MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

MARYLAND STATE HIGHWAY MOBILITY REPORT 2019

2019

MARYLAND STATE HIGHWAY MOBILITY REPORT

Eighth Edition

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MESSAGE FROM THE ACTING ADMINISTRATOR

Connecting Marylanders to life's opportunities is a key part of MDOT's mission. At the Maryland Department of Transportation State Highway Administration (MDOT SHA), we do that through the highway system. Our focus is on people, Maryland citizens, our customers, and making our state accessible to everyone – whether by car, bus, train, tractor trailer, bicycle, or on foot. These various methods of travel must fit together into an overall system that is safe, accessible, reliable and efficient.

MDOT SHA strives to improve the lives of Maryland commuters. The economic vitality of the State, along with the ability to create better opportunities for our citizens, is closely tied to transportation. MDOT SHA understands the direct impact the movement of people and flow of goods has on our citizen's ability to connect to life's opportunities.

As the economy recovers from the COVID-19 pandemic, the performance of our State's transportation system is increasingly important. MDOT SHA faces new challenges and shifting mobility trends each year, creating the need for progressive and cost-effective operations, engineering, and context sensitive design of the transportation system to ensure safety and access for all users. Advancements in technology are changing the way we travel, and this will continue to advance through connected and automated vehicles (CAV). As population increases in Maryland, more drivers access our roadways, and more pedestrians and bicyclists utilize our facilities, MDOT SHA is more determined than ever to deliver the best customer experience and keep Maryland moving forward as safely and reliably as possible.

MDOT SHA uses a combination of policies, programs, and projects to address congestion and reliability challenges for the commuters, business owners, and families who rely on Maryland's transportation network for safe, dependable travel. We are monitoring existing travel trends, identifying accomplishments, challenges, and establishing long-term strategies for improvement, relevance and organizational excellence. **The 2019 Maryland Mobility Report will address performance and mobility trends from 2018, compare the results to past performance, highlight successes, and address key areas requiring improvement.**

MDOT SHA continues to look for unique solutions to respond to increased traffic and mobility issues. The Traffic Relief Plan (TRP) for I-270 and I-495 near the American Legion Bridge will bring private funding to alleviate congestion in several of the most congested segments in Maryland. Other innovations include Transportation Systems Management and Operations (TSMO) solutions such as Smart Traffic Signals along selected corridors that respond to the changing traffic volume demands in real time. SMART signals and more standard reconfigurations of roadway segments have saved drivers approximately 1 million hours delayed in traffic on annual basis. Funding for pedestrian and bicycle projects are made available through several programs and these modes are incorporated as part of other transportation projects. Our "Context Driven: Access and Mobility for All Users" guide will help ensure implemented solutions are appropriate for the surrounding land-use context. In FY 2019, the MDOT SHA managed 470 active

construction projects valued at $3.6 billion and are advancing another 48 advertised projects, totaling 518 projects at $4.2 billion.

MDOT SHA continues to focus on our customers' experiences, with the belief that those experiences are the most important measurement of our success. By assessing our progress and implementing efficient transportation solutions based on data-driven methodologies and customer experience, we will continue to be a leader in transportation performance and define new ways to improve safety, increase mobility, and drive consistent change.

Tim Smith, P.E.
Acting Administrator

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EXECUTIVE SUMMARY

The Maryland Department of Transportation State Highway Administration (MDOT SHA) has established goals to deliver a safe, sustainable, intelligent, and exceptional transportation solutions with a focus on customer service providing the millions of motorists the mobility they desire. This is accomplished through policies, programs and projects that provide for a performance based approach to address transportation issues by focusing on everyday congestion and non-standard events. The 2019 Maryland Mobility Report summarizes the successes, challenges and strategies for the calendar year 2018 system performance.

Mobility and Reliability Trends

Mobility and reliability are often directly related to the number of vehicles on a section of roadway. Higher traffic volumes usually mean more congested conditions. The following is a summary of mobility and reliability trends on the Maryland highway system in 2018.

Vehicle Miles of Travel (VMT) [1]:

- Travel along Maryland's roadways slightly decreased in 2018 versus 2017. The number of vehicle miles of travel (VMT) on its roadway systems amounted to approximately 59.6 billion miles in 2018 which is a 0.4% decrease over 2017 from 59.9 billion miles. Both MDOT and locally managed roadways showed a decrease in VMT between 2018 and 2017.
- Approximately 72% of the statewide VMT occurred on MDOT managed roadways.
- The largest increase in VMT occurred in Howard and Prince George's Counties with each growing by approximately 40 million VMT. The VMT along Montgomery County roads decreased by over 100 million, but is still the 3rd highest County in terms of VMT in Maryland.

Average Daily Traffic (ADT)[2]:

The highest volume roadway locations include:

HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) FREEWAY/EXPRESSWAY SECTIONS		
ROUTE	**LIMITS**	**2018 AADT (THOUSANDS)**
I-270	I-270 Split to MD 117	228-266
I-495	I-270 East Spur to I-95	212-252
I-495	Virginia State Line to I-270 West Spur	228-251
I-95/I-495	MD 4 to I-95	212-251
I-695	I-70 to I-795	189-220

1 - See definition pg. 12
2 - See definition pg. 15

HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) ARTERIAL SECTIONS		
ROUTE	LIMITS	2018 AADT (THOUSANDS)
US 301	Charles County Line to MD 5	103
MD 3	US 50/301 to I-97/MD 32	73-81
MD 5	US 301 to MD 223	65-81
MD 210	Ft. Washington Road to I-95/ I-495	72-80
MD 650	MD 212 to Mahan Rd	57-80

Freeways

- Vehicle probe speed data analysis identified that heavy to severe congested conditions occurred on 10% (155 miles) of the freeway/expressway network in the AM peak hour. Motorists on 16% (262 miles) of the network experienced heavy to severe congested conditions in PM peak hour. There was a slight increase in the number of miles versus 2017 levels and a 1% increase in both the AM and PM peak hours.
- The sections of roadways with higher volumes and greater VMT on the freeway/expressway system, experience greater congestion which is reflected in 19% of the AM peak hour and 29% of the PM peak hour VMT occurred in congested conditions. This remained flat in comparison to 2018 in both the AM and PM peak hours.
- The worst congestion for any particular freeway/ expressway in the AM peak hour was along I-695 Outer Loop (11 miles) and in the PM peak hour along I-495 Inner Loop (14 miles).
- The cost of congestion to travelers on Maryland freeway/expressway system amounted to approximately $2.73 billion dollars annually. This is a decrease of approximately $147 million over 2017 levels.

Arterials

- Motorists on approximately 12% (71 miles) of the selected arterial system experience heavy to severe congested conditions in the AM peak hour and 26% (155 miles) in the PM peak hour. This is a 2 mile decrease in the morning and a 5 mile decrease in the afternoon in 2018 compared to 2017.
- Total congestion costs for freeways/expressways and arterials are estimated to be $3.97 billion.

Intersections

- A failing level of service (LOS F) occurred at thirty-two (32) state highway intersections based on traffic count data from the last three years. This included six intersections that failed in both the AM and PM peak hours.

The most congested freeway/expressway and arterial corridor sections for the AM and PM peak hours are as follows:

2018 MOST CONGESTED FREEWAYS/EXPRESSWAY SECTIONS (AVERAGE WEEKDAY)	
AM Peak Hour (8-9 AM)	**PM Peak Hour (5-6 PM)**
I-495 Outer Loop - I-95 to MD 97	I-495 Inner Loop - Virginia State Line to I-270 West Spur
I-695 Outer Loop - US 1 to Cromwell Bridge Rd	I-695 Inner Loop - MD 139 to Cromwell Bridge Rd
US 50 Westbound - MD 410 to Washington DC Line	I-95/I-495 Inner Loop - I-95 to MD 201
I-695 Outer Loop - MD 129 to US 40	I-495 Inner Loop - I-270 East Spur to MD 97
I-695 Inner Loop - MD 140 to I-83	I-695 Inner Loop – I-95 to I-70
MD 295 Southbound - MD 198 to MD 197	I-95/I-495 Outer Loop- MD 450 to MD 201
I-95/I-495 Inner Loop - MD 414 to I-295	MD 295 Northbound – MD 410 to Powder Mill Rd
I-270 Southbound - I-370 to Montrose Rd	I-270 West Spur Northbound - I-270 Split to I-495
I-270 (Local) Southbound - I-370 to Montrose Rd	I-270 Northbound - I-370 to MD 124
I-270 Southbound – Father Hurley Blvd to MD 124	I-495 Outer Loop – I-270 West Spur to Virginia State Line

2018 MOST CONGESTED ARTERIAL SECTIONS (AVERAGE WEEKDAY)	
AM Peak Hour (8-9 AM)	**PM Peak Hour (5-6 PM)**
MD 32 Eastbound – Triadelphia Rd to MD 108	MD 5 Southbound - MD 223 to US 301
US 29 Southbound – MD 650 to MD 193	MD 3 Southbound – I-97/MD 32 to St. Stephens Church Rd
MD 210 Northbound - Fort Washington Rd to Livingston Rd/ Kerby Hill Rd	MD 152 Northbound – I-95 Ramps to Old Joppa Rd
MD 185 Southbound – I-495 Ramps to MD 191	MD 198 Eastbound – MD 295 to MD 32
MD 97 Southbound – Stone Rd to Magna Way	MD 210 Southbound – Livingston Rd (North) to Kerby Hill Rd/ Livingston Rd (South)
MD 28 Westbound - MD 97 to MD 586	MD 2 Northbound – College Pkwy to Robinson Rd/Leelyn Rd
MD 4 Southbound – Forestville Rd to Dower House Rd	MD 3 Northbound – US 301 to MD 424
MD 3 Southbound - I-97/MD 32 to St Stephens Church Rd	MD 424 Northbound – US 50 to MD 450
MD 2 Southbound – College Pkwy to US 50	MD 185 Northbound – Washington DC Line to I-495 Ramps
MD 586 Westbound – Aspen Hill Rd to MD 355	MD 178 Northbound – Old Generals Highway to I-97

Congestion Reduction Accomplishments

In 2018, MDOT SHA addressed congestion and improved mobility through various policies, programs, and projects. These projects and programs provide benefits for motorists and multi-modal users to yield a safe and modern transportation system. The combined efforts resulted in more than $1.5 billion of annual user savings. User cost savings is achieved by a reduction in delay, fuel consumption and emissions.

2018 USER SAVINGS DUE TO MDOT CONGESTION MANAGEMENT	
CHART	$1,310 Million
Signals	$33 Million
Capital Projects	$110 Million
Park and Ride Program	$54 Million
Total	**$ 1,507 Million**

A summary of the accomplishments associated with these efforts to improve mobility include:

CHART

- The Coordinated Highways Action Response Team (CHART) program efforts included clearing more than 35,000 incidents and assisting approximately 45,000 stranded motorists on Maryland roadways.

- CHART's commitment to improve mobility, reliability, and safety has resulted in a reduction of an estimated 32.8 million vehicle hours of delay amounting to approximately $1,310 million in user savings.

Signals

- Traffic signal timings were reviewed for 146 signals in 18 systems plus 52 other intersections. The retiming of traffic signals resulted in $33 million annual user savings that will continue to provide recurring benefits in the future years.

- A major investment has been made to upgrade arterial corridors through the use of Smart Traffic Signals which are adaptive to real time traffic conditions. The Smart Signal systems have been implemented in seven systems including along sections of MD 2 in Anne Arundel County, MD 139 and US 40 in Baltimore County, US 1 Business/ MD 24 in Harford County, US 1/MD 175 in Howard County and MD 198 and US 301 in Prince George's County.

Capital Projects

- In 2018, several mobility projects were completed. This included projects at the intersections of MD 147 @ Glen Arm Rd/Mt Vista Rd, MD 213 @ Frenchtown Rd, MD 281 @ Muddy Ln, MD 97 @ Burntwoods Road, MD 234 @MD 242, MD 413 @ Tulls Corner Rd and the realignment of the MD 482 intersections with Gorsuch Rd and Cape Horn Rd.

- Roadway widening projects were completed along US 113 from north of Massey Branch to Five Mile Branch Rd, MD 22 between MD 132 an MD 462 and along US 50/301 eastbound over the Severn River Bridge.

- A new interchange was completed at US 15 and Monocacy Blvd.

- The Maryland Transportation Authority completed the widening of I-95 from the Ft. McHenry Tunnel to the existing Express Toll Lanes.

- These completed projects result in an annual user savings of $110 million.

- Several mobility improvement projects are under construction including the widening of I-695 from US 40 to MD 144, the widening of MD 32 and the I-270 Innovative Congestion Management Project. The I-270 project provides for active travel demand management which includes such features as ramp metering.

- Governor Hogan announced the commencement of a Traffic Relief Plan to improve I-270 and I-495 from I-270 to American Legion Bridge as part of a P3 project that would add express toll lanes to these facilities.

Improved Mobility Accomplishments

- Several pedestrian and bicycle projects were completed either as stand-alone construction or as part of MDOT SHA's Complete Streets Policy. This includes construction of approximately nine miles of new sidewalks and 31 miles of marked bicycle lanes. Approximately twelve miles of the marked bike lanes were completed within three miles of transit stations. Statewide more than 69% of the sidewalks are ADA compliant. In addition, the Maryland Bicycle and Pedestrian Plan 2019 Update was completed which identified methods to improve access and safety to all users.

