649	$226	-$143
	High (+50 basis points)	-$154	-$530	-$907

6.2.4 Environmental Considerations

In support of the additional analysis for the Screened Alternatives, existing environmental conditions were further identified through an inventory of readily available public records and resource data, field data collection, and agency consultation. The field delineation and investigation of environmental features was conducted within the I-495 & I-270 Managed Lanes Study corridor study boundary, a 48-mile-long and approximately 600-foot-wide area along the centerlines of I-495 and I-270, spanning two states and three counties. Please note that coordination is ongoing with VDOT and the Virginia resource agencies. The information known at this time is reflected in the preliminary assessment of impacts but will continue to be updated as coordination and additional information becomes available.

The limits of disturbance (LOD) were refined in fall 2019 and used to update the preliminary impacts. Ongoing detailed analyses, including further avoidance and minimization, and a review of direct access locations and constructability resulted in refinements to the LODs. As the study progresses, refinements to the LOD will continue to potentially further avoid and minimize impacts to environmental resources.

A. Right-of-way and Property Resources

Zoning and land use within the corridor study boundary vary from highly built out to sprawling, encompassing residential zones, park/open space, transportation zoning, commercial/employment, mixed-use, and planned unit/planned community areas. Right-of-way, properties, parks and recreation areas were identified based on a detailed review of MDOT SHA plats and land records, as well as county and state property parcel data.

B. Cultural Resources

The MEDUSA Online system, Maryland Inventory of Historic Places, and National Register of Historic Places were reviewed to identify properties listed, eligible or potentially eligible for the National Register of Historic Places. Coordination with the Virginia Department of Historic Properties is ongoing.

C. Natural Resources

Wetlands and waters resources were identified by desktop investigation of National Wetlands Inventory and MDNR Wetlands and Waters Geographic Information System (GIS) data. This data was field-verified through the delineation of features in accordance with the USACE 2012 *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region Version 2.0* and the USACE 2012 *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Coastal Plain Region* (USACE, 2012; USACE, 2010); and the delineation of waters features using the limits defined in 33 CFR § 328.[41]

Floodplains within the corridor study boundary were identified using Maryland iMap and the Federal Emergency Management Agency's Effective Floodplain GIS layer.

Existing forest canopy conditions within the Maryland portion of the corridor study boundary were identified based on field investigations from MDOT SHA's 2006 Capital Beltway Study and 2017 I-270 ICM Program and GIS desktop review of Chesapeake Conservancy Conservation Innovation Center High Resolution Data of forest canopy.

Forest Interior Dwelling Bird Species (FIDS) require larger forest patches to successfully maintain viable populations. FIDS habitat was identified by estimating the size of forest patches within the corridor study boundary from project aerial photography. Those patches that met the definition of FIDS habitat were considered FIDs habitat for the purposes of this Study.

Unique and Sensitive Areas are ecological resources designated by state and local municipalities that do not fall within the regulations of other environmental resources such as waterways or forests. These include areas designated by MDNR such as targeted ecological areas (TEAs) and Green Infrastructure (GI) hubs and corridors; as well as areas designated by Montgomery County such as Special Protection Areas (SPAs) and Environmental Overlay Zones. The locations of TEAs, GI hubs and corridors, SPAs, and Environmental Overlay Zones within the I-495 & I-270 Managed Lanes Study corridor study boundary were determined using a desktop review. Background information and geospatial data for TEAs and GI areas

[41] A two-tiered approach was taken to fieldwork within the corridor study boundary based on the timeline of approved access to properties adjacent to the right-of-way. Tier one fieldwork allowed for full delineation of wetlands and waters features within the MDOT SHA right-of-way, and non-invasive access to properties adjacent to the right-of-way. Non-invasive access allowed access for stream delineation, flagging, photography, characterization of vegetation, and surface hydrology, but not digging soil pits for soil characterization or groundwater hydrology. In areas outside of the MDOT SHA right-of-way, field crews delineated waters features and conducted planning level investigation of wetlands, including conservative estimations of potential wetland boundaries based on surface hydrology and vegetation. Tier two fieldwork involved full or invasive access to adjacent public and private properties as permitted by property owners, including digging soil pits where potential wetlands were identified during tier one fieldwork to delineate the exact boundary of the potential wetland areas.

were obtained from MDNR and Maryland iMap (State of Maryland, 2018). Background information and geospatial data for SPAs and Environmental Overlay Zones in the corridor study boundary were obtained from Montgomery County Atlas.

D. Effects of the Screened Alternatives

The impacts presented in **Table 6-14** were derived by overlaying the environmental inventoried data with the LOD for each of the Screened Alternatives. Coordination between MDOT SHA, subject matter experts, and State and Federal agencies is ongoing and will continue as the Study progresses. This will include prioritization of avoidance and minimization of the environmental impacts and the identification of any needed compensatory mitigation. It should be noted that the environmental impacts consider full replacement of the American Legion Bridge for each alternative. The typical section associated with each alternative is assumed to be the same typical section across the American Legion Bridge.

Table 6-14: Preliminary Effects Comparison of the Screened Alternatives (June 2019)

	Resource	Alternative 1 No Build	Alternative 5	Alternative 8	Alternative 9	Alternative 10	Alternative 13B	Alternative 13C
Environmental	Number of Parks	0	46	47	47	47	47	47
	Potential Use of Section 4(f) Properties* {Potential Use of historic B-W Parkway} (acres)	0	170{63}	176 {63}	176{63}	177{63}	175{63}	177 {63}
	Number of Known Previously Recorded National Register Historic Properties	0	20	21	21	21	21	21
	100-Year Floodplain (acres)	0	123	127	127	128	127	127
	Unique and Sensitive Areas (acres)	0	404	414	414	417	414	416
	Sensitive Species Project Review Area (acres)	0	150	153	153	153	153	153
	Forest canopy (acres)	0	1,452	1,507	1,507	1,519	1,507	1,514
	Wetlands of Special State Concern (acres)	0	0	0	0	0	0	0
	Wetlands – Field Verified (acres)	0	18	19	19	19	19	19
	Waters of the US (linear feet)	0	147,468	150,049	150,049	150,658	150,074	150,285
	Tier II Catchments (acres)	0	54	54	54	54	54	54
	Noise Receptors Impacted	0	3,661	4,470	4,470	4,581	4,411	4,461
Traffic	System-Wide Delay Savings vs. No Build (AM/PM)**	0	20%/22%	23%/33%	34%/33%	35%/34%	27%/22%	26%/34%
Engineering	Total Right-of-way Required (acres)	0	301	335	335	344	335	341
	Number of Properties Directly Effected	0	1,222	1,445	1,445	1,485	1,446	1,462
	Number of Residential Displacements	0	25	34	34	34	34	34
	Number of Business Displacements	0	4	4	4	4	4	4
	Width of Pavement on I-495 (feet)	138–146	170–174	194–198	194–198	194–198	194–198	194–198
	Width of Pavement on I-270 (feet)	228–256	194–198	218–222	218–222	242–248	202–206	226–230
	Capital Costs (billions)	N/A	$7.7 – $8.6	$8.7 – $9.6	$8.7 – $9.6	$9.0 – $10.0	$8.6 – $9.5	$8.9–- $9.9

Notes: * Potential Section 4(f) Properties includes total acres of potential impacts to parks and known historic properties
** Previous versions of this table used a similar metric of Annual Average Hours of Savings per Commuter. System-Wide Delay Savings better reflects benefits to all road users.

- All the alternatives follow the existing highways; therefore, the quantity of impacts is similar.
- Detailed analyses, including further avoidance, minimization and private sector incentives, will be prioritized to reduce the property and environmental impacts.
- Preliminary impacts represented above assume total impacts; temporary and permanent impacts for the Recommended Preferred Alternative will be differentiated in the FEIS.
- Noise receptors are noise-sensitive land uses which include residences, schools, places of worship, and parks, among others.

6.3 Rationale for Alternatives Retained for Detailed Study

The rationale to carry an alternative forward as an ARDS in the DEIS (**Table 6-15**) is presented in this section. After applying the refined screening criteria, all the Screened Alternatives except Alternative 5 met the Study's Purpose and Need to varying degrees. The No Build Alternative does not meet the Study's Purpose and Need but is retained for comparison with other alternatives. The summary of the Screened Alternatives evaluation is shown in **Table 6-16**.

Table 6-15: Alternatives Retained for Detailed Study

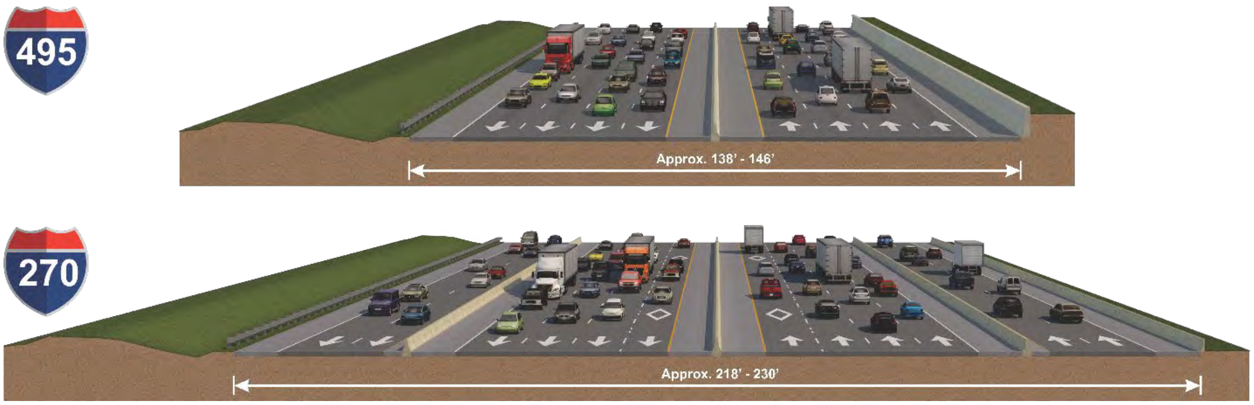
ALTERNATIVE	DESCRIPTION
Alternative 1	No Build
Alternative 8	2-Lane, ETL Managed Lanes Network on I-495 and 1-ETL and 1-Lane HOV Managed Lane on I-270
Alternative 9	2-Lane, HOT Managed Lanes Network on both I-495 & I-270
Alternative 10	2-Lane, ETL Managed Lanes Network on I-495 & I-270 plus 1-Lane HOV Managed Lane on I-270 only
Alternative 13B	2-Lane, HOT Managed Lanes Network on I-495; HOT Managed, Reversible Lane Network on I-270
Alternative 13C	2-Lane, ETL Managed Lanes Network on I-495; ETL Managed, Reversible Lane Network and 1-Lane HOV Managed Lane on I-270

6.3.1 Alternative 1

The No Build Alternative, often called the base case, includes all other projects except this Study in *Visualize 2045* (the CLRP for the National Capital Region) adopted by the MWCOG, TPB in 2018 (**Figure 6-2**). The No Build Alternative includes other projects impacting the facilities that are subject to this Study. Specifically, the CLRP reflects the extension of the I-495 express lanes in Virginia from the Dulles Toll Road interchange to the American Legion Bridge. The No Build Alternative also includes the I-270 ICM Contract Project, which is providing a series of projects to improve mobility and safety at key points along I-270 targeted to reduce congestion at key bottlenecks along the corridor. All improvements are being implemented within the existing roadway right-of-way and are anticipated to be completed by the end of 2020. While these improvements will improve mobility and safety, they will not address the long-term capacity need for the I-270 corridor.

The CLRP also includes transit improvement projects including the Purple Line, improvements to MARC, and the construction of a BRT network. The MTA and Montgomery County have current BRT studies underway to provide additional travel choices and relieve congestion in the adjacent roadway networks. These other BRT studies and the construction of the Purple Line are addressing the transit demand within the Study corridors. However, as concluded in the 2002 MDOT SHA *Capital Beltway / Purple Line Study* (2002 Study), "Congestion on the Beltway itself as well as demand on the other transportation facilities is so great that no single highway or transit improvement will provide significant relief to the long-term demand," (page S-17). The 2002 Study also recommended that studies of the highway and transit alternatives be conducted separately because transit operates more efficiently if it serves areas where people live and work. Furthermore, the 2002 Capital Beltway / Purple Line Study concluded that the implementation of any potential transit alignment corridor would provide an alternative to driving on adjacent, congested highways. While transit may not significantly improve conditions on the Beltway itself, it would provide additional mobility on a regional scale.