- Approximately 6,800 commuters on an average weekday utilize a MDOT SHA or MDOT MDTA park and ride lot to connect to transit or ride with other commuters. These 106 lots are operated in 20 counties. This provided an annual user savings of $54 million.

- The I-270 and US 50 corridors provide for high occupancy vehicle (HOV) lanes to encourage ridesharing and increased person throughput. The I-270 HOV lanes provide as much as 14 minutes in the morning and 23 minutes in the evening in travel time savings. Person throughput along a corridor is substantially increased with a HOV lane accommodating over 600 additional people compared to a non-HOV lane.

Freight Movement

- In 2018, construction was completed on four new virtual weigh stations increasing the total number to 16 active sites.

- The design is underway to provide up to ten additional truck parking spaces on I-70 eastbound and westbound Welcome Centers at South Mountain and planning studies are on-going to expand the I-95/I-495 site.

- Two at-grade railroad crossings were improved to increase safety.

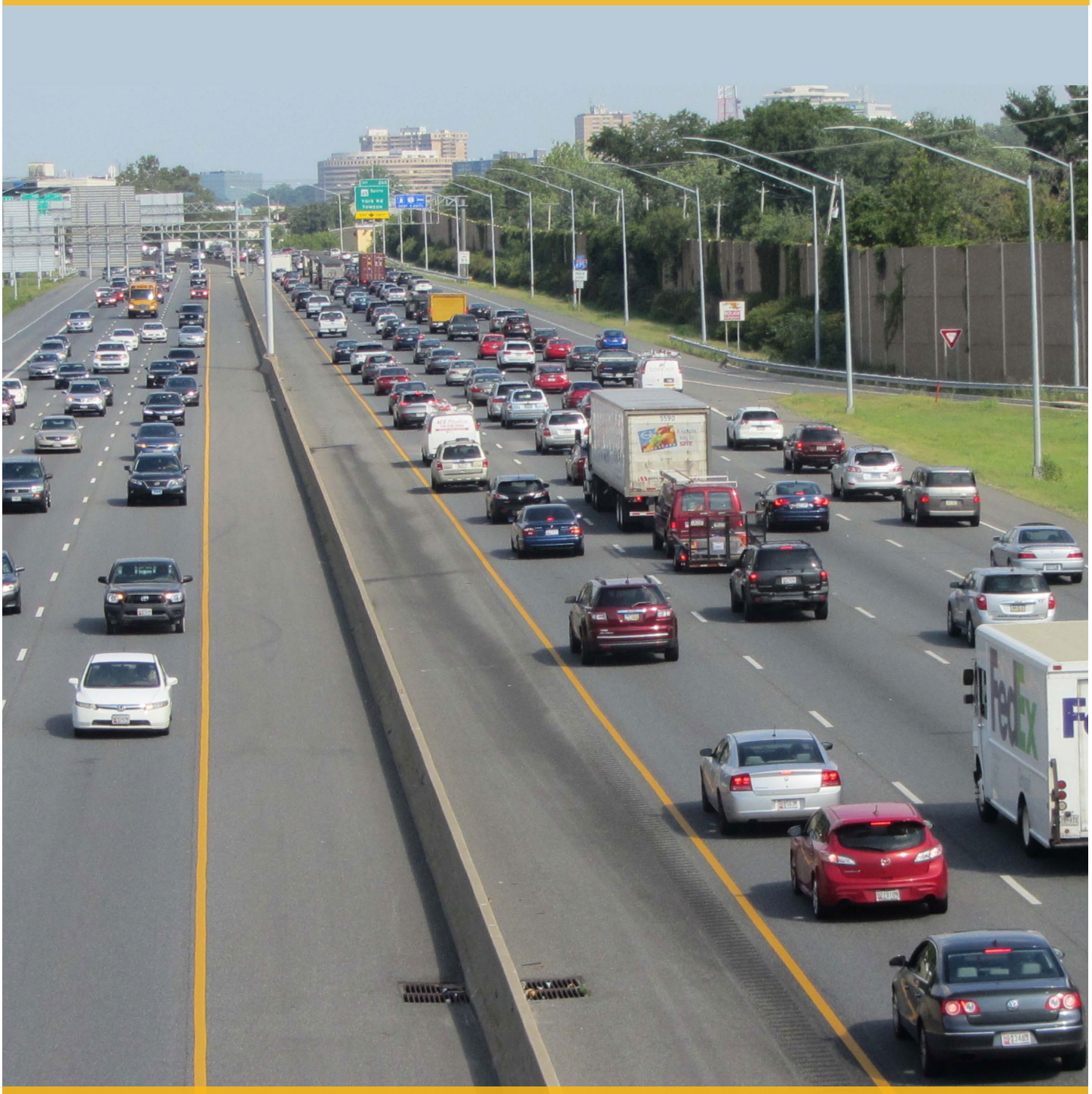
- Various other commercial vehicle initiatives included expediting the processing of permits through the One Hauling Permit System, evaluating methods to improve overnight truck parking including surveying truckers, establishing the National Highway Freight Network, the Critical Urban and Rural Freight Corridors and the Maryland Multi-Modal Freight Network, implementation of the Maryland Strategic Goods Movement Plan and updating of the Maryland Freight Story Map and Advanced Data Viewer.

Transportation Systems Management and Operations (TSMO)

- Various TSMO initiatives advanced from a planning, design and construction standpoint. A TSMO Master Plan was established and various policies and guidance were developed. Studies included analyzing 230 miles of corridors to develop TSMO recommendations for implementation. On-going projects include the SMART (adaptive) signals along various arterial corridors, I-270 Innovation Congestion Management Plan, the I-270/I-495 Traffic Relief Plan and the planning and design for the I-695 hard shoulder running project.

- Connected and Automated Vehicle (CAV) initiatives are taking place to support innovative Maryland deployment efforts. Along a corridor of US 1, "connected" devices are being incorporated in an effort to test Vehicle-to-Infrastructure (V2I) benefits. Meanwhile, internal teams are creating planning tools, generating training materials, and producing outreach initiatives to progress on a 26-part CAV Strategic Action Plan.

MARYLAND MOBILITY STATISTICS



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INTRODUCTION

The 2019 Maryland Mobility Report provides a comprehensive review of performance and mobility trends in calendar year 2018 including accomplishments. This report follows a general theme of "What is Happening" and "What is MDOT SHA Doing" and "What are the Outcomes". Actions taken in 2019 to address 2018 conditions may be discussed herein. The Maryland Mobility Report is released annually by Maryland Department of Transportation State Highway Administration (MDOT SHA) illustrating:

- The agency's data driven methodologies to identify and address congestion issues;
- Transportation investments for a safe, efficient and reliable movement of goods and services; and
- Processes to monitor existing travel trends, identifying successes, challenges and strategies to improve the transportation services.

Highlights of the 2019 Maryland Mobility Report include:

- Traffic volume trends;
- Pedestrian and bicycle projects and programs;
- Roadway and freight characteristics;
- Most congested freeway/expressway sections;
- Most congested arterial sections;
- Overall freeway/expressway and arterial performance comparisons;
- Projects completed in 2018 and their benefits;
- Programs to address mobility and their results (these may include activities announced in 2019); and
- Transportation Systems Management and Operations (TSMO) and Connected and Automated Vehicles (CAV) activities.

The Maryland Mobility Report is a joint effort of the MDOT SHA's Office of Preliminary Planning and Engineering (OPPE) and the Office of CHART and ITS Development.

Transportation Infrastructure

Maryland supports mobility throughout the State with a wide range of transportation options including mass transit service through subways, commuter rail, light rail, and buses operated by MDOT Maryland Transit Administration (MDOT MTA), Washington Metropolitan Area Transit Authority and local transit operators. Maryland transportation infrastructure consists of bicycle and walking facilities including a series of off road trails such as the Chesapeake and Ohio Canal Towpath to sidewalks or bike paths along its highways. Heavy rail passengers are served by the Amtrak Northeast Corridor with major stops in Baltimore at Penn Station and BWI Thurgood Marshall Airport. By air, 27 million annual passengers arrive/ depart at Baltimore – Washington Thurgood Marshall Airport. The Maryland Transportation network include the Helen Delich Bentley Port of Baltimore, which handles the 9th largest amount of international cargo and 218,000 persons in 2018 departed on cruise lines. The MDOT State Highway Administration provides infrastructure that supports all modes of transportation across the state, including automobiles, mass transit, airplanes, trains, ships, bikes and pedestrians (Figure 1).

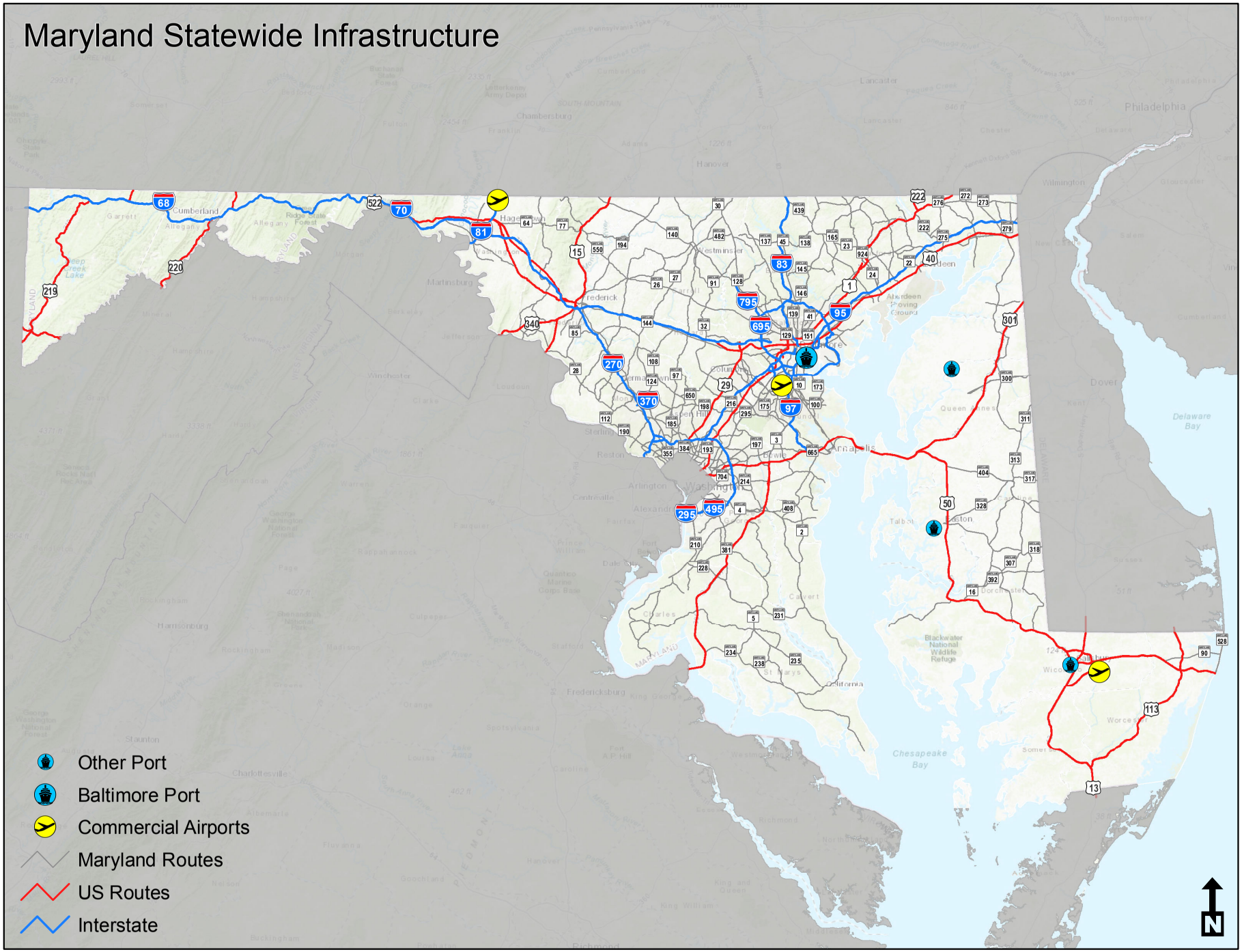
Roadways

A major portion of the roadway facilities are operated by the Maryland Department of Transportation (MDOT). The MDOT SHA maintains interstates, US routes and numbered Maryland routes with the exception of interstate and routes through Baltimore City and portions maintained by Maryland Transportation Authority (MDTA) which operates all toll facilities. Roadways are based on a functional classification which identifies the roads primary travel needs whether it be access or mobility. The functional classification of the roadways ranges from freeways to local streets (Table 1).

Table 1

ROADWAY FUNCTIONAL CLASSIFICATION	
CLASSIFICATION	FUNCTION
Freeway/Expressways	Controlled access facilities with limited points of ingress/egress. These facilities are designed for long distance travel at higher speeds.
Arterials	Highest functioning road normally with traffic signals. There roadways serve as interconnection between major corridors and are utilized for longer distance trips.
Collectors	Gathers traffic from local roads and funnels to arterial system. Serves both land access and traffic circulation.
Locals	Provides direct access to adjacent land use and do not carry through traffic.

Figure 1


Maryland Statewide Infrastructure
Other Port
Baltimore Port
Commercial Airports
Maryland Routes
US Routes
Interstate
N

MDOT is responsible for roadways that are the highest function. Despite having the lowest number of roadway miles, the facilities that MDOT SHA maintains have the highest number of lanes (Table 2). Therefore, most of these roadways carry the highest traffic volumes and present the most issues from a congestion and mobility standpoint.

Table 2

MILEAGE STATISTICS					
ROAD TYPE	ROADWAY MILES	PERCENTAGE OF ROADWAY MILES	LANE MILES[1]	AVERAGE NUMBER OF LANES/MILE	OWNERSHIP
Interstate Routes	488	2%	2,851	5.8	MDOT, MDTA, Baltimore City
US Routes	759	2%	2,689	3.5	MDOT, Baltimore City
Maryland Routes	4,189	13%	10,567	2.5	MDOT
Other Roadways	25,797	83%	52,690	2.0	Counties, Municipalities

1- Lane Miles = Roadway Miles x Number of Lanes

Roadways are analyzed to determine traffic operations. The operations are graded from level of service (LOS) 'A' to 'F' with 'A' being the best and 'F' being the worst (Table 3). For purposes of this report, the intersection analysis is conducted via the critical lane analysis technique.

Table 3

INTERSECTION LEVEL OF SERVICE DEFINITION	
LEVEL OF SERVICE	DESCRIPTION
A	Minimal delays
B	Low level of delay and queuing
C	Delays and queues are constant
D	Moderate delays and queues but motorist clear in one green indication
E	Long queues and delays with some motorist having to wait more than one green indication
F	Most motorists having to wait more than one green indication

In addition for locations where LOS 'F' conditions exist, a further measure is developed to determine a more in-depth appraisal of operations. This is the volume/capacity ratio which represents the critical lane volume divided by the capacity which is considered to be 1,600.

Major Structures - Bridges and Tunnels

Bridges and tunnels provide for the valuable connection over/under waterways, around rail, or across other highways. Bridges are owned by many different agencies with MDOT SHA responsible for the highest number of bridges (Table 4 and Figure 2). MDTA maintains two tunnels in Maryland.

MARYLAND'S MOST DISTINCTIVE BRIDGES AND TUNNELS

American Legion Bridge (I-495)

Fort McHenry Tunnel (I-95)

Harbor Tunnel (I-895)

Harry Nice Bridge (US 301)

Hatem Bridge (US 40)

Key Bridge (MD 695)

Thomas Johnson Memorial Bridge (MD 4)

Tydings Memorial Bridge (I-95)

William Preston Lane Memorial (Bay) Bridge (US 50/301)

Woodrow Wilson Memorial Bridge (I-95/I-495)

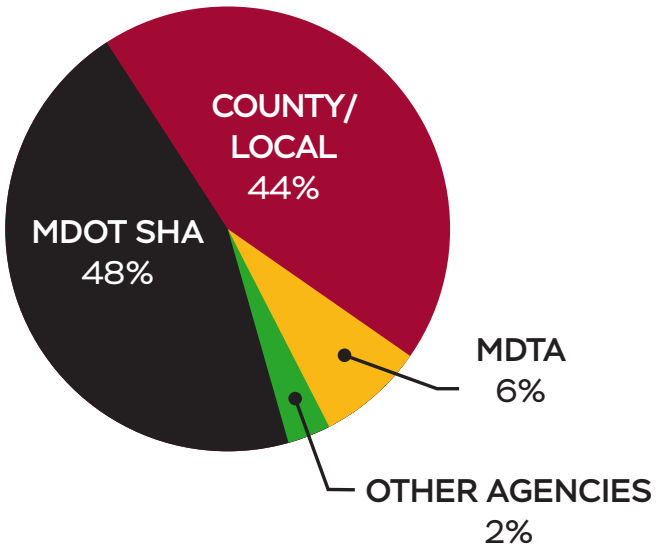
Table 4

MARYLAND BRIDGES BY OWNERSHIP

OWNER	NUMBER OF BRIDGES
MDOT SHA	2,546
County/Local	2,353
MDOT MDTA	322
Other Agencies	136

Figure 2

BRIDGE OWNERSHIP BY AGENCY



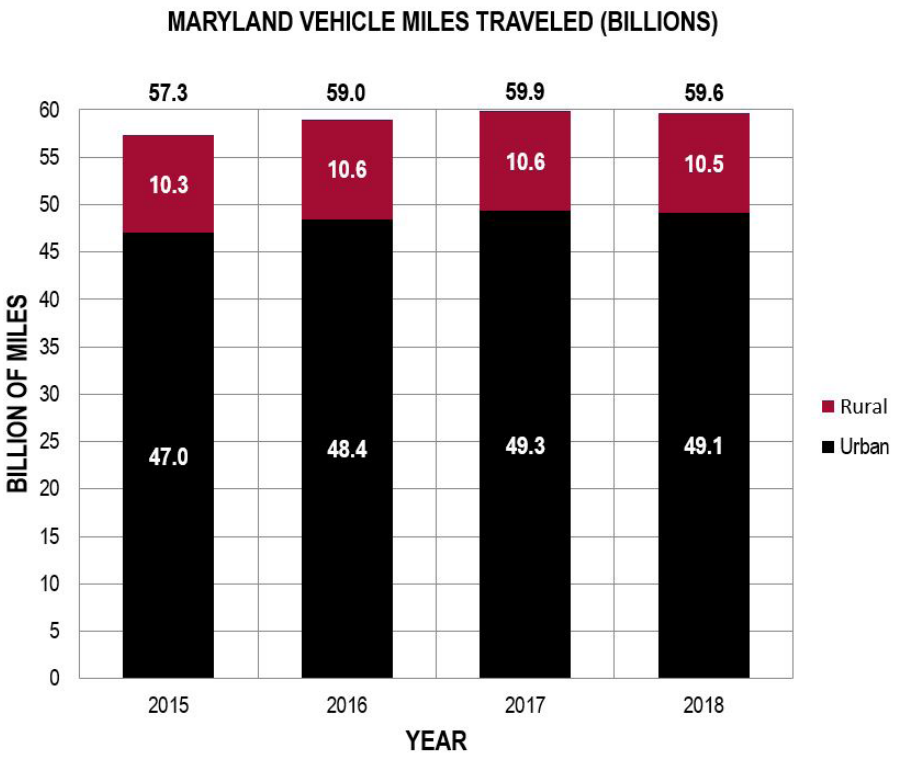
Traffic Trends

A standard performance measure to evaluate overall roadway usage is Vehicle Miles Traveled (VMT). VMT is defined as the number of vehicles times the distance traversed along the system and is calculated for various roadway classifications on a local, regional, state, and national level. A comparison of VMT allows for a method to track growth and demands on different roadways.

Vehicle Miles Traveled - Total/Urban/Rural

After three straight years of VMT increases, 2018 showed a slight decrease compared to 2017. This amounted to 0.3 billion VMT decrease occurring in both the rural and urban areas (Figure 3).

Figure 3



VMT decreased by 0.4% between 2017 and 2018 to 59.6 billion.

Vehicle Miles Traveled - By Agency and Facility Type

The amount of VMT along MDOT SHA and MDTA roadways far exceeds travel along other locally owned roadways. Despite MDOT SHA and MDTA roadways accounting for 17% of the lane miles, 72% of the VMT occurs on these roadways (Figure 4 and Table 5). The Maryland numbered routes account for the highest amount of VMT with close to 20 billion miles (Figure 5 and Table 6).

Table 5

VMT BY AGENCY	
AGENCY	VMT (BILLIONS)
MDOT SHA	39,156
County/Local/Others	16,874
MDOT MDTA	3,599

Table 6

VMT BY ROADWAY CLASSIFICATION	
ROADWAY DESIGNATION	VMT (BILLIONS)
Maryland Routes	19,705
Interstates Routes	14,960
County/Local/Others	17,989
US Routes	6,975

Figure 4

VMT BY AGENCY

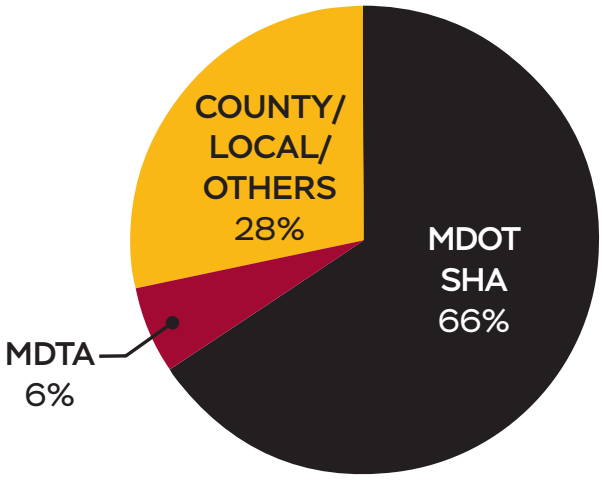
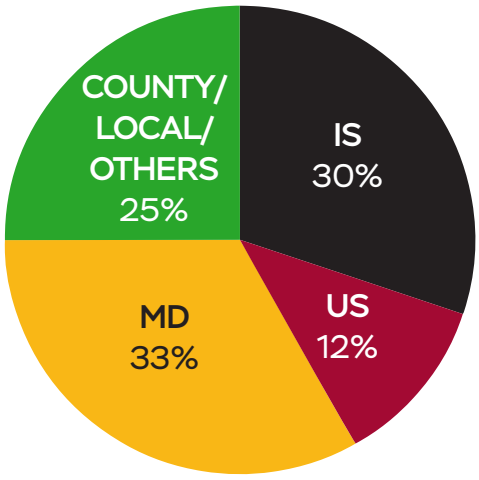


Figure 5

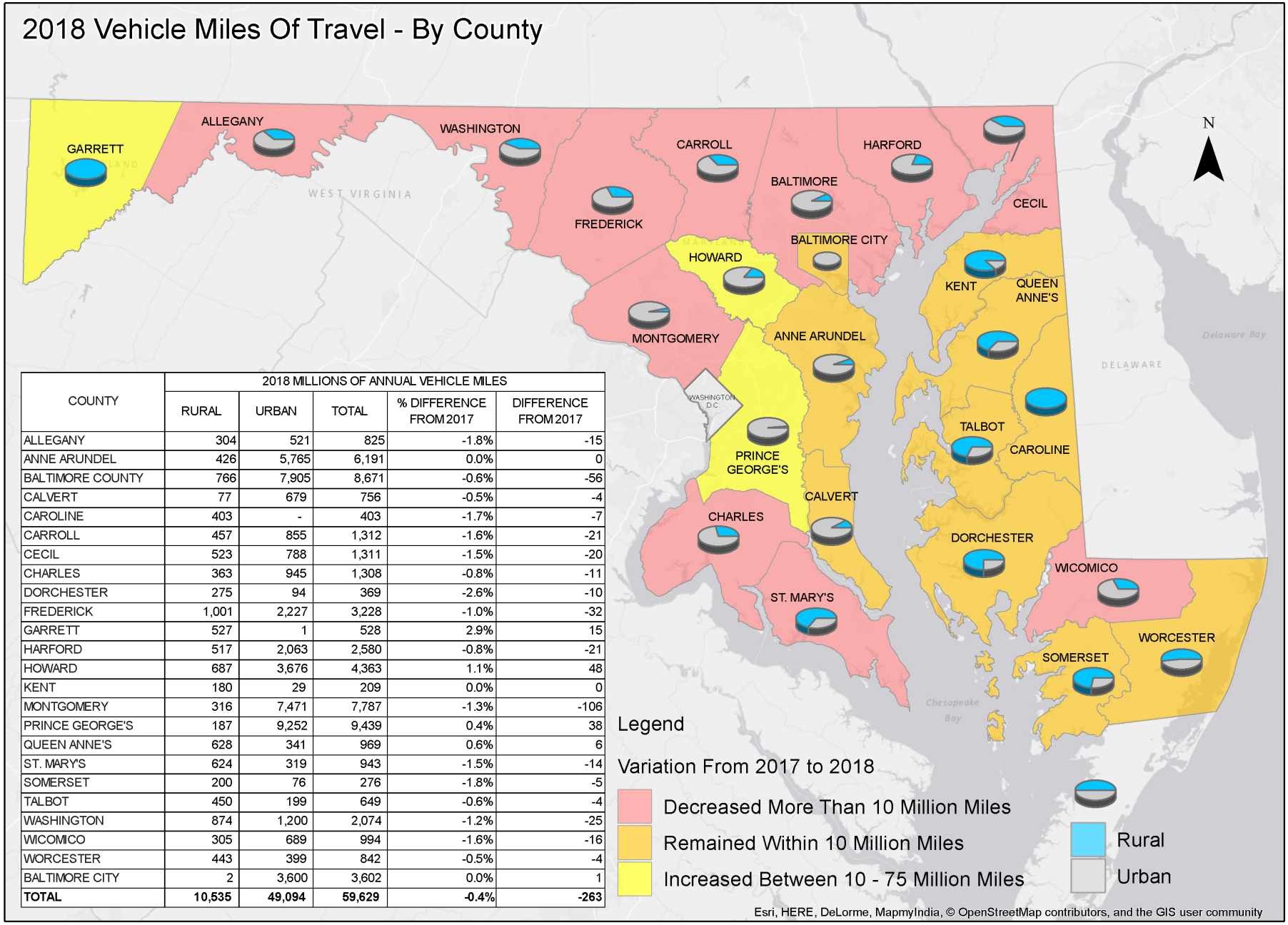
VMT BY ROADWAY CLASSIFICATION



Vehicle Miles Traveled - By County

VMT was computed on a countywide basis. Garrett County had the largest percentage increase and Dorchester County experienced the largest decrease (Figure 6). The reason for the high percentage change in VMT in these counties is due to the relatively low volumes where small changes make for high percentage changes.