Figure 6-2: Alternative 1 Typical Sections



Routine maintenance and safety improvements along I-495 and I-270 are included in the No Build Alternative. However, it does not include new improvements to I-495 and I-270. Alternative 1 does not meet the Study's Purpose and Need as it does not achieve the following: accommodate existing and future long-term traffic, enhance trip reliability, provide an additional roadway travel choice, accommodate Homeland Security, improve the movement of goods and services, nor enhance multimodal connectivity. This alternative would not provide a revenue source. Also, Alternative 1 is not consistent with the *Visualize 2045* Plan. However, consistent with NEPA requirements, ***Alternative 1: No Build is carried forward into the DEIS as an Alternative Retained for Detailed Study*** to serve as a base case for comparing the other alternatives.

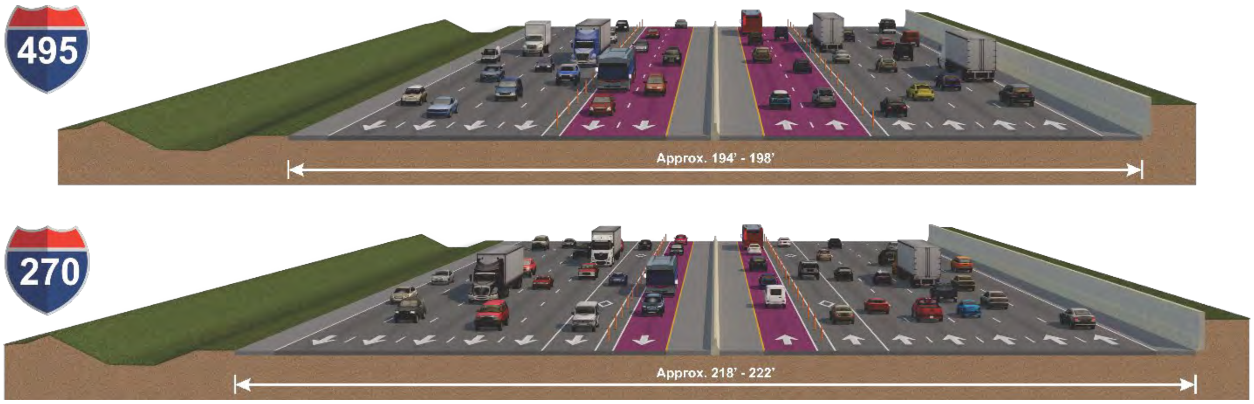
6.3.2 Alternative 8

This alternative consists of adding two ETL managed lanes in each direction on I-495, retaining one existing HOV lane in each direction on I-270, and adding one ETL managed lane in each direction on I-270 (**Figure 6-3**). Buses would be permitted to use the managed lanes.

Alternative 8 is rated "medium" for the metrics of system-wide delay, corridor travel time and speed, TTI in the GP Lanes, and density and LOS. On I-495, Alternative 8 would provide better trip reliability and better accommodate existing and long-term traffic compared to Alternative 5 because Alternative 8 would increase managed capacity with two ETL lanes on I-495. However, on I-270, Alternative 8 would have speed and reliability issues related to the effects of slow-moving vehicles in the one-lane ETL, like Alternative 5.

As documented during the Preliminary Range of Alternatives Screening, Alternative 8 would continue to provide an additional roadway travel choice through the provision of adding managed lanes.

Figure 6-3: Alternative 8 Typical Sections



Alternative 8 is rated as having "medium" ease of use for travelers since it includes GP, HOV, and ETLs, requiring users to choose between two systems to use, the GP/HOV lane system or ETL system, when they are approaching the interchange from a crossroad or along the mainline approaching the start of the system.

Alternative 8 would provide additional capacity to assist in accommodating population evacuation and improving emergency response.

Alternative 8 is rated "medium" for the metric of throughput and "high" for the effect on local roadway network, both of which are used to measure the criterion of movement of goods and services. Alternative 8 is expected to provide vehicle throughput benefits primarily during the AM peak period, but not have as significant throughput benefits during the PM peak period. In terms of effect on local roadway network, Alternative 8 performs "high," similar to Alternatives 9, 10, 13B, and 13C.

Alternative 8, was rated as providing a "high" for enhancement to connectivity to and between existing transit facilities, because it would include new direct access ramps and two managed lanes per direction on both I-495 and I-270.

Alternative 8 would be less likely to be financially self-sufficient than Alternative 9 and would provide a net payment to the state up to $2,627 million. If both the interest rate and construction cost are high, then the state would be required to pay up to a $584 million subsidy, as shown in **Table 6-9**.

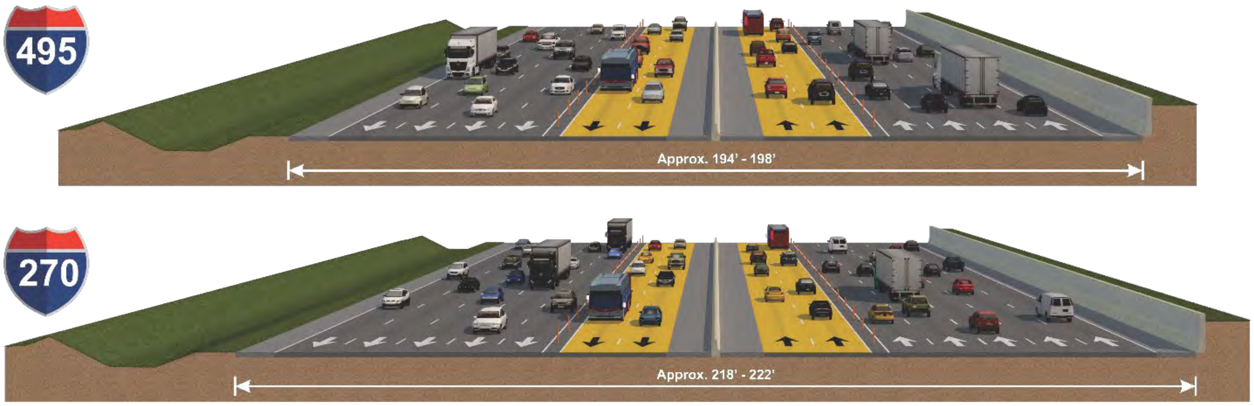
Alternative 8 would result in similar impacts to resources compared to the other Screened Alternatives (**Table 6-14**). The ability to minimize or mitigate impacts and permit Alternative 8 would be similar to other Screened Alternatives.

MDOT SHA is carrying Alternative 8 forward into the DEIS as an Alternative Retained for Detailed Study because it meets the Study's Purpose and Need.

6.3.3 Alternative 9

This alternative consists of adding two HOT managed lanes in each direction on I-495, converting the one existing HOV lane in each direction to a HOT managed lane on I-270, and adding one HOT managed lane in each direction on I-270, resulting in a two-lane, managed lanes network on both highways (**Figure 6-4**). Buses would be permitted to use the managed lanes.

Figure 6-4: Alternative 9 Typical Sections



Alternative 9 would perform well for most metrics used to measure existing traffic and long-term traffic growth and trip reliability, including a rating of “high” for system-wide delay, corridor travel time and speed, and density and LOS. Alternative 9 is rated “medium” for the metric of TTI in the GP Lanes. Alternative 9 would provide system-wide delay savings of more than 30 percent during the AM and PM peak periods compared to No Build Alternative, and significant travel times savings in both the GP lanes and especially the HOT/ETL lanes. Alternative 9 would outperform Alternative 5 and Alternative 8 and would not suffer from the effects of slow-moving vehicles in the managed lanes because the two HOT lanes under Alternative 9 provides enough passing opportunities on both I-495 and I-270.

As documented during the Preliminary Range of Alternatives Screening, Alternative 9 would continue to provide an additional roadway travel choice through the provision of adding two managed lanes.

Alternative 9 is rated as having “medium” ease of use for travelers since it includes both GP and HOT lanes requiring users to choose between two systems when approaching the interchange access points from the crossroad.

Alternative 9 would provide additional capacity to assist in accommodating population evacuation and improving emergency response.

Alternative 9 is rated “high” for both movement of goods and services metrics of throughput and effect on local roadway network. Alternative 9 would result in significant increases in vehicle throughput at multiple key locations during both the AM and the PM peak periods and is projected to reduce daily delay for arterials in Prince George’s and Montgomery Counties by approximately 6 percent compared to the No Build Alternative.

Alternative 9, was rated as providing a “high” enhancement to connectivity to and between existing transit facilities because it would include new direct access ramps and two managed lanes per direction on both I-495 and I-270.

The results indicated that Alternative 9 would be the most likely to be financially self-sufficient and would provide a net payment to the state up to $2,762 million. If both the interest rate and construction cost are high, then the state would be required to pay up to a $482 million subsidy, as shown in **Table 6-8**.

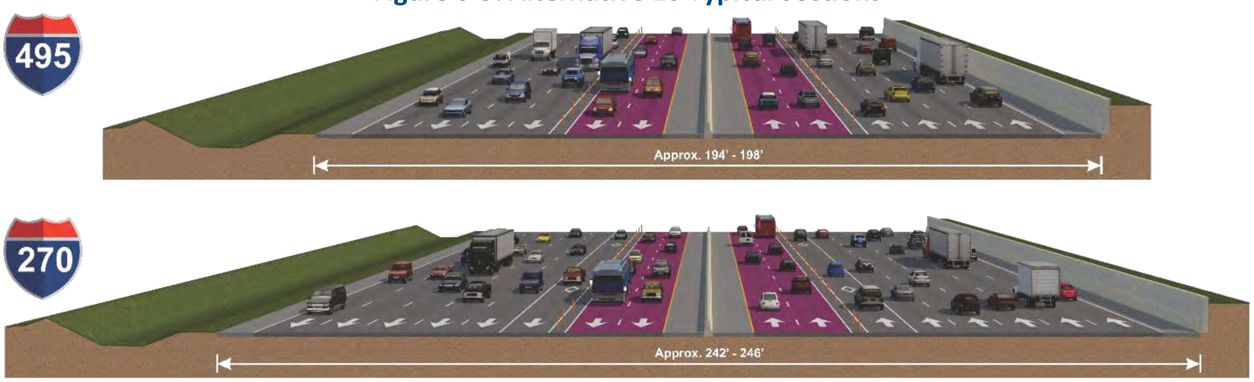
Alternative 9 would impact a similar number of resources compared to the other Screened Alternatives (**Table 6-14**). The ability to minimize or mitigate impacts and permit Alternative 9 would be similar to other Screened Alternatives.

MDOT SHA is carrying Alternative 9 forward into the DEIS as an Alternative Retained for Detailed Study because it meets the Study's Purpose and Need.

6.3.4 Alternative 10

This alternative consists of adding two ETL managed lanes in each direction on I-495, retaining one existing HOV lane per direction on I-270, and adding two ETL managed lanes in each direction on I-270 (**Figure 6-5**). Buses would be permitted to use the managed lanes.

Figure 6-5: Alternative 10 Typical Sections



Alternative 10 would perform well for all metrics used to measure the criteria of existing traffic and long-term traffic growth and trip reliability, including a rating of "high" for system-wide delay, corridor travel time and speed, and TTI in the GP Lanes. Alternative 10 is rated "medium" for density and LOS. Alternative 10 would provide system-wide delay savings of more than 30 percent during the AM and PM peak periods compared to No Build Alternative, and significant travel times savings in both the GP lanes and especially the ETL lanes. Alternative 10 would also provide travel time and reliability benefits of two ETL lanes which allow for passing maneuvers around slow-moving vehicles in the managed lanes.