Figure 6



COUNTY	2018 MILLIONS OF ANNUAL VEHICLE MILES				
	RURAL	URBAN	TOTAL	% DIFFERENCE FROM 2017	DIFFERENCE FROM 2017
ALLEGANY	304	521	825	-1.8%	-15
ANNE ARUNDEL	426	5,765	6,191	0.0%	0
BALTIMORE COUNTY	766	7,905	8,671	-0.6%	-56
CALVERT	77	679	756	-0.5%	-4
CAROLINE	403	-	403	-1.7%	-7
CARROLL	457	855	1,312	-1.6%	-21
CECIL	523	788	1,311	-1.5%	-20
CHARLES	363	945	1,308	-0.8%	-11
DORCHESTER	275	94	369	-2.6%	-10
FREDERICK	1,001	2,227	3,228	-1.0%	-32
GARRETT	527	1	528	2.9%	15
HARFORD	517	2,063	2,580	-0.8%	-21
HOWARD	687	3,676	4,363	1.1%	48
KENT	180	29	209	0.0%	0
MONTGOMERY	316	7,471	7,787	-1.3%	-106
PRINCE GEORGE'S	187	9,252	9,439	0.4%	38
QUEEN ANNE'S	628	341	969	0.6%	6
ST. MARY'S	624	319	943	-1.5%	-14
SOMERSET	200	76	276	-1.8%	-5
TALBOT	450	199	649	-0.6%	-4
WASHINGTON	874	1,200	2,074	-1.2%	-25
WICOMICO	305	689	994	-1.6%	-16
WORCESTER	443	399	842	-0.5%	-4
BALTIMORE CITY	2	3,600	3,602	0.0%	1
TOTAL	**10,535**	**49,094**	**59,629**	**-0.4%**	**-263**

Annual Average Daily Traffic (AADT)

The MDOT SHA determines the traffic volumes along the roadways through its traffic data collection program. The data is collected with equipment and personnel at numerous sections of roadway. Annual average daily traffic (AADT) measures the volume of traffic each day divided by the number of days in a year. The highest volumes along freeways, arterials and toll facility crossings range to upwards of 265,000 vehicles per day (Table 7).

Table 7

HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) VOLUMES (VEHICLES PER DAY)	
FREEWAY SECTION	2018 AADT
I-270 N of I-270 Split	266,000
I-270 N of Montrose Rd	254,000
I-495 E of MD 650	252,000
I-495 N of Virginia State Line	251,000
I-95/I-495 W of US 1	251,000
ARTERIAL SECTION	2018 AADT
US 301/MD 5 S of McKendree Rd	103,000
MD 5 S of MD 223	81,000
MD 3 N of Prince George's County Line	81,000
MD 3 N of MD 424	80,000
MD 650 S of I-495	80,000
MDTA TOLL FACILITY CROSSINGS	2018 AADT
I-95 Ft. McHenry Tunnel	126,000
I-95 Tydings Bridge	85,000
I-895 Harbor Tunnel	74,000
US 50/301 Bay Bridge	74,000

Trajectory Data

Trajectory analytics uses data generated from mobile navigation applications on vehicles to determine origin-destination and routing patterns. This big data allows for a much larger sample size, more detailed information and better understanding of trip patterns. Previously, usually only one day samples were conducted and were assumed to represent the traffic for the entire year. Origin-destinations patterns were determined through license plate studies which were often very difficult to measure on high speed facilities, or through the use of computer forecasting models. Now with big data this information can be determined on a large scale basis, such as an entire County, or be performed for a selected roadway segment. The data can be broken down by vehicle classification (i.e. type of truck, car, bus), day of week and time of day.

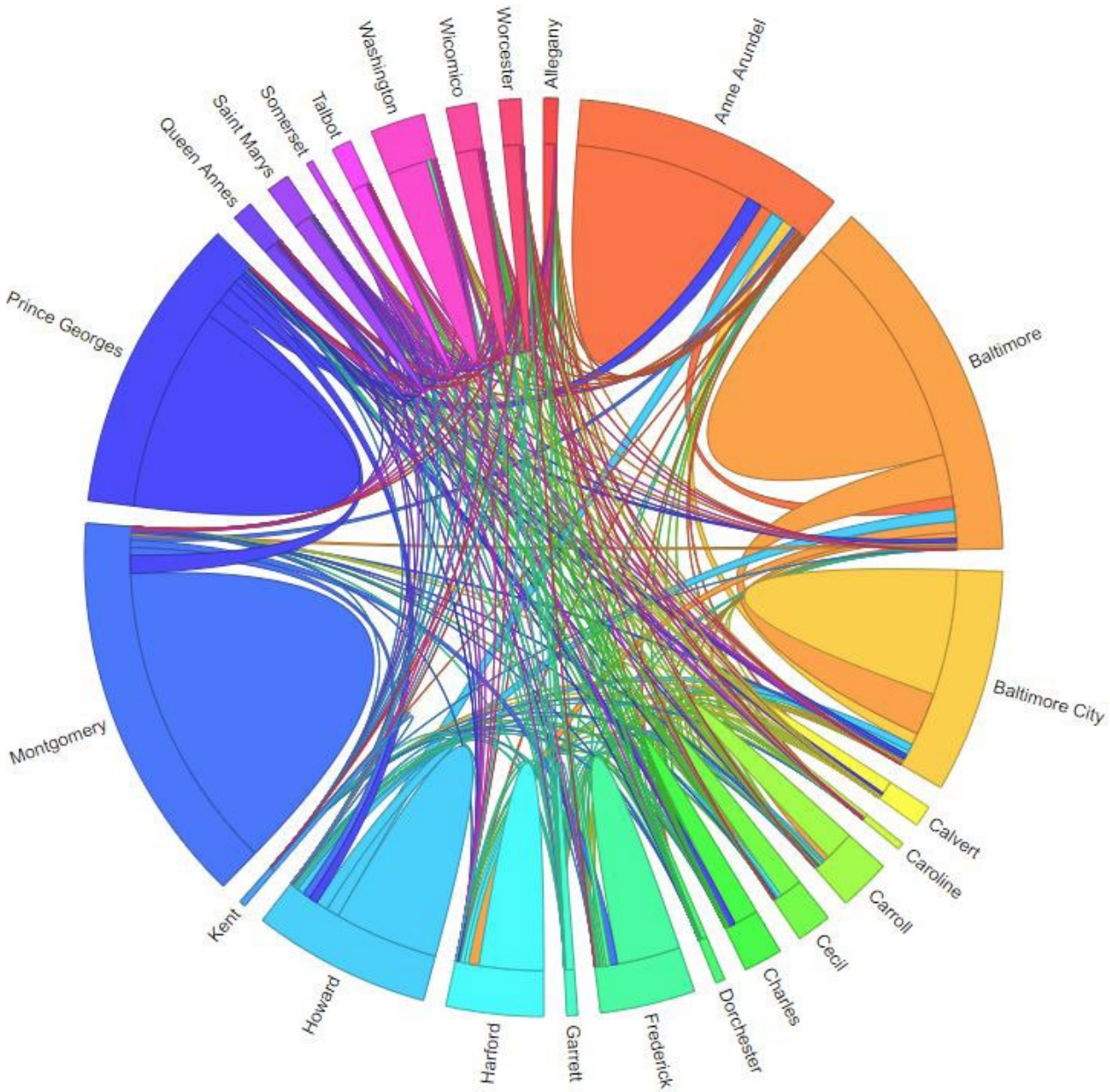
The analysis of this data for Maryland and Washington DC shows that Intercity/Intercounty (origin and destination both within the same County/City) are the highest percentage of trips. For example, trips beginning and ending in Montgomery County represent the highest percentage of trips statewide. The highest locations of Intracounty/Intracity trips occur in the Baltimore-Washington region (Table 8 and Figure 7).

Table 8

STATEWIDE MOST POPULAR COUNTY TRIP PATTERNS *(DOES NOT INCLUDE TRIPS THAT OCCUR WITHIN THE SAME COUNTY)*	
1) Baltimore County to & from Baltimore City	6) Anne Arundel County to & from Baltimore County
2) Prince George's County to & from Washington DC	7) Anne Arundel County to & from Howard County
3) Montgomery County to & from Washington DC	8) Anne Arundel County to & from Baltimore City
4) Montgomery County to & from Prince George's County	9) Baltimore County to & from Howard County
5) Anne Arundel County to & from Prince George's County	10) Baltimore County to & from Harford County

Figure 7

CHORD DIAGRAM OF TRIPS IN MARYLAND AND WASHINGTON DC



Source: RITIS

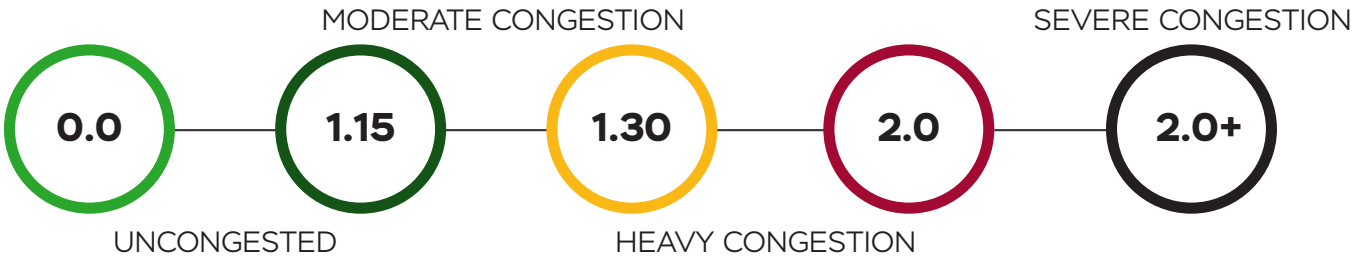
Congestion Trends

There are two types of congestion. The first type is called recurring congestion, which occurs everyday in the morning (AM) and afternoon (PM) peak periods. This type of congestion is influenced by high automobile and truck traffic volumes, narrow lane and shoulder widths and geometrics of the roadway. Freeway/expressway operations are also influenced by area where traffic enters and exits the roadway. Among other major roadways termed as arterials motorist confront delays at traffic signals, due to geometrics and different speeds of motorists. The second type is called non-recurring congestion which occurs during incidents including crashes, vehicle breakdowns, work zones, inclement weather that causes motorists to experience slowing or stop and go traffic conditions.

One way to measure congestion is through the use of vehicle probe data. Probes are vehicles equipped with sensors or GPS integrated into vehicles that transmit real time data. The analysis of this data provides an evaluation of mobility. Vehicle probe speed datasets are available from a variety of sources on a minute by minute basis. The data is provided by INRIX, a company that collects traffic speed data from an estimated 100 million probe vehicles nationwide including commercial vehicle fleets. In addition, MDOT SHA collects traffic volume data on its roadways that is used for analysis. The University of Maryland Center for Advanced Transportation Technology (UMD CATT) uses the vehicle probe data speed and traffic volume data to develop metrics to measure congestion and reliability.

Figure 8

METRIC: MEASUREMENT OF CONGESTION (TRAVEL TIME INDEX)



VEHICLE PROBE DATA ANALYSIS CONSISTS OF:

FREEWAY/ EXPRESSWAY SYSTEM

1,657 Directional Miles Statewide

ARTERIAL SYSTEM

589 Directional Miles Statewide

A primary measure of congestion is the Travel Time Index (TTI). The TTI compares the 50th percentile travel time on a segment of roadway for a particular hour to the travel time of a trip during the off-peak (off-peak is considered when free flow or uncongested conditions exist). The higher the TTI the longer the travel time.

Congestion Measures

Statewide congestion is measured by various metrics for the morning AM peak hour (8:00 AM-9:00 AM) and for the afternoon PM peak hour (5:00 PM-6:00 PM) which represents the two worst hours of congestion. The first metric is number of roadway miles on the Freeway/Expressway or major arterial system that operate with heavy or severe congestion. The next measure takes into account how many motorists and the distance they travel in the worse conditions or the percent of VMT that experienced heavy to severe congestion (Table 9 and 10).

As seen in Table 9, a slight increase occurred in the number of miles in both the AM and PM peak hours that experienced the worst levels of congestion on the freeway/expressway system. The statewide arterial system saw a slight improvement in operations from 2017 to 2018.