As documented during the Preliminary Range of Alternatives Screening, Alternative 10 would continue to provide an additional roadway travel choice through the provision of adding two managed lanes.

Alternative 10 is rated as having "medium" ease of use for travelers since it includes GP, HOV, and ETLs, requiring users to choose between two systems, the GP/HOV lane system or ETL system, when they are approaching the interchange access points from a crossroad or along the mainline approaching the start of the system.

Alternative 10 would provide additional capacity to assist in accommodating population evacuation and improving emergency response.

Alternative 10 is rated "high" for the metrics of throughput and effect on local roadway network used to measure the criterion of movement of goods and services. Alternative 10 is expected to have the greatest increase in vehicle throughput at all four key locations during the PM peak period as well as significant increases during the AM peak period. Alternative 10 is projected to reduce daily delay for arterials in Prince George's and Montgomery Counties by approximately 6 percent compared to No Build conditions.

Alternative 10 was rated as providing a "high" enhancement to connectivity to and between existing transit facilities because it would include new direct access ramps and two managed lanes per direction on both I-495 and I-270.

Alternative 10 would be the next most likely to be financially self-sufficient after Alternative 9 with a net payment to the state as high as $2,711 million. If both the interest rate and construction cost are high, then the state would be required to pay up to a $604 million subsidy, as shown in **Table 6-10.**

Alternative 10 would impact a slightly greater number of resources compared to the other Screened Alternatives (**Table 6-14**). The ability to minimize or mitigate impacts and permit Alternative 10 would be similar to other Screened Alternatives.

MDOT SHA is carrying Alternative 10 forward into the DEIS as an Alternative Retained for Detailed Study because it meets the Study's Purpose and Need.

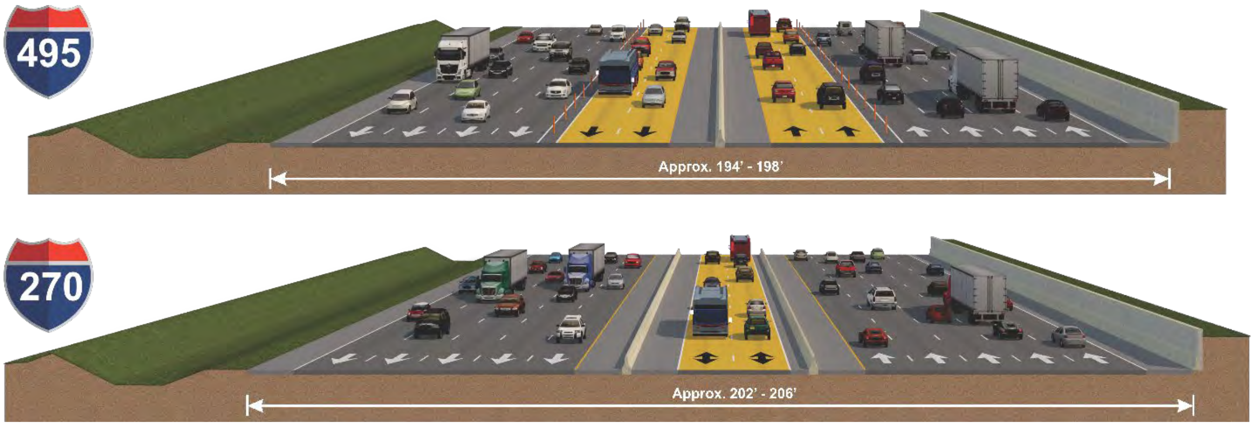
6.3.5 Alternative 13B

Alternative 13B would provide a two-lane, HOT managed lanes network on I-495 similar to Alternative 9. This alternative would also convert the existing HOV lanes on I-270 to two HOT managed reversible lanes while maintaining the existing GP lanes (**Figure 6-6**). Buses would be permitted to use the managed lanes.

Alternative 13B is rated "medium" for the metrics of corridor travel time and speed, TTI in the GP Lanes, and density and LOS, but is rated "low" for the system-wide delay metric. Similar to Alternatives 8, 9, and 10, Alternative 13B would provide better trip reliability and better accommodate existing and long-term traffic growth on I-495. However, on I-270, Alternative 13B would only provide better trip reliability and accommodate existing and long-term traffic growth in the peak direction of travel during each peak period. For example, Alternative 13B would provide corridor travel time and speed, and TTI benefits on I-270 SB during the AM peak, but would perform worse than the No Build Alternative in the SB direction during the PM peak. Similarly, Alternative 13B would provide corridor travel time and speed and TTI benefits on I-270 NB only during the PM peak period.

While the reversible HOT lanes on I-270 could accommodate the peak traffic demand, the reversible HOT lanes would have negative impacts to travel along I-495 during the AM peak period. During this time, no NB HOT lanes would be available along I-270, which would preclude any travelers along I-495 from using the HOT lanes if they were also destined for travel along NB I-270. This would reduce the potential demand for the HOT lanes along both directions of I-495 approaching I-270 and increase the demand for the already over-capacity adjacent GP lanes.

Figure 6-6: Alternative 13B Typical Sections



As documented during the Preliminary Range of Alternatives Screening, Alternative 13B would continue to provide an additional roadway travel choice through the provision of managed lanes.

Alternative 13B is rated as having a "low" ease of use for travelers as there are several issues related to the operations of a reversible lane system on I-270 beyond making the decision between two systems, GP or managed. Reversible lanes allow access for drivers in both directions; therefore, the driver needs to know which direction the system is operating in when they approach the access points, and then decide which system they want to access. Additionally, to restrict motorists for using the ramps in the off-peak direction and allow access from the peak direction, Alternative 13B would require significant additional infrastructure and operational elements, which would include deployable gates at access points, overhead lane use control signals, signing, and system-wide monitoring. These features provide additional information that the traveler will have to understand if they intend to use the reversible managed lanes. Finally, these features would require operations and maintenance time and costs for the full term of the project.

Reversible lanes can only be operated in one direction at a time. This requires the lanes to be closed to traffic during "changeover" operations when the direction of traffic is switched. During these periods, which would be required at least twice per day during typical weekdays, the capacity of the reversible lanes would not be available to either direction of traffic. VDOT operates reversible lanes in the National Capital Region along I-395 and I-95 and indicated to MDOT SHA that the "changeover" between peak traffic directions is estimated to be 2 hours in the afternoon and 2 hours overnight based on its experience. Additionally, the reversible lane system offers less flexibility than full-time capacity in both directions because the peak direction is not always consistent throughout the corridors and during different travel times (weekdays versus weekends, seasonal variations) and as such the reversible lanes often cannot serve the peak direction of travel.

Reversible HOT lanes would be more challenging to use than alternatives that provide managed lanes in both directions. Travelers would have to be aware on when the reversible lanes are in operation in a given direction. This could be learned if the reversible lanes are operated on a standard schedule during typical peak periods, but not if the direction of the reversible lanes varies during other times to best accommodate traffic demand. Reversible lanes have the potential to increase wrong-way driving from travelers entering the system from the non-peak direction.

Alternative 13B would provide additional capacity to assist in accommodating population evacuation and improvement emergency response.

Alternative 13B is rated "high" for the metric of effect on local roadway network but rated "low" for the metric of throughput. These two metrics were combined to generate a rating of "medium" for the criterion of movement of goods and services. Alternative 13B performed similar to most other Screened Alternatives with approximately six percent reduction in total delay for all arterials in Prince George's and Montgomery Counties. However, Alternative 13B was one of the lowest performing Screened Alternatives for throughput. Although Alternative 13B would provide some benefits compared to No Build Alternative, it would provide smaller increases in throughput at key locations than Alternatives 8, 9, 10, and 13C, including no improvement at I-270 at Montrose Road during the PM peak hour.

Alternative 13B was rated as providing a "medium" enhancement for connectivity to and between existing transit facilities because it would include new direct access ramps and two managed lanes per direction on both I-495 and I-270 in the peak direction. However, it would not accommodate transit nor non-reversible alternatives because the managed lanes would not be available for use by transit in the non-peak direction or when the reversible lanes are closed. Any transit routes that include both I-495 and I-270 would be forced to use the adjacent GP lanes on I-495 when the reversible lanes on I-270 are operating in the opposite direction or closed during changeover operations and would not reap the benefits of faster and more reliable trips in the HOT/ETL lanes.

Alternative 13B would range between being not be financially self-sufficient with a subsidy required from the state of approximately $1,088 million to being self-sufficient with a net payment to the state up to $1,907 million subsidy, as shown in **Table 6-11.**

Alternative 13B would have a similar roadway footprint/LOD as Alternatives 8 and 9. The typical section of Alternative 13B would be narrower than Alternatives 8 and 9, but the direct access interchanges would be more complex as they would require individual ramps to provide access for individual reversible lane movements resulting in a larger LOD than Alternatives 8 and 9.

Alternative 13B would impact a similar number of resources compared to the other Screened Alternatives (**Table 6-14**). The ability to minimize or mitigate impacts and permit Alternative 13B would be similar to other Screened Alternatives.

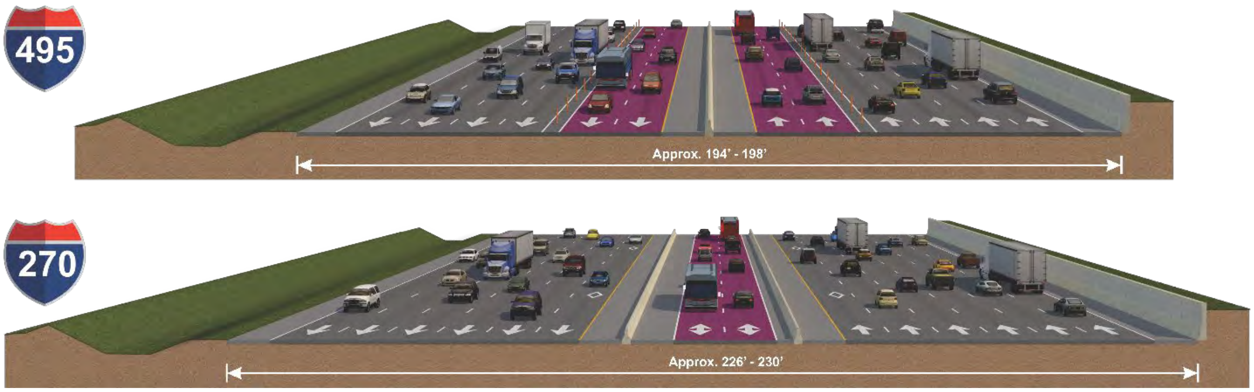
MDOT SHA is carrying Alternative 13B forward into the DEIS as an Alternative Retained for Detailed Study because it meets the Study's Purpose and Need.

6.3.6 Alternative 13C

Alternative 13C would provide a two-lane, ETL managed lanes network on I-495 similar to Alternatives 8 and 10. This alternative considers retaining the existing HOV lanes in both directions and adding two ETL managed, reversible lanes on I-270 (**Figure 6-7**). Buses would be permitted to use the managed lanes.

Alternative 13C is rated "medium" for the metrics of system-wide delay, corridor travel time and speed, TTI in the GP Lanes, and density and LOS used to measure the criteria of existing traffic and long-term traffic growth and trip reliability. Similar to Alternative 13B, Alternative 13C would provide trip reliability and better accommodate traffic on I-495 but would only provide trip reliability and accommodate traffic in the peak direction of travel on I-270. Alternative 13C would slightly outperform Alternative 13B for the system-wide delay metric because one HOV lane would be maintained in the non-peak direction under this alternative.

Figure 6-7: Alternative 13C Typical Sections



While the reversible ETLs on I-270 could accommodate the peak traffic demand, it would have significant negative impacts to travel along I-495 during the AM peak period. During this time, no NB ETLs would be available along I-270, which would preclude any travelers along I-495 from using the ETLs if they were destined to travel along NB I-270. This would reduce the potential demand for the ETLs along both directions of I-495 approaching I-270 and increase the demand for the already over-capacity adjacent GP lanes.