Table 9

STATEWIDE FREEWAY/EXPRESSWAY SYSTEM
(AVERAGE WEEKDAY AM & PM PEAK HOUR HEAVY TO SEVERE CONGESTION SUMMARY)

HEAVY TO SEVERE CONGESTION	2016		2017		2018		CHANGE FROM 2017 TO 2018	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Roadway Miles	148	246	151	254	155	262	+4	+8
Percent of Roadway Miles	9	15	9	15	10	16	+1	+1
Percent of Peak Hour VMT Impacted	17	26	19	29	19	29	0	0

Table 10

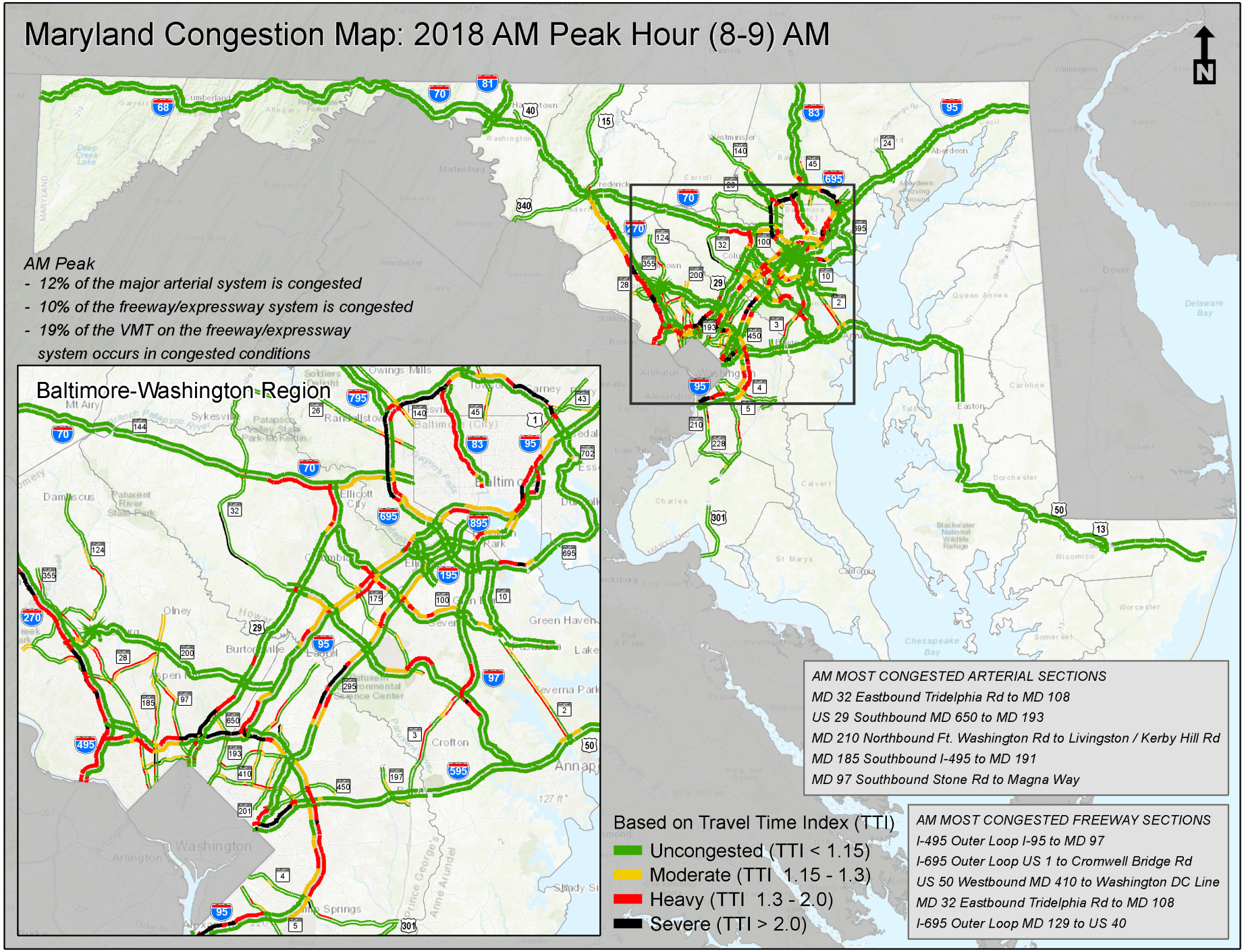
STATEWIDE MAJOR ARTERIAL SYSTEM
(AVERAGE WEEKDAY AM & PM PEAK HOUR HEAVY TO SEVERE CONGESTION SUMMARY)

HEAVY TO SEVERE CONGESTION	2017		2018		CHANGE FROM 2017 TO 2018	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**
Roadway Miles	73	160	71	155	-2	-5
Percent of Roadway Miles	13	29	12	26	-2	-3

The average weekday AM and PM peak hour level of congestion for the freeway/expressway and arterial system based on the TTI were developed. In addition to AM and PM peak hour analysis, certain areas such as the Eastern Shore experiences greater congestion on summer weekends. Statewide TTI maps were developed for the 6-7 PM Friday, 11-12 PM Saturday and Sunday from 5-6 PM as follows:

- Statewide Congestion AM Peak Hour 7-8 AM - Figure 9
- Statewide Congestion PM Peak Hour 5-6 PM - Figure 10
- Statewide Congestion Friday Summer 6-7 PM - Figure 11
- Statewide Congestion Saturday Summer 11 AM-12 PM - Figure 12
- Statewide Congestion Sunday Summer 5-6 PM - Figure 13

Figure 9


Maryland Congestion Map: 2018 AM Peak Hour (8-9) AM
N
AM Peak
- 12% of the major arterial system is congested
- 10% of the freeway/expressway system is congested
- 19% of the VMT on the freeway/expressway system occurs in congested conditions
Baltimore-Washington Region
AM MOST CONGESTED ARTERIAL SECTIONS
MD 32 Eastbound Tridelphia Rd to MD 108
US 29 Southbound MD 650 to MD 193
MD 210 Northbound Ft. Washington Rd to Livingston / Kerby Hill Rd
MD 185 Southbound I-495 to MD 191
MD 97 Southbound Stone Rd to Magna Way
Based on Travel Time Index (TTI)
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 - 1.3)
Heavy (TTI 1.3 - 2.0)
Severe (TTI > 2.0)
AM MOST CONGESTED FREEWAY SECTIONS
I-495 Outer Loop I-95 to MD 97
I-695 Outer Loop US 1 to Cromwell Bridge Rd
US 50 Westbound MD 410 to Washington DC Line
MD 32 Eastbound Tridelphia Rd to MD 108
I-695 Outer Loop MD 129 to US 40

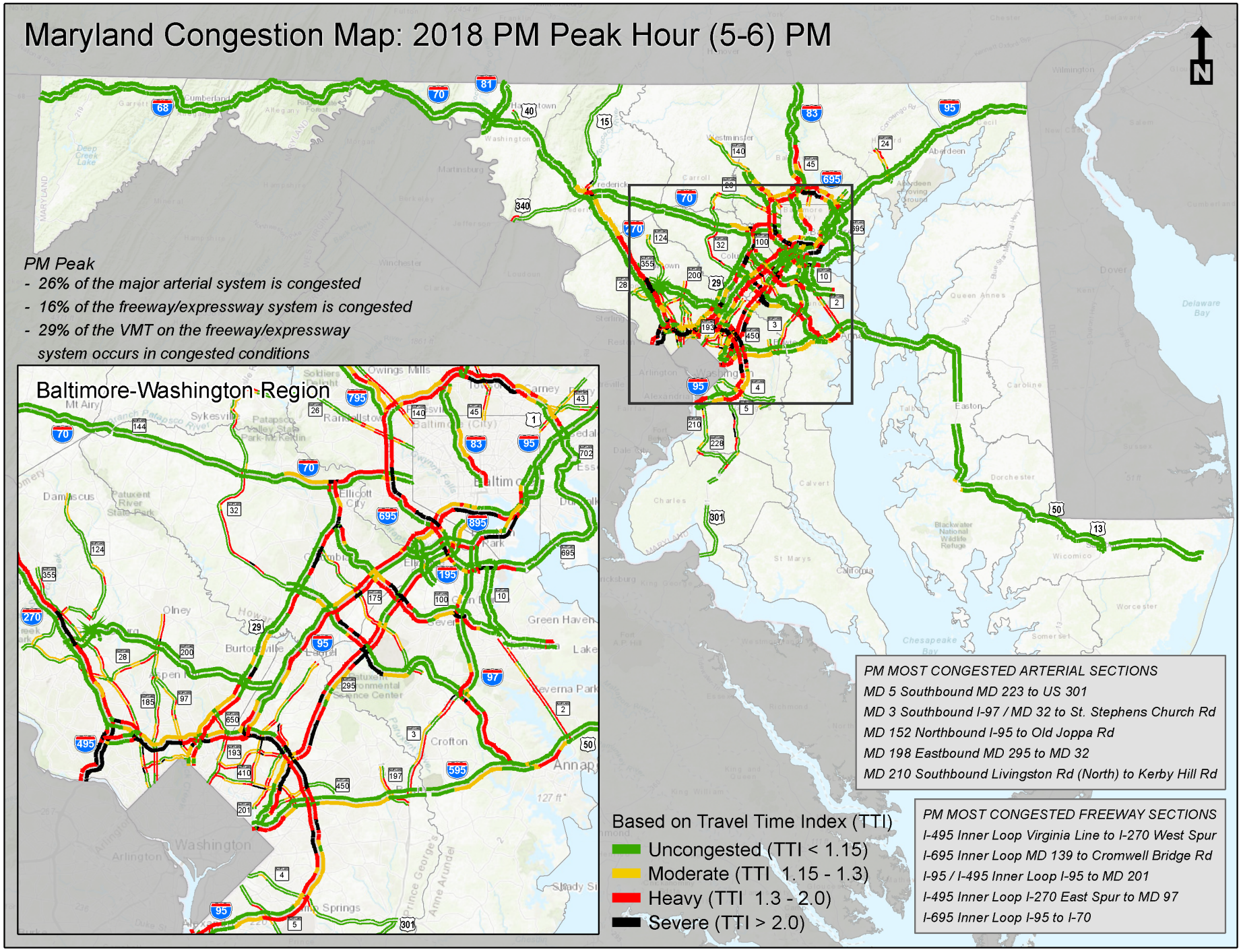

Maryland Congestion Map: 2018 PM Peak Hour (5-6) PM
N
PM Peak
- 26% of the major arterial system is congested
- 16% of the freeway/expressway system is congested
- 29% of the VMT on the freeway/expressway system occurs in congested conditions
Baltimore-Washington Region
Based on Travel Time Index (TTI)
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 - 1.3)
Heavy (TTI 1.3 - 2.0)
Severe (TTI > 2.0)
PM MOST CONGESTED ARTERIAL SECTIONS
MD 5 Southbound MD 223 to US 301
MD 3 Southbound I-97 / MD 32 to St. Stephens Church Rd
MD 152 Northbound I-95 to Old Joppa Rd
MD 198 Eastbound MD 295 to MD 32
MD 210 Southbound Livingston Rd (North) to Kerby Hill Rd
PM MOST CONGESTED FREEWAY SECTIONS
I-495 Inner Loop Virginia Line to I-270 West Spur
I-695 Inner Loop MD 139 to Cromwell Bridge Rd
I-95 / I-495 Inner Loop I-95 to MD 201
I-495 Inner Loop I-270 East Spur to MD 97
I-695 Inner Loop I-95 to I-70

Figure 11

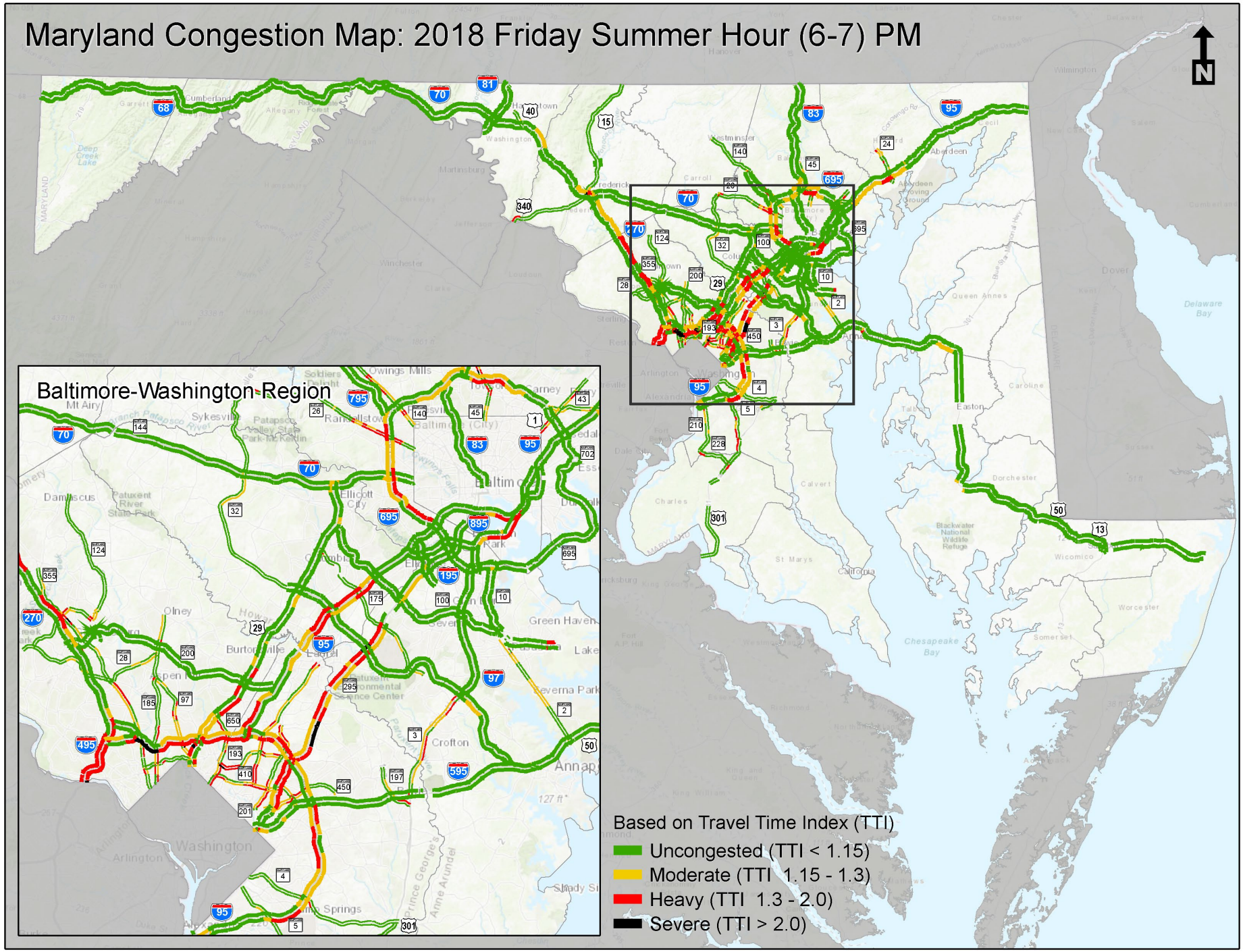

Maryland Congestion Map: 2018 Friday Summer Hour (6-7) PM
N
Baltimore-Washington Region
Based on Travel Time Index (TTI)
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 - 1.3)
Heavy (TTI 1.3 - 2.0)
Severe (TTI > 2.0)

Figure 12

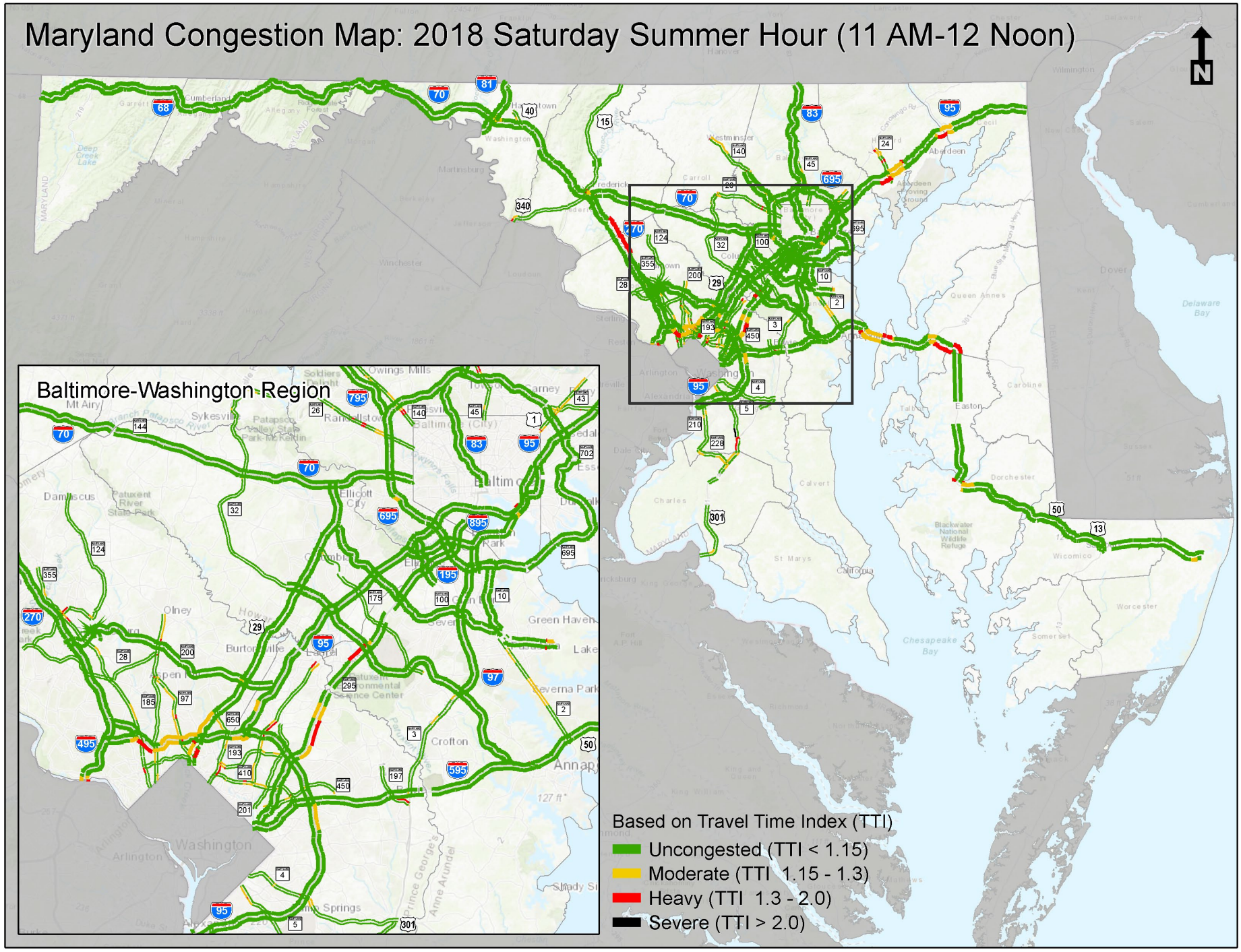
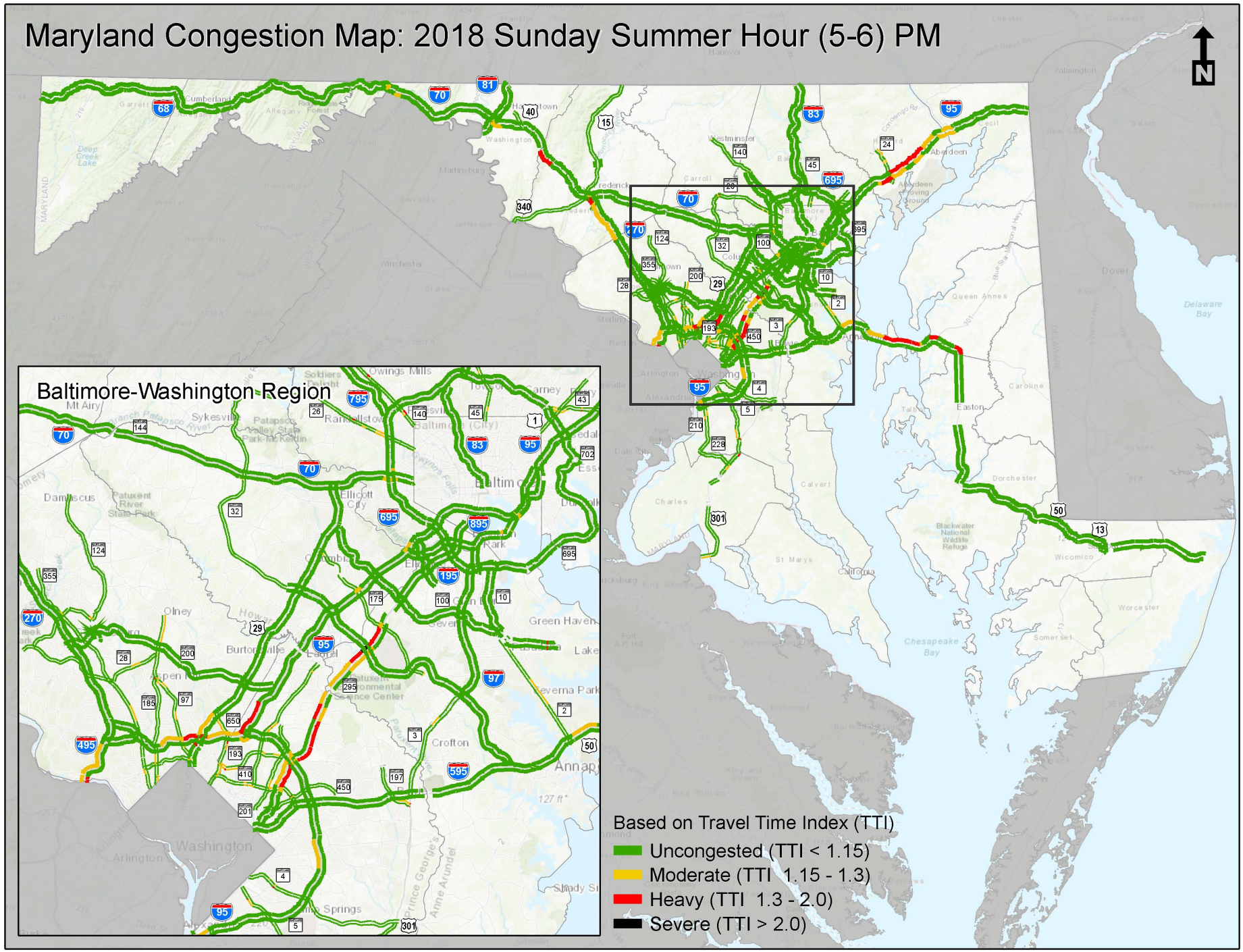

Maryland Congestion Map: 2018 Saturday Summer Hour (11 AM-12 Noon)
N
Baltimore-Washington Region
Based on Travel Time Index (TTI)
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 - 1.3)
Heavy (TTI 1.3 - 2.0)
Severe (TTI > 2.0)

Figure 13


Maryland Congestion Map: 2018 Sunday Summer Hour (5-6) PM
N
Baltimore-Washington Region
Based on Travel Time Index (TTI)
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 - 1.3)
Heavy (TTI 1.3 - 2.0)
Severe (TTI > 2.0)

Cost of Congestion

MDOT SHA estimates the statewide cost of congestion based on auto delay, truck delay and wasted fuel and emissions. The cost of congestion is itemized for both the freeway/expressway and arterial network. The cost of congestion decreased by about $86 million (Table 11). Much of this savings from 2017 cost estimates is due to reduced congestion in the Washington DC region which includes Montgomery, Prince George's and Frederick counties.

Table 11

TOTAL COST OF CONGESTION ON FREEWAYS/EXPRESSWAYS AND ARTERIALS ($ MILLIONS)				
REGION	2016	2017	2018	CHANGE FROM 2017 TO 2018
Freeway/ Expressways	$2,111	$2,874	$2,727	$-147
Arterials	N/A	$1,180	$1,241	$+61
TOTAL	N/A	$4,054	$3,968	$-86

I 495 @ MD 190

Top 15 Congested Corridor Sections

The TTI developed for individual segments were combined together to develop the Top 15 most congested freeways/expressway and arterial sections during the AM and PM peak hours. The freeway/expressway corridors range from three to eight miles in length or include the entire length of a freeway (I-370) or Spur (I-270 East or West Spur) while the arterial corridors range from two to five miles. The Top 15 sections for the worst congestion during the AM and PM peak hour were developed. They are shown as follows:

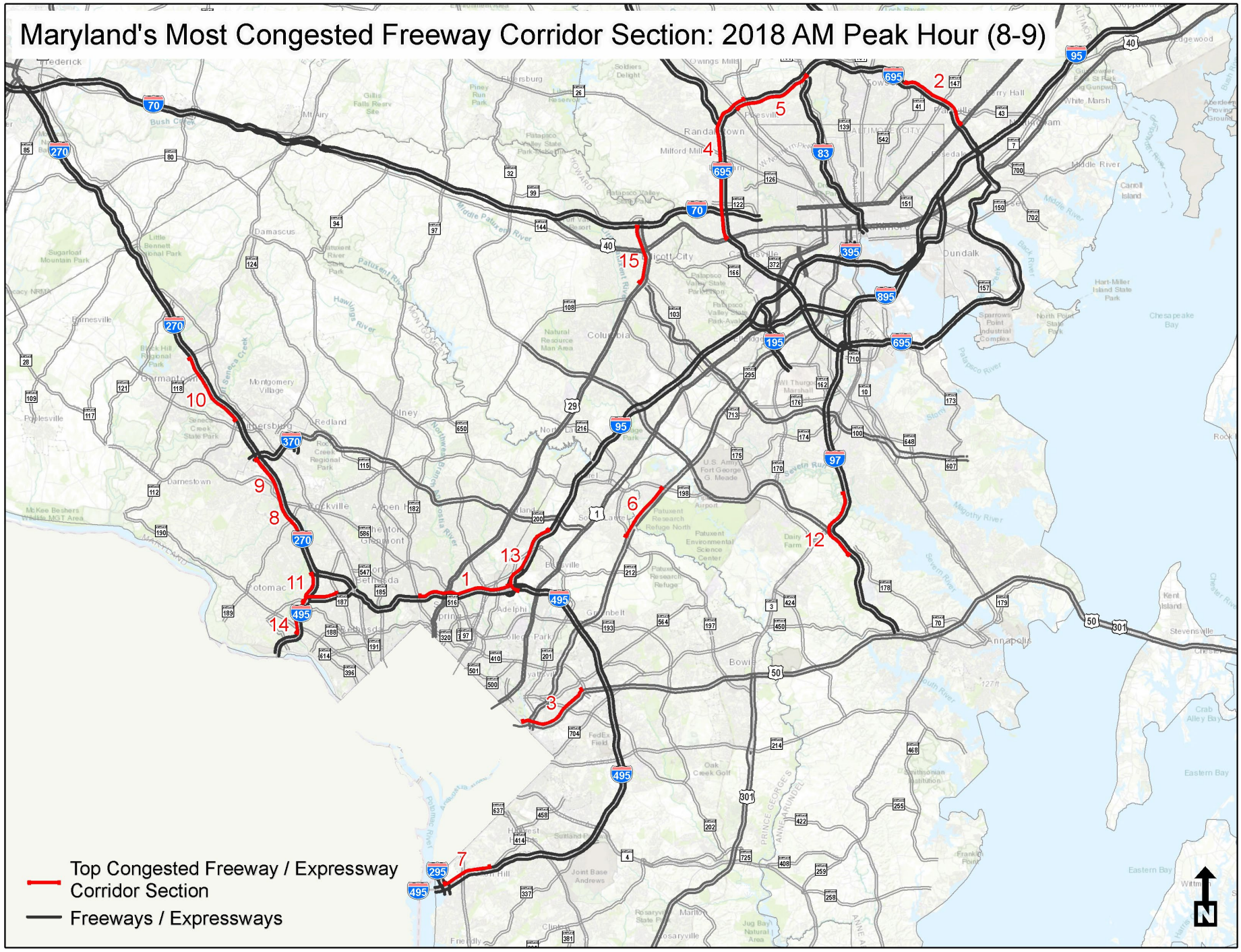
- Most Congested Freeway/Expressway Sections AM Peak Hour - Table 12, Figure 14
- Most Congested Freeway/Expressway Sections PM Peak Hour - Table 13, Figure 15
- Most Congested Arterial Sections AM Peak Hour - Table 14, Figure 16
- Most Congested Arterial Sections PM Peak Hour - Table 15, Figure 17

Most Congested Weighted Average = (ΣIndividual Segment TTI x Section Length)/Total Section Length.