As documented during the Preliminary Range of Alternatives Screening, Alternative 13C would continue to provide an additional roadway travel choice through the provision of managed lanes.

Alternative 13C is rated as having a "low" ease of use for travelers as there is are several issues related to the operations of a reversible lane system on I-270 beyond making the decision between two systems, GP or managed. Reversible lanes allow access for drivers in both directions; therefore, the driver needs to know which direction the system is operating in when they approach the access points, and then decide which system they want to access. Additionally, to restrict motorists for using the ramps in the off-peak direction and allow access from the peak direction, the Alternative would require significant additional infrastructure and operational elements, which would include deployable gates at access points, overhead lane use control signals, signing, and system-wide monitoring. These features provide additional information that the traveler will have to understand if they intend to use the reversible managed lanes. Finally, these features would require operations and maintenance time and costs for the full term of the project.

Reversible lanes can only be operated in one direction at a time. This would require the lanes to be closed to traffic during "changeover" operations when the direction of traffic is switched. During these periods, which would be required at least twice per day during typical weekdays, the capacity of the reversible lanes would not be available. As described under Alternative 13B, VDOT indicated to MDOT SHA that the "changeover" between peak traffic directions is estimated to be 2 hours in the afternoon and 2 hours overnight based on its experience. Additionally, the reversible lane system would offer less flexibility than full-time capacity in both directions because the peak direction would not always be consistent throughout the corridors and during different travel times (weekdays versus weekends, seasonal variations) and as such, the reversible lanes often could not serve the peak direction of travel.

Reversible ETLs would be more challenging to use than alternatives that provide managed lanes in both directions. Travelers would have to be aware on when the reversible lanes are in operation in a given direction. This could be learned if the reversible lanes are operated on a standard schedule during typical peak periods, but not if the direction of the reversible lanes varies during other times to best accommodate traffic demand. Reversible lanes have the potential to increase wrong-way driving from travelers entering the system from the non-peak direction.

Alternative 13C would provide additional capacity to assist in accommodating population evacuation and improvement emergency response.

Alternative 13C is rated “high” for both movement of goods and services metrics of throughput and effect on local roadway network. Alternative 13C results in the greatest increases in vehicle throughput at multiple key locations during both the AM and the PM peak periods and is projected to reduce daily delay for arterials in Prince George’s and Montgomery Counties by approximately 6 percent compared to No Build conditions.

Alternative 13C was rated as providing a “medium” enhancement for connectivity to and between existing transit facilities because it would include new direct access ramps and two managed lanes per direction on both I-495 and I-270 in the peak direction. However, it would not accommodate transit as well as non-reversible alternatives because the managed lanes would not be available for use by transit in the non-peak direction or when the reversible lanes are closed. Any transit routes that include both I-495 and I-270 would be forced to use the adjacent GP lanes on I-495 when the reversible lanes on I-270 are operating in the opposite direction or closed during changeover operations and would not reap the benefits of faster and more reliable trips in the HOT/ETL lanes.

Alternative 13C would range between being not financially self-sufficient with a subsidy required from the state of approximately $998 million to being self-sufficient with a net payment to the state up to $2,065 million subsidy, as shown in **Table 6-12.**

Alternative 13C will have a similar roadway footprint/LOD as Alternative 10. The typical section of Alternative 13C is narrower than Alternative 10, but the direct access interchanges are more complex as they require individual ramps to provide access for individual reversible lane movements.

Alternative 13C would impact a similar number of resources compared to the other Screened Alternatives (**Table 6-14**). The ability to minimize or mitigate impacts and permit Alternative 13C would be similar to other Screened Alternatives.

MDOT SHA recommends carrying Alternative 13C forward into the DEIS as an Alternative Retained for Detailed Study because it meets the Study’s Purpose and Need.

6.3.7 Summary

As a result of the additional traffic, financial, and environmental analysis completed on the Screened Alternatives, the ARDS are Alternatives 1, 8, 9, 10, 13B, and 13C (**Table 6-16**). As mentioned above, Alternative 1: No Build, provides a baseline comparison to the other alternatives. The detailed evaluations for the ARDS will be documented in the DEIS.

Table 6-16: Screened Alternatives Summary

Alternative #	Name/ Description	Engineering									Homeland Security	Movement of Goods and Services	Multimodal Connectivity
		Existing Traffic and Long-Term Traffic Growth (H/M/L)			Trip Reliability: Provides a Dependable Travel Time (H/M/L)		Additional Roadway Travel Choice (Y or N)		Ease of Usage for Travelers (H/M/L)		Accommodates a Population Evacuation and Improves Emergency Response (Y or N)	Improve Movement of Freight, Services & commuting Employees (H/M/L)	Enhances Access to Existing Transit (H/M/L)
		Network Delay	Corridor Travel Time/ Speed	Density & LOS	GP Lanes	HOT/ETL Lanes	I-495	I-270	I-495	I-270			
1	No Build (Existing): All projects in CLRP (including I-270 ICM improvements)	○	○	○	○	○	N	N	●	◓	N	○	○
5[42]	1-Lane, HOT Managed Lane Network: Add one HOT managed lane in each direction **on I-495** and convert one existing HOV lane in each direction to a HOT managed lane **on I-270**	○	◓	○	○	◓	Y	Y	◓	◓	Y	○	◓
8	2-Lane, ETL Managed Lane Network on I-495 and 1-Lane, ETL and 1-Lane, HOV Managed Lane on I-270 Only: Add two ETL managed lanes in each direction **on I-495** and add one ETL managed lane and retain one existing HOV lane in each direction **on I-270**	◓	◓	◓	◓	◓	Y	Y	◓	◓	Y	◓	●
9	2-Lane, HOT Managed Lane Network: Add two HOT managed lanes in each direction **on I-495** and convert one existing HOV lane to a HOT managed lane and add one HOT managed lane in each direction **on I-270**	●	●	●	◓	●	Y	Y	◓	◓	Y	●	●
10	2-Lane, ETL Managed Lane Network on I-495 and 2-Lane ETL and 1-Lane HOV Managed Lane on I-270 Only: Add two ETL managed lanes in each direction **on I-495 and on I-270** and retain one existing HOV lane in each direction **on I-270** only	●	●	◓	●	●	Y	Y	◓	◓	Y	●	●
13B	2-Lane, HOT Managed Lane Network on I-495 and 2-Lane HOT Managed Reversible Lane Network on I-270: Convert existing HOV lanes to two HOT managed reversible lanes **on I-270**	○	◓	◓	◓	●	Y	Y	◓	○	Y	◓	◓
13C	2-Lane, ETL Managed Lane Network on I-495 and ETL Managed Reversible Lanes and HOV Managed Lane on I-270 Only: Retains the existing HOV lanes in both directions and adding two ETL managed, reversible lanes on I-270	◓	◓	◓	◓	●	Y	Y	◓	○	Y	●	◓

KEY: ○ Low | ◓ Medium | ● High | N: No | Y: Yes

[42] Alternative 5 is included in this table for comparison purposes and shown in gray. It has been dropped as a Screened Alternative based on additional financial analysis and the deficiencies in addressing the existing traffic and long-term traffic growth and trip reliability. Alternative 5 was determined not to be a reasonable alternative as it does not meet the Study's Purpose and Need, and it is not financially viable.

6.4 Alternatives Dropped from Further Consideration

Additional alternatives were evaluated and ultimately determined to not meet the study Purpose & Need and therefore are not being advanced by MDOT SHA as ARDS in the DEIS. These include Alternative 5 and the MD 200 Diversion Alternative. Details for these alternatives and the rationale for not carrying them forward as ARDS are presented below.

6.4.1 Alternative 5

Alternative 5 consists of adding one HOT managed lane in each direction on I-495 and converting the one existing HOV lane in each direction to a HOT managed lane on I-270. Buses would be permitted to use the managed lanes.

Alternative 5 would perform the worst of the Screened Alternatives for most metrics used to evaluate the criteria of existing traffic and long-term traffic growth and trip reliability, including a rating of "low" for system-wide delay, TTI in the GP Lanes, density, and LOS. Alternative 5 would be expected to provide some corridor travel time and speed benefits compared to the No Build Alternative, but lags behind Alternative 9 and Alternative 10. Additionally, slow-moving vehicles could cause slower speeds for all following vehicles on single-lane managed lane facilities, as documented in NCHRP Report 03-96. In practice, single-lane systems may perform even worse than VISSIM simulation models indicate, particularly for congestion and reliability metrics, because the models do not capture the impacts of these slow-moving vehicles. Therefore, the VISSIM results for corridor travel time and speeds, as well as TTI, may slightly overestimate the benefits of Alternative 5, which includes only one HOT/ETL, compared to No Build.

As documented during the Preliminary Range of Alternatives Screening, Alternative 5 would continue to provide an additional roadway travel choice through the provision of adding one managed lane.

Alternative 5 is rated as having "medium" ease of use for travelers since it includes both GP and HOT lanes, requiring users to choose between two systems when approaching the interchange access points from the crossroad.

Alternative 5 would provide additional capacity to assist in accommodating population evacuation and improving emergency response.

Alternative 5 is rated as "low" for the metric of throughput and "medium" for the effect on local roadway network, both of which are used to measure the criterion of movement of goods and services. In terms of throughput, Alternative 5 is the only Screened Alternative that does not demonstrate a significant increase in vehicle throughput during the AM peak period and has minimal increase in throughput at key locations during the PM peak period. Although MWCOG model results indicated Alternative 5 would have approximately 3% lower total daily delay for arterials in Prince George's and Montgomery Counties, this improvement is approximately half the benefits of the other Screened Alternatives.

Alternative 5, was rated as providing a "medium" enhancement to connectivity to and between existing transit facilities and accommodating buses in the managed lanes. However, because it would only provide one HOT lane, the buses could be slowed behind the slowest moving vehicle, described as the "snail" effect.

Alternative 5 would provide a revenue source; however, additional analysis was completed to determine the likelihood of financial viability (**Table 6-7** and **Table 6-13**). Alternative 5 would have system-wide ADT in the HOT lanes of approximately 50,000 vehicles. This value is the lowest of all Screened Alternatives and is approximately 35% lower than the projected managed lanes ADT for Alternative 9, the alternative with the highest managed lanes ADT. The preliminary capital cost for Alternative 5 would be $8.1 billion, the lowest of the Screened Alternatives and approximately 14% less than Alternative 10, the alternative with the highest cost. The potential revenue for Alternative 5 could be slightly reduced because the HOV vehicles in the HOT lanes would either have a reduced toll or travel for free. In comparing the HOT lanes ADT versus the preliminary capital cost, Alternative 5 would have a lesser likelihood of being financial viability than all other Screened Alternatives except Alternative 13C.

Additional financial analysis on the recommended ARDS was completed in June 2019 to assess financial viability. The results indicated that Alternative 5 would not be financially viable and would require a payment by the state of approximately $580 million, as shown in **Table 6-7**. The revenue shortfall for Alternative 5 would be the largest of any of the Build Alternatives, and therefore it is the least financially viable. The financial analysis is preliminary, and it is possible that the inputs used to compute the financial viability of Alternative 5 could change. However, if any of the inputs change it is anticipated that it would result in a consistent change for all the Build Alternatives. Therefore, any changes in the inputs would result in a consistent change in the financial viability for all alternatives, resulting in the same comparative difference between the alternatives. The conclusion is that Alternative 5 would always be the least financially viable.

Alternative 5 would impact a smaller number of resources compared to the other Screened Alternatives (**Table 6-14**); however, the impact reduction is a small amount when compared to the size and scale of the overall project improvements over 48 miles. The ability to minimize or mitigate impacts and permit Alternative 5 would be similar to other Screened Alternatives.

Based on additional financial analysis and the deficiencies in addressing the existing traffic and long-term traffic growth and trip reliability, Alternative 5 is not a reasonable alternative as it does not meet the Study's Purpose and Need, and therefore is ***not being retained for detailed study in the DEIS***.

6.4.2 MD 200 Diversion Alternative

Following the Spring 2019 public workshops and agency meetings, a few Cooperating and Participating agencies requested that MDOT SHA evaluate an alternative, through the NEPA process, that would provide an alternative route for travelers to use MD 200 (Intercounty Connector) instead of the top side of I-495 between I-270 and I-95 to avoid or reduce impacts to significant, regulated resources and residential displacements. In compliance with Section 4(f) of the United States Department of Transportation Act of 1966, the alternative was also evaluated to determine if it could be a feasible and prudent alternative that would provide the least overall harm to park resources along the topside of I-495 including: Rock Creek Park, Sligo Creek Stream Valley Park, Northwest Branch Stream Valley Park, and other smaller parks.

The purpose of this analysis was to evaluate the MD 200 Diversion Alternative to the same level of detail as the Screened Alternatives to determine if it would meet the Purpose and Need of the study, and thus be considered a reasonable alternative to be carried forward for detailed study in the DEIS.

As shown in **Figure 6-8**, the MD 200 Diversion Alternative would consist of the following elements:

- No widening or capacity improvements along I-495 between the I-270 West Spur and I-95.
- Consideration of Transportation System Management/Transportation Demand Management (TSM/TDM) improvements along I-495 between the I-270 East Spur and I-95.
- Two managed lanes added in each direction on I-495 between the study limits south of George Washington Parkway, at the Virginia Department of Transportation HOT lane extension south of the American Legion Bridge, and the I-270 West Spur.
- Two managed lanes[43] added in each direction on I-495 between I-95 and the study limits west of MD 5.
- Conversion of the one existing HOV lane in each direction to a HOT managed lane on I-270 and the addition of one HOT managed lane in each direction on I-270, resulting in a two-lane managed lanes network on I-270.
- Two managed lanes added in each direction of I-95 between the MD 200 and I-495.

In the near term, the premise of this alternative has merit due to the currently available capacity on MD 200, an MDTA facility. As such, MDOT SHA is working with MDTA to encourage through traffic from points north on I-95 that is destined for the American Legion Bridge or beyond (and the reverse movement) to utilize MD 200 to take advantage of the near-term spare capacity and potentially provide some relief to the top side of I-495. In an attempt to divert some of this traffic, MDOT SHA is proposing to MDTA to provide travel times for I-495 and MD 200 using the existing dynamic messaging signs. If the travel times show the trip is shorter on MD 200 and the toll is amenable to travelers, then they may choose to divert to MD 200.

However, in addressing the Study's Purpose and Need, the MD 200 Diversion Alternative must also accommodate long-term traffic growth, enhance trip reliability, and improve the movement of goods and services. In the design year of 2040, the traffic analysis results indicate that the MD 200 Diversion Alternative would perform worse than most of the Screened Alternatives in many metrics used to evaluate the reasonableness of the alternatives. The following summarizes the results of these metrics:

- For system-wide delay, along I-495 and I-270, the alternative would perform the worst of all Screened Alternatives and would only save 3 to 7 percent in delay compared to the No Build Alternative (with 20 to 35 percent for the retained build alternatives).
- For corridor travel time and speed, the alternative would have the lowest average speed compared to the Screened Alternatives. Additionally, there would be a 15 percent decrease in speed along the I-495 Inner Loop during the morning peak period compared to the No Build, and the HOT lanes on the I-495 Inner Loop would not achieve the federally-mandated average speed of 45 miles per hour.
- For density and LOS, the alternative would have the highest number of lane miles operating at LOS F and the highest percentage of failing lane-miles amongst the Screened Build Alternatives.

[43] For the purposes of the traffic, environmental or financial analysis, the tolling operation whether HOT or Express Toll Lanes, would not be a differentiating factor.

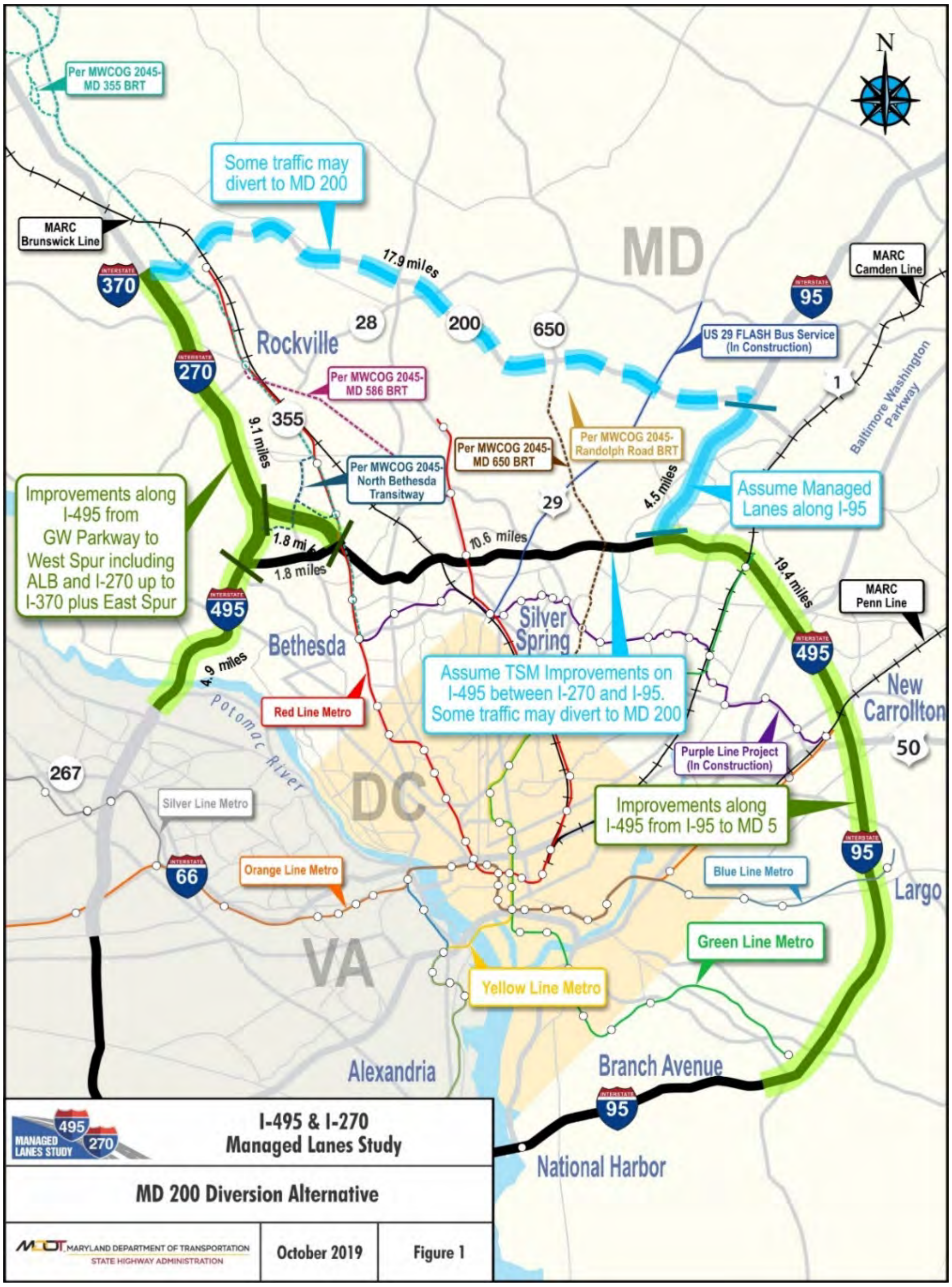
- For TTI, the average TTI on the GP lanes within the study area would be 1.6, which is the second worst of the Screened Alternatives. Two segments of the I-495 Inner Loop would be projected to have TTI values that exceed 2.0 during the PM peak period and therefore would be considered "severe" congestion based on MDOT SHA criteria.
- For vehicle throughput, the alternative would have similar average throughput to Alternative 5, which was removed as an ARDS. Additionally, the top side of I-495 would perform worse than the No Build in the morning peak period and would have approximately half of the throughput benefit of the ARDS across the American Legion Bridge (15 percent with the MD 200 Diversion Alternative compared to 35 percent in the PM peak under Alternative 9 and 10).
- For the effect on the local roadway network, the MD 200 Diversion Alternative would be projected to reduce delay on north-south arterials due to the additional proposed widening along I-95, particularly in Prince George's County. However, it would reduce the benefit on east-west arterials in Montgomery County and the District of Columbia compared to the Screened Alternatives.
- The MD 200 Diversion Alternative would have a cost of $7.2 to $7.9 Billion.

Regarding environmental impacts, the MD 200 Diversion Alternative would include the No Build on the topside of I-495, therefore, it would avoid resources within this area. However, it would include improvements to I-95, which would add to the overall potential environmental impacts for this alternative. While the MD 200 Diversion Alternative would avoid the use of important resources along the topside of I-495, it would still impact significant environmental resources in other areas and would not address the significant congestion issues, despite the cost of $7.2 to $7.9 Billion (**Table 6-17**).

For financial viability, the MD 200 Diversion Alternative would require a subsidy of public funding, which means that even with the toll revenues, the State would have to pay over $310 Million.

Overall, the operational analyses show that a continuous, unbroken network of managed lanes along I-495 is necessary to meet the Study's Purpose and Need (specifically accommodating long-term traffic growth and enhancing trip reliability) and for the project to be financially viable. The section of I-495 between the I-270 East Spur and I-95 carries the *second highest* ADT volume in Maryland and the Outer Loop from I-95 to US 29 was ranked the *#1 most congested freeway section* in Maryland during the AM peak. In addition, the section of I-495 Inner Loop from the I-270 East Spur to MD 97 was ranked the *third most congested freeway section* in Maryland during the PM peak on an average weekday in 2017. Finally, the *top three most unreliable* freeway segments in Maryland during the AM peak are all located on the I-495 Outer Loop between I-95 and MD 193 and during the PM peak, I-495 Inner Loop at MD 355 ranks as the *sixth most unreliable* freeway segment in Maryland. FHWA and MDOT SHA would not retain an alternative (MD 200 Diversion Alternative) for detailed study that would not address the worst traffic deficiencies in Maryland, nor meet the Study's Purpose and Need.

Figure 6-8: MD 200 Diversion Alternative



Note: The proposed BRT Lines on the map indicate which MWCOG model included them, either 2040 or 2045. The traffic analysis in support of the MD 200 Diversion Alternative and ARDS was based on the 2040 MWCOG model.

Based on the results, the MD 200 Diversion Alternative was not be carried forward as an ARDS for the Study as it does not meet the Study's Purpose and Need. Refer to the MD 200 Diversion Alternative Analysis Results Paper as appendix to this *Alternatives Technical Report* (**Appendix A**) for additional details.

Table 6-17: Preliminary Effects Comparison of the Screened Alternatives (June 2019 impacts) and the MD 200 Diversion Alternative

	Resource	Alternative 1 No Build	Alternative 5	Alternative 8	Alternative 9	Alternative 10	Alternative 13B	Alternative 13C	MD 200 Diversion Alt
Environmental	Number of Parks	0	46	47	47	47	47	47	35
	Potential Use of Section 4(f) Properties* {Potential Use of Historic BW Parkway in acres}	0	170 {63}	176 {63}	176 {63}	177 {63}	175 {63}	177 {63}	136 {63}
	Number of Known Previously Recorded National Register Historic Properties	0	20	21	21	21	21	21	12
	100-Year Floodplain (acres)	0	123	127	127	128	127	127	80
	Unique and Sensitive Areas (acres)	0	404	414	414	417	414	416	405
	Sensitive Species Project Review Area (acres)	0	150	153	153	153	153	153	271
	Forest canopy (acres)	0	1,452	1,507	1,507	1,519	1,507	1,514	1,258
	Wetlands of Special State Concern (acres)	0	0	0	0	0	0	0	0
	Wetlands – Field Verified (acres)	0	18	19	19	19	19	19	18
	Waters of the US (linear feet)	0	147,468	150,049	150,049	150,658	150,074	150,285	121,097
	Tier II Catchments (acres)	0	54	54	54	54	54	54	54
	Noise Receptors Impacted	0	3,661	4,470	4,470	4,581	4,411	4,461	Not Avail
Traffic	System-Wide Delay Savings vs. No Build (AM/PM)**	0	20%/22%	23%/33%	34%/33%	35%/34%	27%/22%	26%/34%	3%/7%
Engineering	Total Right-of-way Required (acres)	0	301	335	335	344	335	341	273
	Number of Properties Directly Effected	0	1,222	1,445	1,445	1,485	1,446	1,462	1,076
	Number of Residential Displacements	0	25	34	34	34	34	34	0
	Number of Business Displacements	0	4	4	4	4	4	4	1
	Width of Pavement on I-495 (feet)	138–146	170–174	194–198	194–198	194–198	194–198	194–198	194–198
	Width of Pavement on I-270 (feet)	228–256	194–198	218–222	218–222	242–248	202–206	226–230	218–222
	Width of Pavement on I-95 (feet)	144	N/A	N/A	N/A	N/A	N/A	N/A	196
	Capital Costs (billions)	N/A	$7.7 – $8.6	$8.7 – $9.7	$8.7 – $9.6	$9.0 – $10.0	$8.6 – $9.5	$8.9 –- $9.9	$7.2 - $7.9

Notes: * Potential Section 4(f) Properties includes total acres of potential impacts to parks and known historic properties and does not reflect additional avoidance and minimizations efforts coordinated with the resource agencies in July and August 2019.