Table 12

2018 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS - AM PEAK HOUR					
AM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	I-495 Outer Loop	I-95 to MD 97	4.9	Montgomery/ Prince George's	3.89
2	I-695 Outer Loop	US 1 to Cromwell Bridge Road	4.3	Baltimore	2.85
3	US 50 WB	MD 410 to Washington D.C. Line	3.9	Prince George's	2.46
4	I-695 Outer Loop	MD 129 to US 40	7.5	Baltimore	2.35
5	I-695 Inner Loop	MD 140 to I-83	3.9	Baltimore	2.33
6	MD 295 SB	MD 198 to MD 197	3.4	Anne Arundel/ Prince George's	2.30
7	I-95/I-495 Inner Loop	MD 414 to I-295	3.6	Prince George's	2.28
8	I-270 SB	I-370 to Montrose Road	4.4	Montgomery	2.21
9	I-270 Local SB	I-370 to Montrose Road	4.6	Montgomery	2.20
10	I-270 SB	Father Hurley Blvd. to MD 124	4.0	Montgomery	1.97
11	I-270 Spur SB	I-270 Split to I-495 (West)	2.0	Montgomery	1.83
12	I-97 SB	Benfield Boulevard to MD 178	4.0	Anne Arundel	1.82
13	I-95 SB	South of MD 200 to I-495	4.2	Prince George's	1.75
14	I-495 Outer Loop	MD 187 to Cabin John Parkway	3.6	Montgomery	1.69
15	US 29 SB	I-70 to MD 100	3.7	Howard	1.50

Figure 14


Maryland's Most Congested Freeway Corridor Section: 2018 AM Peak Hour (8-9)
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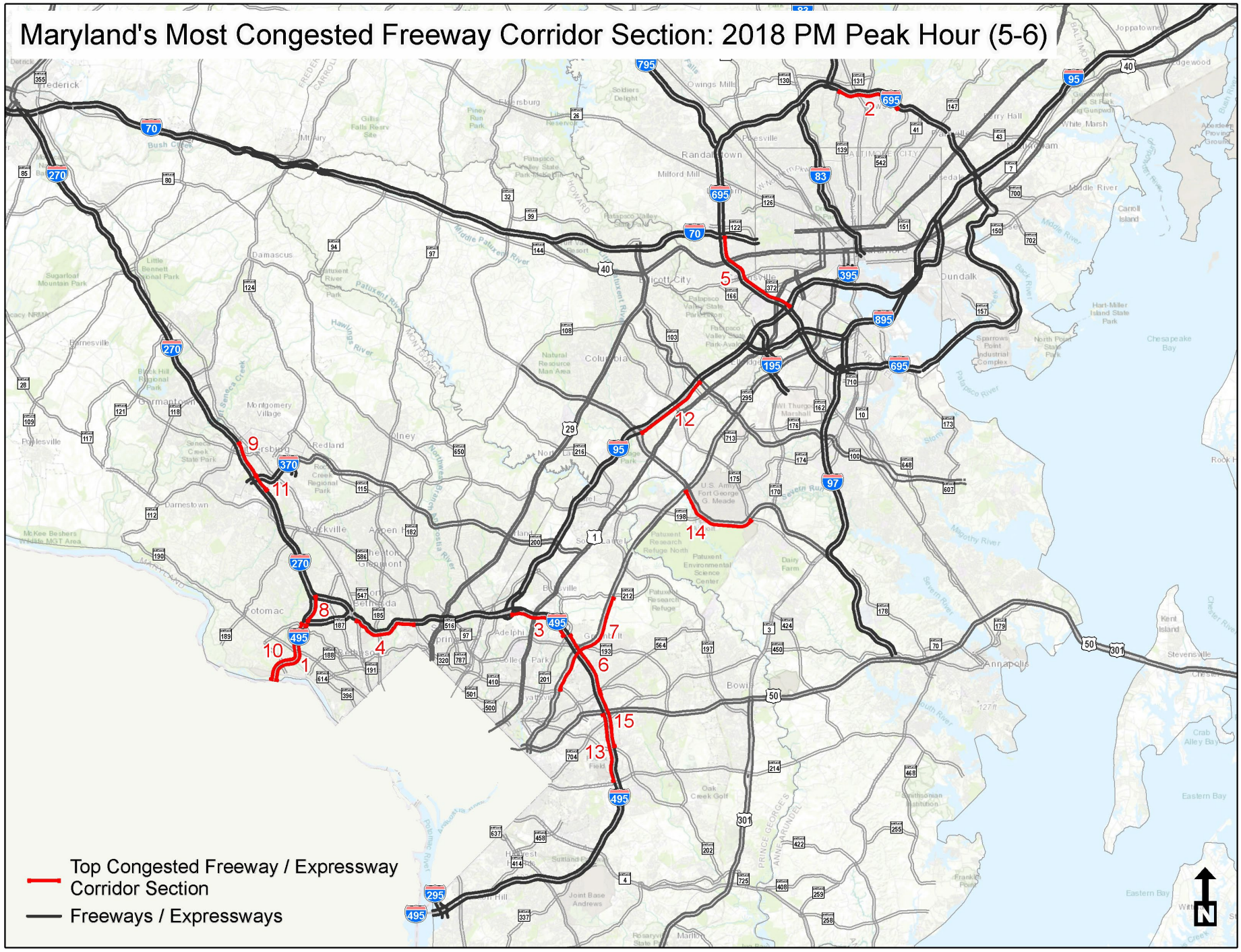
Top Congested Freeway / Expressway Corridor Section
Freeways / Expressways
N

Table 13

2018 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS - PM PEAK HOUR					
AM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	I-495 Inner Loop	Virginia State Line to I-270 West Spur	3.7	Montgomery	3.55
2	I-695 Inner Loop	MD 139 to Cromwell Bridge Road	3.5	Baltimore	3.19
3	I-95/I-495 Inner Loop	I-95 to MD 201	3.2	Prince George's	2.66
4	I-495 Inner Loop	I-270 East Spur to MD 97	3.7	Montgomery	2.64
5	I-695 Inner Loop	I-95 to I-70	5.9	Baltimore	2.41
6	I-95/I-495 Outer Loop	MD 450 to MD 201	3.5	Prince George's	2.24
7	MD 295 NB	MD 410 to Powder Mill Road	6.5	Prince George's	2.23
8	I-270 West Spur NB	I-270 split to I-495	1.8	Montgomery	2.23
9	I-270 NB	I-370 to MD 124	3.1	Montgomery	2.22
10	I-495 Outer Loop	I-270 West Spur to Virginia State Line	3.4	Montgomery	2.12
11	I-270 Local NB	Shady Grove Road to MD 124	3.7	Montgomery	1.96
12	I-95 NB	MD 32 to MD 100	4.2	Howard	1.92
13	I-95/I-495 Inner Loop	US 50 to MD 214	4.4	Prince George's	1.90
14	MD 32 EB	MD 295 to MD 175	4.7	Anne Arundel	1.89
15	I-95/I-495 Outer Loop	MD 202 to MD 450	3.7	Prince George's	1.87

Figure 15


Maryland's Most Congested Freeway Corridor Section: 2018 PM Peak Hour (5-6)
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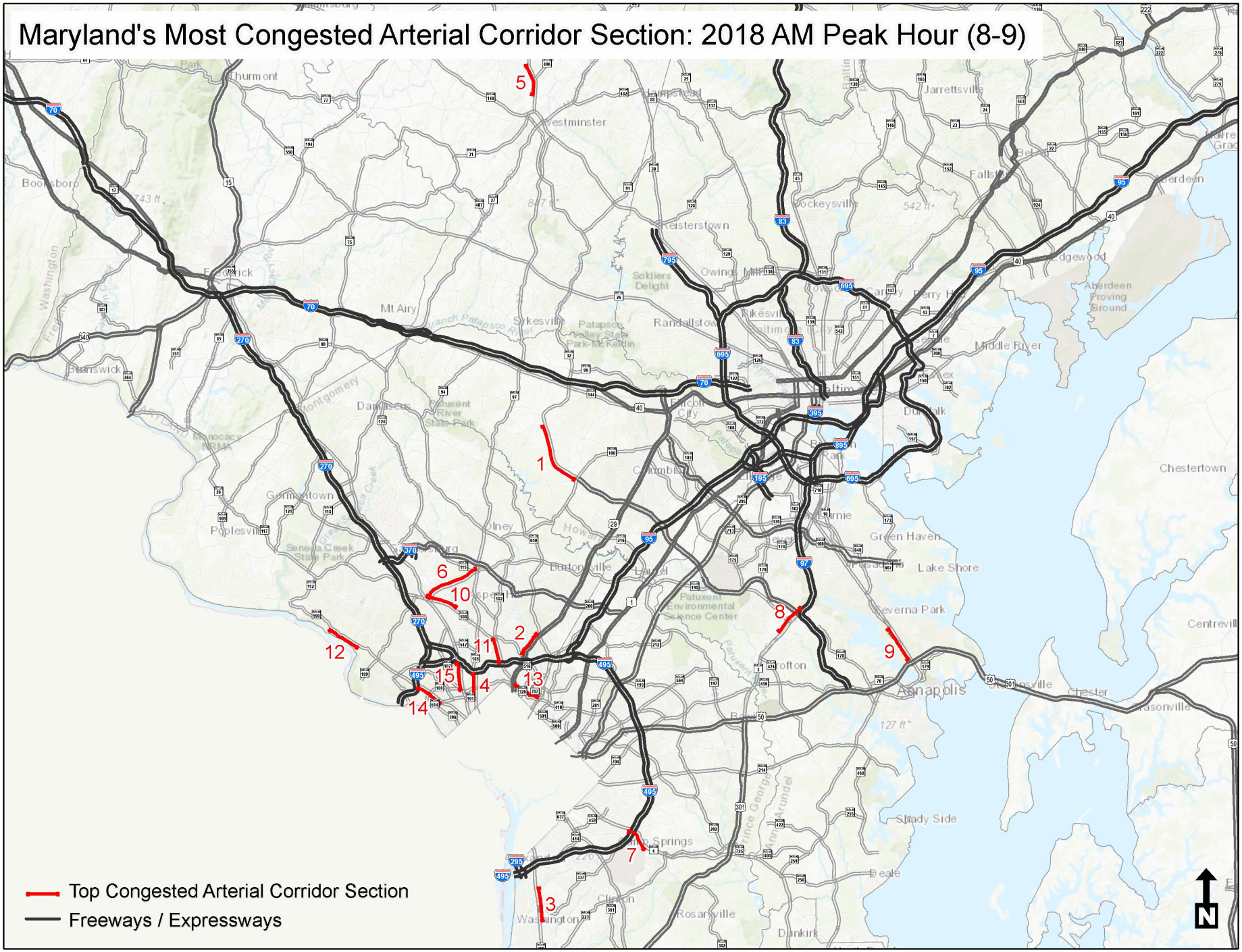
Top Congested Freeway / Expressway Corridor Section
Freeways / Expressways
N