** Previous versions of this table used a similar metric of Annual Average Hours of Savings per Commuter. System-Wide Delay Savings better reflects benefits to all road users.

- All the alternatives follow the existing highways; therefore, the quantity of impacts is similar.
- Detailed analyses, including further avoidance, minimization and private sector incentives, will be prioritized to reduce the property and environmental impacts.
- Preliminary impacts represented above assume total impacts; temporary and permanent impacts will be differentiated in the FEIS.
- Noise receptors are noise-sensitive land uses which include residences, schools, places of worship, and parks, among others. Noise analysis along the I-95 portion of the MD 200 Diversion Alternative was not available.

6.5 Alternative 9M

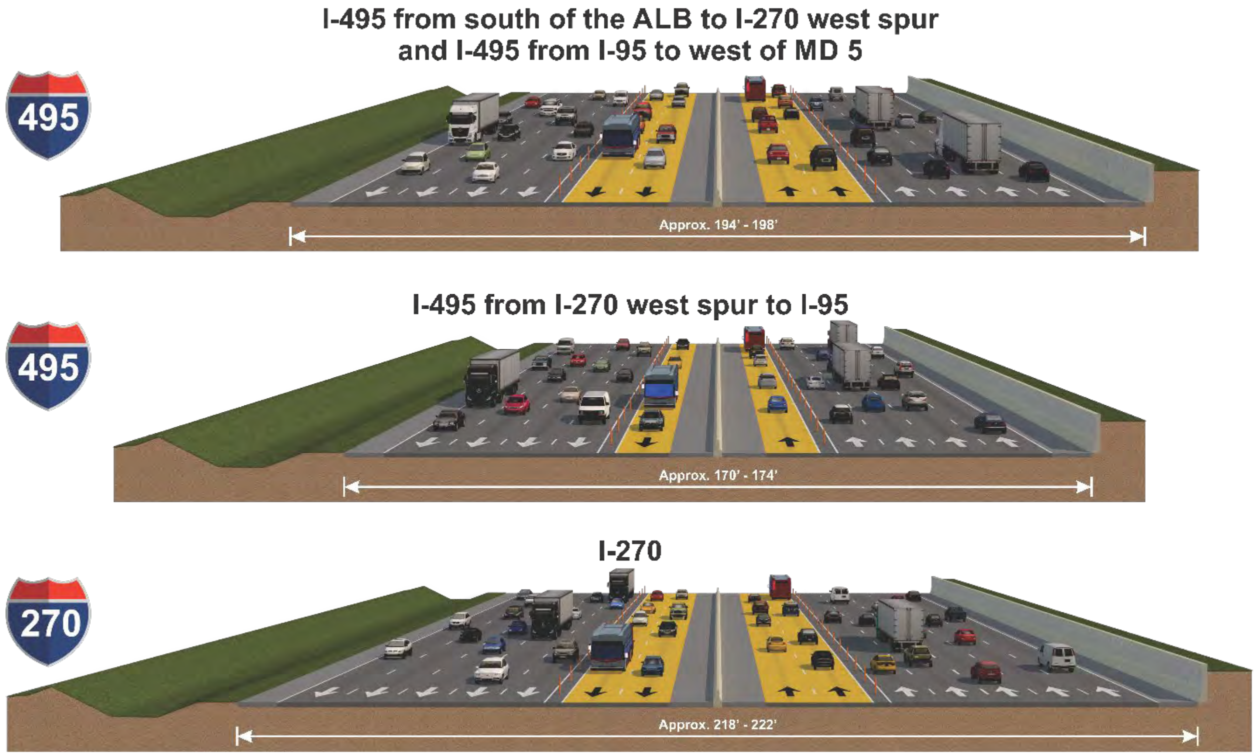
MDOT SHA and FHWA evaluated an additional alternative for the Study called Alternative 9 Modified (Alternative 9M) in response to public and agency comments. Alternative 9M would consist of a blend of Alternative 5 and Alternative 9 in an effort to avoid or reduce impacts to sensitive environmental resources and property relocations on the top side of I-495. The evaluation was completed to determine if the alternative, which includes a reduction of lanes on the top side of I-495, would sufficiently meet the Study's Purpose and Need. Alternative 9M, shown in **Figure 6-9** and **Figure 6-10**, would consist of the following:

- Two HOT managed lanes added in each direction on I-495 on the west side between the Study limits south of the George Washington Memorial Parkway and the I-270 West Spur, including the American Legion Bridge. (Similar to Alternative 9, shown in orange on **Figure 6-10**).
- Conversion of the one existing HOV lane in each direction to a HOT managed lane on I-270 and the West Spur, and the addition of one HOT managed lane in each direction on I-270 and the West Spur, resulting in a two-lane managed lanes network. (Similar to Alternative 9, shown in purple on **Figure 6-10**).
- Conversion of the one existing HOV lane in each direction to a HOT managed lane on the I-270 East Spur. (Similar to Alternative 5, shown in blue on **Figure 6-10**).
- One HOT managed lane in each direction on I-495 between the I-270 West Spur and I-95. (Similar to Alternative 5, shown in blue on **Figure 6-10**).
- Two HOT managed lanes added in each direction on I-495 on the east side between I-95 and the Study limits west of MD 5. (Similar to Alternative 9, shown in green on **Figure 6-10**).

The build elements, including managed lane access locations and interchange improvements, would be the same as they were for Alternatives 5 and 9, where the typical section is consistent with each of those alternatives; however, the managed lanes would need to transition from one to two lanes in each direction and vice versa. These transitions are described below and are shown in **Figure 6-11**.

- At the I-270 West Spur interchange, one northbound managed lane would continue along I-495 to the east and two northbound managed lanes would continue north on the I-270 West Spur. Two southbound managed lanes would come from the I-270 West Spur to join one southbound managed lane from I-495.
- At the I-270 Y-split, one northbound managed lane would come from the East Spur to join two northbound managed lanes from the West Spur. The three southbound managed lanes on I-270 would split so that one managed lane would go to the East Spur and two would go to the West Spur.
- At the I-95 interchange on I-495, the southbound I-95 managed lane ramp would join with one eastbound managed lane from I-495 to the west and would continue eastbound as two managed lanes. The two westbound managed lanes on I-495 east of the interchange would split so that one lane would exit to I-95 northbound and one managed lane would continue westbound on I-495.

Figure 6-9: Alternative 9M Typical Sections

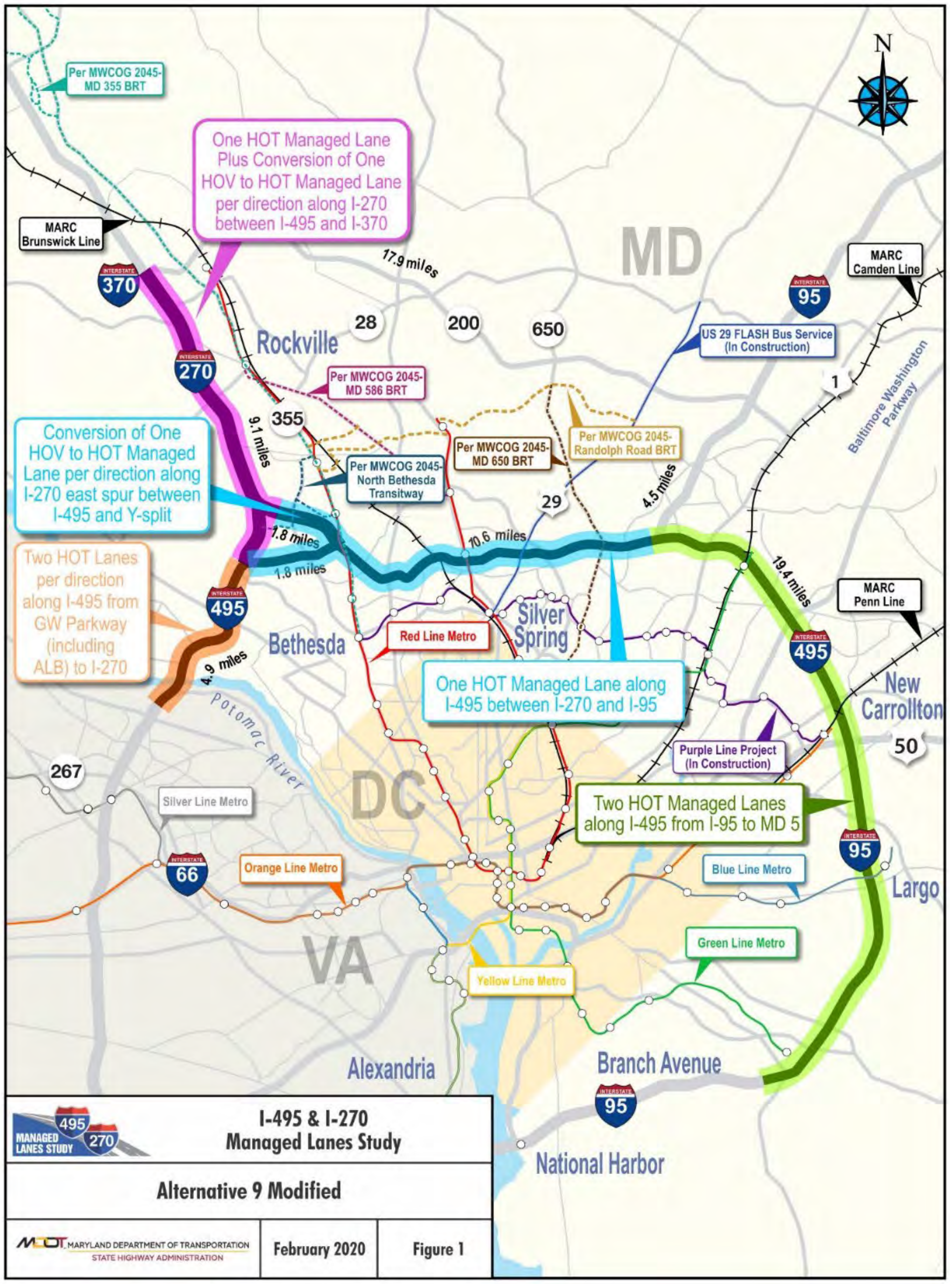


The traffic analysis results indicated that Alternative 9M would be expected to provide operational benefits compared to the No Build Alternative and other Alternatives that were studied and dropped from consideration, such as Alternative 5 and the MD 200 Diversion Alternative. However, the effectiveness of Alternative 9M is limited because this alternative provides less additional capacity (one HOT lane per direction) in the area of the greatest need (top side of I-495) compared to the ARDS, which each provide two managed lanes per direction along I-495 within the Study limits. As a result, Alternative 9M ranks behind all the ARDS (Alternatives 8, 9, 10, 13B, and 13C) in many of the traffic metrics studied and summarized below:

- For system-wide delay, along I-495 and I-270, Alternative 9M would reduce the average delay per vehicle in the system by approximately 30 percent during both the AM and the PM peak periods compared to the No Build Alternative. During the AM peak period, the benefits are less than the benefits of Alternative 9 and Alternative 10 but indicate greater delay savings than other Screened Alternatives. During the PM peak period, the performance of Alternative 9M is worse compared to the other Screened Alternatives, only providing greater delay savings than Alternative 5 and Alternative 13B. This result can be attributed to congestion caused by constraints on the top side of I-495 due to the reduction from two managed lanes to one on I-495 between I-95 and I-270, and the residual effects of this congestion propagating throughout the network.
- For corridor travel time and speed, Alternative 9M would be projected to improve travel times along I-495 in both directions during both the AM and the PM peak periods compared to No Build conditions, but travel time savings would be less than most other Screened Alternatives. Considering travel along both the Inner and Outer Loop, during the AM peak period and PM peak period, Alternative 9M provides consistently greater travel time savings than Alternative 5.

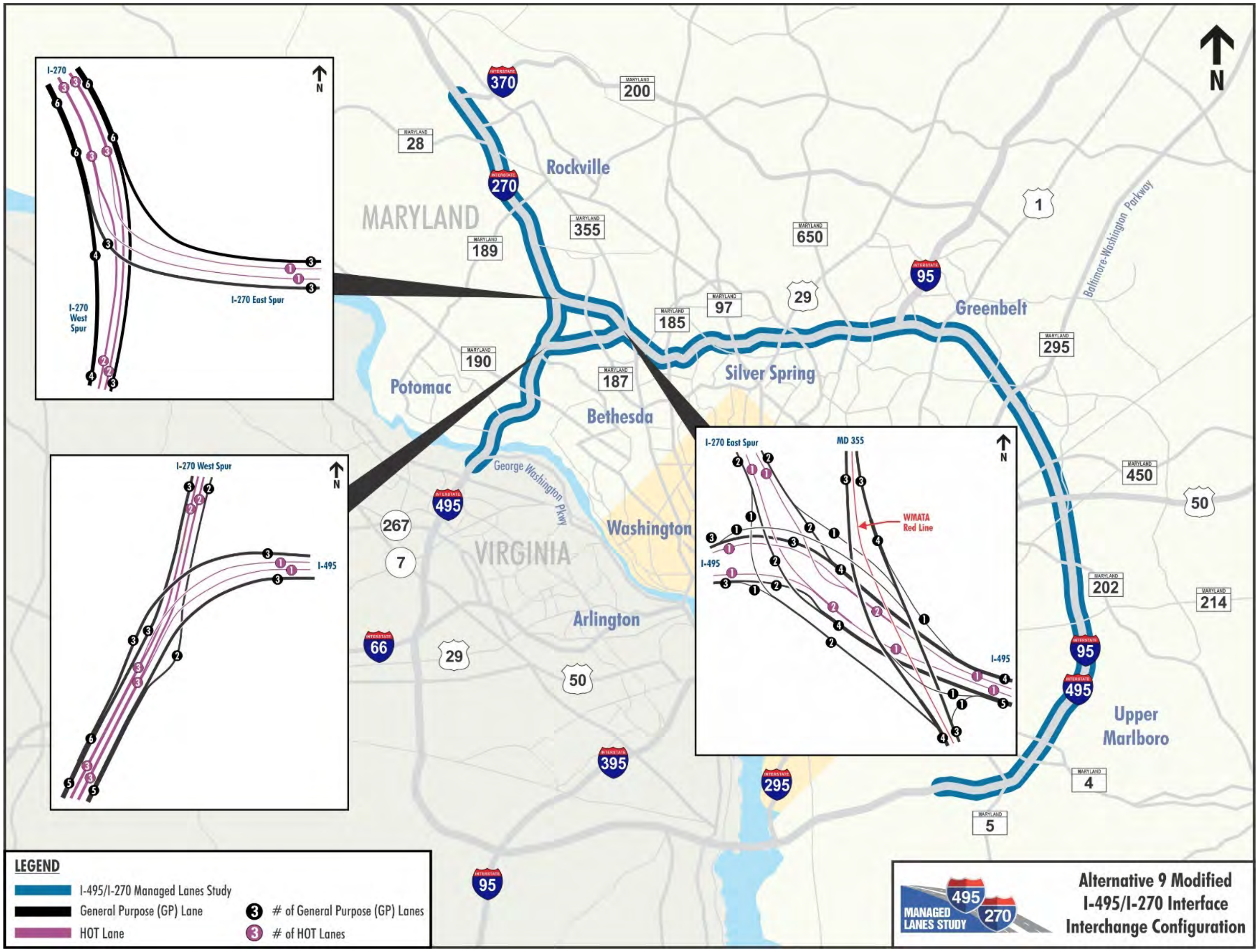
However, all other Screened Alternatives perform better in one or both directions during one or both peak periods than Alternative 9M.

Figure 6-10: Alternative 9 Modified



- For density and LOS, Alternative 9M would be projected to have a lower number of failing lane miles during both the AM peak period and the PM peak period compared to the No Build conditions but would have a higher percentage of failing lane miles compared to Alternatives 8, 9, 10, and 13B. Alternative 9M is also projected to perform better than Alternative 5, and similar to Alternative 13C, in terms of the average percentage of lane-miles operating at LOS F.

Figure 6-11: Alternative 9M I-495 / I-270 Interchange Interface



- For TTI, Alternative 9M would not be expected to have any segments with “severe” congestion during the 2040 AM peak period and it would have one “uncongested” segment: I-270 northbound, which is uncongested during the AM peak period for all alternatives, including the No Build. During the PM peak period, two segments of the Inner Loop would be projected to operate in the “severe congestion” category under Alternative 9M, from George Washington Memorial Parkway to I-270 and from I-270 to I-95. The segment of the I-495 Inner Loop from I-270 to I-95 would experience severe congestion due to minimal capacity improvements along this currently congested and unreliable freeway segment. The adjacent segment of the I-495 Inner Loop from George Washington Memorial Parkway to I-270 would experience severe congestion due to the propagation of congestion and queue spillback where the managed lanes would transition from one lane to two. Similarly, the segment of I-270 southbound from I-370 to I-495 would also be expected to operate in the “severe congestion” category under Alternative 9M due to the propagation of congestion and queue spillback where the managed lanes cross-section would change. Overall, Alternative 9M outperforms Alternative 5 in the metric of TTI with an average TTI value of 1.58 compared to 1.69 but does not outperform any of the other Screened Alternatives.
- For vehicle throughput, the results of the analysis indicated that there is a correlation between increased capacity and increased throughput. On I-495 west of I-95, where a single managed lane would be provided, Alternative 9M would provide additional throughput compared to the No Build Alternative during the AM peak period and PM peak period but would provide 10 to 15 percent less additional throughput compared to other Screened Alternatives that include two managed lanes along this segment. At other locations where additional capacity would be provided under Alternative 9M, the results indicated that additional throughput would be similar to, but still less than under other Screened Alternatives that maintained two managed lanes throughout the entire network. This result could be attributed to congested conditions along the top side of I-495 that would prevent vehicles from accessing sections with additional capacity in the two managed lanes. Overall, Alternative 9M would outperform Alternative 5 in the metric of vehicle throughput with an average value of 17,850 vehicles per hour compared to 16,996 vehicles per hour, but it would not outperform any of the other Screened Alternatives.
- For the effect on the local roadway network, Alternative 9M would be expected to reduce delay on the arterials in Montgomery and Prince George’s counties and the District of Columbia compared to the No Build conditions. The expected reductions in delay are greater than Alternative 5, but less than the other Screened Alternatives.

Refer to the Alternative 9 Modified Preliminary Evaluation Memorandum as appendix to this *Alternatives Technical Report* (**Appendix B**) for full results of the traffic analysis. Alternative 9M would also introduce safety and operational challenges due to the inconsistent cross-section along I-495.

Regarding environmental impacts, there are relatively small differences between Alternatives 5 and 9 compared to the overall total amount of impacts. In turn, the environmental impacts for Alternative 9M would be less than Alternative 9, but the same as or greater than Alternative 5. Under Alternative 9M, there would be:

- 3.5 acres more Section 4(f) impacts than Alternative 5, but 2.1 acres less than Alternative 9;
- 0.9 acres more wetland impacts than Alternative 5, but 0.2 acres less than Alternative 9;

- 43.4 acres more forest impacts than Alternative 5, but 20.2 acres less than Alternative 9; and
- 2.2 acres more floodplain impact than Alternative 5, but 3.0 acres less than Alternative 9.

While Alternative 9M would reduce impacts, it would still impact significant environmental resources in other areas and would not address the congestion issues on the top side of I-495, despite an estimated cost range between $8.5 and $9.4 Billion. The LODs and associated impacts for Alternative 9M are from January 2020 and the impacts for Alternatives 5 and Alternative 9 are from November 2019 and reflect the latest, ongoing coordination on avoidance and minimization efforts with the resource agencies. The comparison of the impacts for the Build Alternatives is presented in **Table 6-19**.

For financial viability, the results indicated that Alternative 9M cashflow estimates would be less likely to be financially self-sufficient than Alternatives 8, 9, and 10 with lower overall revenue potential. Assuming the mid-range results for capital cost and interest rates, positive excess cashflows would be approximately $459 million. As shown in **Table 6-18**, under a lower construction price and lower interest rate scenario, the positive excess cashflows would be estimated at $2,190 million, compared to the result for a higher construction price and higher interest rate scenario, which indicate negative cashflows where the State may be required to provide a subsidy of approximately $827 million.

Table 6-18: Range of Cashflows at Financial Close for Alternative 9 Modified (in millions)

Cashflows		Capital Cost Range (in millions)		
		Low (-5%)	Mid	High (+5%)
Interest Rate Range	Low (-50 basis points)	$2,190	$1,723	$1,258
	Mid	$924	$459	-$4
	High (+50 basis points)	$0	-$414	-$827

In comparison, Alternative 9 could provide a net payment to the State of up to of $2,762 million which is the largest estimated net payment compared to the other Screened Alternatives. Alternative 9M could provide a higher net payment to the State than Alternatives 5, 13B, and 13C, but less than Alternatives 8, 9, and 10.

In summary, Alternative 9M would meet the Study's Purpose and Need better than Alternative 5, but not as well as Alternatives 8, 9, and 10. Further investigation will be required as the Study moves into the FEIS stage to evaluate the safety and operational impacts of Alternative 9M, particularly in the transition areas where capacity in the managed lanes drops from two lanes to one lane. Further, an evaluation of the toll rate implications of Alternative 9M will need to be performed. Refer to the Alternative 9 Modified Preliminary Evaluation Memorandum as appendix to this *Alternatives Technical Report* (**Appendix B**) for additional details.

MDOT SHA recommends carrying Alternative 9M forward into the DEIS as a Build Alternative because it meets the Study's Purpose and Need.

Table 6-19: Summary of Effects Comparison of the Build Alternatives

	Resource	Alternative 1 No Build	Alt 5[1]	Alt 8	Alt 9	Alt 9M	Alt 10	Alt 13B	Alt 13C
Environmental	Total Potential Impacts to Section 4(f) Properties including park and historic properties (acres)	0	140.7	146.3	146.3	144.2	148.5	145.0	146.2
	Number of Historic Properties with Adverse Effect [Adverse effect cannot be determined[2]]	0	13 [7]	13[7]	13[7]	13[7}	13[7]	13[7]	13[7]
	100-Year Floodplain (acres)	0	114.3	119.5	119.5	116.5	120.0	119.5	119.9
	Unique and Sensitive Areas (acres)	0	395.3	408.2	408.2	401.8	410.8	406.7	408.6
	Sensitive Species Project Review Area (acres)	0	0	0	0	0	0	0	0
	Forest canopy (acres)	0	1,433.8	1,497.4	1,497.4	1,477.2	1,514.5	1,488.8	1,503.2
	Wetlands of Special State Concern	0	0	0	0	0	0	0	0
	Wetlands (acres)	0	15.4	16.3	16.3	16.1	16.5	16.3	16.5
	Wetland 25-foot buffer (acres)	0	51.2	53.1	53.1	52.7	53.6	53.1	53.5
	Waters of the US (linear feet)	0	153,702	155,922	155,922	155,229	156,984	155,822	156,632
	Tier II Catchments (acres)	55.2	55.3	55.3	55.3	55.3	55.3	55.3	55.3
	Noise Receptors Impacted	0	3,661	4,470	4,470	4,249	4,581	4,411	4,461
Traffic	System-Wide Delay Savings vs. No Build (AM/PM)[3]	0	20%/22%	23%/33%	34%/33%	30%/30%	35%/34%	27%/22%	26%/34%
Engineering	Total Right-of-way Required (acres)	0	284.9	323.5	323.5	313.4	337.3	318.9	329.3
	Number of Properties Directly Effected	0	1,240	1,475	1,475	1,392	1,518	1,447	1,479
	Number of Residential Relocations	0	25	34	34	25	34	34	34
	Number of Business Relocations	0	4	4	4	4	4	4	4
	Width of Pavement on I-495 (feet)	138–146	170–174	194–198	194–198	170- 198	194–198	194–198	194–198
	Width of Pavement on I-270 (feet)	228–256	194–198	218–222	218–222	218-222	242–248	202–206	226–230
	Capital Cost Range [Construction & ROW] (billions)	N/A	$7.8–$8.5	$8.7 – $9.6	$8.7 – $9.6	$8.5 - $9.4	$9.0 – $10.0	$8.7 - $9.6	$8.8 - $9.7

Notes: [1] MDOT SHA and FHWA determined Alternative 5 is not a reasonable alternative, but it is included in Table 6-19 for comparison purposes only.
[2] Based on current design information, effects cannot be fully determined on these 7 historic properties. MDOT SHA will evaluate these properties further as design advances.
[3] Previous versions of this table used a similar metric of Annual Average Hours of Savings per Commuter. System-Wide Delay Savings better reflects benefits to all road users.

- Preliminary impacts represented above assume total impacts; permanent and temporary impacts will be distinguished in the FEIS.
- The right-of-way is based on State records research and filled in with county right-of-way, as necessary. With the Section 4(f) properties, some boundaries vary based on the presence of easements and differences in the size and location of historic and park boundaries.
- Noise receptors are noise-sensitive land uses which include residences, schools, places of worship, and parks, among other uses. Note that these numbers include receptors that do not have an existing noise wall as well as receptors that have an existing noise wall which is expected to be replaced.

6.6 Multi-Modal Considerations

A key element of the Study's purpose includes enhancing existing and planned multimodal mobility and connectivity. In furtherance of this key consideration and to address agency and public comments received to-date, MDOT SHA has further identified opportunities to enhance transit mobility and connectivity within the recommended ARDS. These would include the following elements:

- Allowing transit usage of the managed lanes to provide an increase in speed of travel, assurance of a reliable trip, and connection to local bus service/systems on arterials that directly connect to activity and economic centers.
- Accommodating direct and indirect connections from the proposed managed lanes to existing transit stations and planned Transit Oriented Development at the Silver Spring Metro (US 29), Shady Grove (I-370), Greenbelt Metro (Cherrywood Lane), New Carrollton Metro (US 50), and Branch Avenue Metro (MD 5).

MDOT SHA also committed to working with WMATA to consider the results of the Washington Area Bus Transformation Study. While the Study is ongoing, initial results of a public survey[44] which ran between September and November 2018 identified several barriers to riding local bus. The top barriers included:

- Doesn't come frequently enough;
- Too slow;
- Doesn't go where I need it to go;
- No direct service/I would have to transfer; and
- Doesn't reliably get me to my destination on time

The opportunity to use the proposed managed lanes, for any of the recommended Build Alternatives, could address some or all of these identified barriers by:

- Improving existing bus operating speeds as managed lanes would provide free flow of traffic;
- Increasing trip reliability as dynamically priced managed lanes provide the opportunity for a free-flow trip;
- Providing the opportunity for planned or modified bus service to connect to underserved suburban to suburban transit markets; and
- Connecting bus service directly or indirectly to existing transit stations.

Lastly, MDOT SHA convened a Transit Summit on May 17, 2019 with MDOT MTA, FTA, WMATA, Montgomery County Ride on and Prince George's County The Bus with the goal of establishing a Transit Working Group to further explore transit opportunities to meet the purpose and need of the I-495 & I-270 Managed Lanes Study. Additional opportunities that are identified through this Transit Working Group may be further considered equally among the ARDS as the Study progresses and would be included in the DEIS.

[44] https://bustransformationproject.com/resources/public-survey-results/

6.7 Build Alternatives

After applying the refined screening criteria based on additional engineering, traffic, financial, and environmental analyses and evaluating two additional alternatives (MD 200 Diversion Alternative and Alternative 9 Modified), there are six Build Alternatives and the No Build Alternative identified as the ARDS (also referred to as the Build Alternatives) that will be carried forward into the DEIS (**Table 6-20**).

Table 6-20: Alternatives Retained for Detailed Study (Build Alternatives)

Alternative	Description
Alternative 1	No Build
Alternative 8	Two-Lane, ETL Managed Lanes Network on I-495 and One-Lane ETL and One-Lane HOV Lane on I-270
Alternative 9	Two-Lane, HOT Managed Lanes Network on both I-495 & I-270
Alternative 9M	Two-Lane, HOT Managed Lanes Network on west and east side of I-495 and on I-270; One-Lane HOT Managed Lane on top side of I-495
Alternative 10	Two-Lane, ETL Managed Lanes Network on I-495 & I-270 plus One-Lane HOV Lane on I-270 only
Alternative 13B	Two-Lane, HOT Managed Lanes Network on I-495; HOT Managed, Reversible Lane Network on I-270
Alternative 13C	Two-Lane, ETL Managed Lanes Network on I-495, ETL Managed, Reversible Lane Network and One-Lane HOV Lane on I-270

7

7 PROPERTY ACQUISITIONS AND RELOCATIONS

Property acquisitions for right-of-way in the I-495 & I-270 Managed Lanes Study include either partial or full acquisitions. A partial acquisition is considered one that does not cause a business or residential relocation. For the purposes of this analysis, a full property acquisition resulting in a relocation has been assumed where a principle building of a residence, business, or community facility is located within 20 feet of an Alternative's limits of disturbance as described in Section 5.2. Also, for the purposes of this analysis, a partial acquisition (no relocation) has been assumed where a principle building is located more than 20 feet from an Alternative's LOD.

7.1 No Build Alternative

The No Build Alternative would include only routine maintenance and safety improvements along I-495 and I-270. It would not entail improvements to either route and would result in no property acquisition for right-of-way.

7.2 Build Alternatives

As shown in **Table 7-1**, the Build Alternatives would impact between 284.9 and 337.3 acres of right-of-way from properties adjacent to the existing I-495 and I-270 roadway alignments. Generally, the assumed property acquisition for right-of-way would include acquiring strips of land from undeveloped areas or areas of trees from the edges of properties adjacent to I-495 or I-270. Acquisition of a few larger areas were also assumed for the accommodation of stormwater management facilities. The Build Alternatives would not eliminate existing access or provide new access to impacted properties, as none of these properties are currently accessed directly from I-495 or I-270. Where property relocations are assumed, the principle building is located close to the existing roadway. Roadway widening along I-495 and reconfiguration of interchanges to accommodate the proposed widening would locate the edge of roadway even closer to these properties.

Acquisitions for right-of-way differ under each Build Alternative, with Alternative 5 requiring the least amount of additional right-of-way (Alternative 5 is not a reasonable alternative, but is included in this Chapter for comparison purposes only) and Alternative 10 requiring the most additional right-of-way. Right-of-way impacts for each of the Build Alternatives are summarized below:

Table 7-1: Right-of-Way Needs of the Build Alternatives

	Alternative 5*	Alternatives 8 and 9	Alternative 9M	Alternative 10	Alternativ e 13B	Alternative 13C
Residential Properties Impacted (# of properties)	926	1,127	1,046	1,164	1,105	1,127
Residential Relocations[45] (# of properties)	25	34	25	34	34	34
Business/Other Properties Impacted[46] (# of properties)	314	348	346	354	342	352
Business Relocations (# of properties)	4	4	4	4	4	4
TOTAL Right-of-Way (# of properties)	**1,240**	**1,475**	**1,392**	**1,518**	**1,447**	**1,479**
TOTAL Right-of-Way (acres)	**284.9**	**323.5**	**313.4**	**337.3**	**318.9**	**329.3**

Note: *MDOT SHA and FHWA determined Alternative 5 is not a reasonable alternative, but it is included in Table 7-1 for comparison purposes only.

- **Alternative 5** would result in 25 residential relocations located in Forest Glen and Silver Spring in Montgomery County. This would also include four business/other property relocations: one medical office property located in South Kensington; one warehouse/office property and a small business property located in Four Corners; and one warehouse/office property in Glenarden.
- **Alternatives 8** and **9** would result in 34 residential relocations located in Forest Glen and Silver Spring in Montgomery County. This would also include the same four business/other relocations impacted under Alternative 5.
- **Alternative 9M** would include the same 25 residential relocations and four business relocations impacted under Alternative 5.
- **Alternative 10** would include the same 34 residential relocations and four business relocations impacted under Alternatives 8 and 9.
- **Alternative 13B** would include the same 34 residential relocations and four business relocations impacted under Alternatives 8 and 9.
- **Alternative 13C** would include the same 34 residential relocations and four business relocations impacted under Alternatives 8 and 9.

[45] Property owners affected by relocation would receive relocation assistance in accordance with The Federal Uniform Relocation and Real Estate Acquisition Policies Act of 1970 and amended by the Surface Transportation and Uniform Relocation Assistance Act of 1987 (The Uniform Act).

[46] Other Properties Impacted is equal to the sum of impacted properties with non-residential land use designations, including Commercial/Employment, Industrial, Mixed-use, Park/Open Space, Planned Unit/Planned Community, and Transportation.

8

8 PRELIMINARY COST ESTIMATES

Preliminary capital cost estimates were prepared for the six Build Alternatives in accordance with the MDOT SHA 2017 *Highway Construction Cost Estimating Manual* at a planning level using the major quantities method of estimation. Where available, unit costs provided by MDOT SHA in the March 2018 and July 2019 Common Item Guides were applied to this estimate. Quantities and costs for wetland, stream, parkland, and forest mitigation were estimated based on environmental mitigation costs from previous large MDOT SHA projects, including the ICC and the Woodrow Wilson Bridge. The preliminary cost estimates are in 2019 dollars and include a 25 percent contingency. The recommended range of contingency factors for the planning/concept development phase is 25-40 percent, and 25 percent was selected at the direction of MDOT SHA. The construction costs used in the financial analysis were adjusted to reflect assumed efficiencies in costs for major items such as asphalt pavement and structural materials. The cost estimates for each Alternative are summarized in **Table 8-1**.

Table 8-1: Preliminary Cost Estimates for Build Alternatives

Alternative	Construction & Overhead Cost	Right-of-Way Cost	Total Cost
Alternative 1 (No Build)	$0	$0	$0
Alternative 5*	$8.2 B	$0.28 B	$8.50 B
Alternative 8/9	$9.3 B	$0.32 B	$9.59 B
Alternative 9M	$9.0 B	$0.31 B	$9.36 B
Alternative 10	$9.6 B	$0.34 B	$9.94 B
Alternative 13B	$9.2 B	$0.32 B	$9.55 B
Alternative 13C	$9.3 B	$0.34 B	$9.64 B

Notes: *MDOT SHA and FHWA determined Alternative 5 is not a reasonable alternative, but it is included in Table 8-1 for comparison purposes only.

- The Total costs may not equal the sum of the Construction and Overhead costs and Right-of-Way costs due to rounding.

9

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