Table 14

2018 MOST CONGESTED ARTERIAL SECTIONS - AM PEAK HOUR					
AM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	MD 32 EB	Triadelphia Road to MD 108	4.8	Howard	2.41
2	US 29 SB	MD 650 to MD 193	2.2	Montgomery	2.22
3	MD 210 NB	Fort Washington Road to Livingston/Kerby Hill Road	2.6	Prince George's	1.89
4	MD 185 SB	I-495 to MD 191	2.1	Montgomery	1.81
5	MD 97 SB	Stone Road to Magna Way	2.3	Carroll	1.53
6	MD 28 WB	MD 97 to MD 586	4.1	Montgomery	1.52
7	MD 4 SB	Forestville Road to Dower House Road	2.0	Prince George's	1.51
8	MD 3 SB	I-97/MD 32 to St. Stephens Church Road	2.9	Anne Arundel	1.50
9	MD 2 SB	College Parkway to US 50	2.8	Anne Arundel	1.49
10	MD 586 WB	Aspen Hill Road to MD 355	2.4	Montgomery	1.49
11	MD 97 SB	MD 193 to I-495	2.1	Montgomery	1.49
12	MD 190 EB	Luvie Ct to Piney Meetinghouse Road	2.5	Montgomery	1.48
13	MD 410 WB	MD 650 to US 29	2.1	Montgomery	1.48
14	MD 190 EB	I-495 to MD 614	2.1	Montgomery	1.47
15	MD 355 SB	I-495 to MD 410	2.4	Montgomery	1.43

Figure 16


Maryland's Most Congested Arterial Corridor Section: 2018 AM Peak Hour (8-9)
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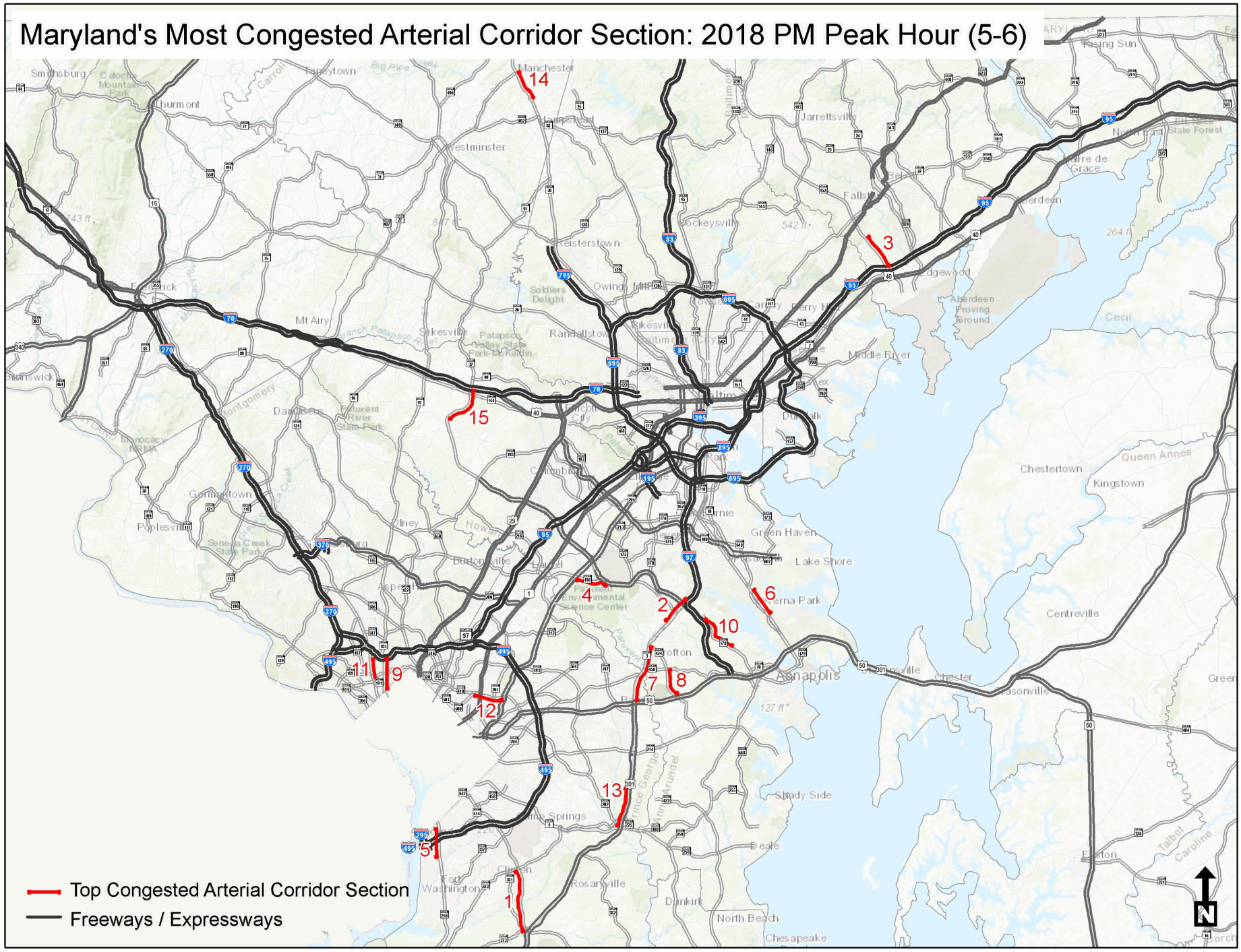
Top Congested Arterial Corridor Section
Freeways / Expressways
N

Table 15

2018 MOST CONGESTED ARTERIAL SECTIONS - PM PEAK HOUR					
AM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	MD 5 SB	MD 223 to US 301	4.4	Prince George's	2.21
2	MD 3 SB	I-97/MD 32 to St Stephens Church Road	2.9	Anne Arundel	1.98
3	MD 152 NB	I-95 to Old Joppa Road	2.8	Harford	1.84
4	MD 198 EB	MD 295 to MD 32	2.2	Anne Arundel	1.83
5	MD 210 SB	Livingston Road (North) to Kerby Hill Road	2.4	Prince George's	1.83
6	MD 2 NB	College Parkway to Robinson Road/Leelyn Drive	2.5	Anne Arundel	1.82
7	MD 3 NB	US 301 to MD 424	4.3	Anne Arundel/ Prince George's	1.80
8	MD 424 NB	US 50 to MD 450	2.4	Anne Arundel	1.78
9	MD 185 NB	Maryland/D.C. Line to I-495	2.5	Montgomery	1.76
10	MD 178 NB	Old General Highway to I-97	2.8	Anne Arundel	1.75
11	MD 355 NB	MD 191 to Cedar Lane	2.1	Montgomery	1.72
12	MD 410 EB	MD 500 to MD 295	2.3	Prince George's	1.70
13	US 301 SB	Leeland Road to MD 4	3.1	Prince George's	1.70
14	MD 30 NB	MD 30 Bus. to MD 27	2.4	Carroll	1.65
15	MD 32 WB	Burntwoods Road to I-70	2.9	Howard	1.64


Maryland's Most Congested Arterial Corridor Section: 2018 PM Peak Hour (5-6)
Top Congested Arterial Corridor Section
Freeways / Expressways
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Freeway/Expressway Corridor Summary

The highest classification of roadways are freeways and expressways. A summary of Maryland's freeway/expressway corridors' performance including average TTI, average PTI, number of miles, average daily traffic and number of lanes was developed (Table 16). These numbers represent the average values for the entire roadway. Several segments of these freeways/ expressways as identified in Table 16 have much higher TTI and PTIs. The variation between the segments is shown in the Peak Hour Statewide Congestion and Reliability Maps.

The Maryland Mobility Report Supplement provides additional in-depth information about the mobility performance of these corridors.

Table 16

2018 FREEWAY/EXPRESSWAY FACILITY PERFORMANCE SUMMARY

ROUTE	NO. OF MILES	AVG TTI		ANNUAL AVERAGE DAILY TRAFFIC (IN THOUSANDS)	NO. OF LANES
		AM	PM		
I-70: Pa. State Line to US 40 (Frederick)	48	1.00	1.00	22-82	4
I-70: US 40 (Frederick) to I-695	43	1.00	1.01	17-107	6
I-81	12	1.00	1.01	56-74	4
I-83	26	1.01	1.05	46-146	4-6
I-95: I-495 to I-695	40	1.18	1.24	164-251	8
I-95: I-695 to Delaware State Line	45	1.00	1.00	62-190	6-12
I-97	17	1.09	1.15	24-162	4-6
I-270	41	1.21	1.22	87-266	4-12
I-495	42	1.29	1.58	110-252	6-8
I-695	35	1.22	1.42	123-220	6-8
I-795	8	1.02	1.06	59-121	4-6
I-895	15	1.13	1.14	14-86	4
US 50: Washington DC Line to Chesapeake Bay Bridge	33	1.02	1.05	72-165	4-10
MD 32: MD 108 to I-97	22	1.02	1.11	48-100	4
MD 100: US 29 to MD 177	22	1.04	1.19	29-111	4-8
MD 200: I-370 to US 1	19	1.00	1.00	11-58	4-6
MD 295: MD 201 to Waterview Ave	29	1.14	1.37	80-118	4-6

Major Arterial Corridor Summary

The next highest classification of roadways after freeways/expressways is arterials. Thirty-four major arterial corridors were selected based on observed traffic operations, traffic volumes, regional significance, and availability of data to analyze in further detail. Traffic analysis was performed to identify the most congested intersections and segments and the accompanying levels of service, TTI, and PTI on a segment basis. Various roadway characteristics such as the number of lanes, speed limits, signalized intersections, and traffic/transit ridership data were analyzed.

A summary of the operational characteristics of each of these corridors was developed (Table 17).

The Maryland Mobility Report Supplement contains additional information related to various characteristics and performance measures of these arterial roadways.

Table 17

2018 MAJOR ARTERIAL FACILITY PERFORMANCE SUMMARY

ROUTE	LIMITS	NO. OF MILES	ANNUAL AVERAGE DAILY TRAFFIC (IN THOUSANDS)	CONGESTED MILEAGE			
				HEAVY TO SEVERE CONGESTION			
				AM EB/NB	AM WB/ SB	PM EB/NB	PM WB/ SB
MD 2	US 50/301 to MD 10	8.4	48-66	0.0	0.8	6.5	3.7
MD 3	US 50/301 to I-97	8.8	68-81	1.2	1.7	5.8	0.8
MD 4	DC Line to Dower House Rd.	6.6	22-76	0.0	0.9	0.0	0.9
MD 5	I-95 to DC Line	3.1	31-62	0.6	0.0	0.0	0.5
MD 5	US 301 to MD 223	5.4	65-82	4.1	0.0	0.0	4.8
MD 24	US 40 to US 1	7.9	23-70	0.0	0.0	3.6	0.5
MD 26	MD 32 to Balt. City Line	14.1	9-47	0.5	0.0	0.9	2.2
MD 28	Riffle Ford Rd to MD 97	11.9	26-50	1.6	2.9	3.2	0.4
MD 32	MD 108 to MD 26	16.3	21-29	0.0	5.4	8.8	0.0
MD 43	I-695 to US 40	6.0	27-55	0.0	1.0	1.1	0.9
MD 45	Balt. City Line to Shawan Rd.	9.3	23-41	0.4	0.4	3.5	2.8
MD 85	English Muffin Way to I-70	3.4	17-52	1.6	0.0	1.6	0.0
MD 97	DC Line to MD 108	12.7	28-63	0.5	0.0	3.4	0.4
MD 124	MD 28 to MD 108	16.7	11-74	0.0	1.3	1.2	0.7
MD 140	MD 97 to Balt. City Line	20.4	25-50	0.0	0.0	3.2	5.1
MD 175	MD 32 to US 29	12.2	19-76	0.0	0.0	2.9	1.3
MD 185	DC Line to MD 97	8.3	35-72	0.0	3.4	3.4	1.6
MD 193	MD 201 to MD 650	5.5	32-48	0.0	1.6	2.9	0.7

Table 17 - Continued

2018 MAJOR ARTERIAL FACILITY PERFORMANCE SUMMARY							
ROUTE	LIMITS	NO. OF MILES	ANNUAL AVERAGE DAILY TRAFFIC (IN THOUSANDS)	CONGESTED MILEAGE HEAVY TO SEVERE CONGESTION			
				AM EB/NB	AM WB/ SB	PM EB/NB	PM WB/ SB
MD 197	US 301 to MD 450	3.2	19-35	0.0	0.0	1.7	0.0
MD 201	MD 450 to MD 212	7.4	24-41	0.0	0.6	2.8	1.5
MD 210	MD 228 to I-95	10.3	27-75	3.7	0.0	0.0	2.5
MD 228	MD 210 to US 301	6.8	39-40	0.0	0.0	1.5	0.0
MD 355	DC Line to MD 27	19.7	33-64	0.8	2.2	8.2	2.5
MD 410	MD 355 to US 29	3.8	15-27	0.0	1.1	1.4	0.0
MD 410	MD 650 to Pennsy Dr.	7.7	21-48	0.4	2.0	3.9	0.3
MD 450	MD 202 to MD 704	6.3	26-66	0.0	0.0	0.0	0.2
MD 450	Housley Rd. to MD 2	1.2	33-48	0.0	0.0	0.0	0.2
MD 650	DC Line to US 29	6.0	36-62	0.0	0.0	3.1	2.3
US 1	MD 410 to MD 198	10.7	20-47	0.0	0.0	1.4	3.3
US 1	Balt. City Line to Honeygo Blvd.	5.6	27-47	0.0	0.7	1.0	0.7
US 29	MD 97 to MD 650	3.8	35-67	0.0	2.0	1.0	0.3
US 29	Industrial Pkwy. to MD 198	4.4	62-68	0.0	1.9	2.5	0.0
US 40	I-70 to Cleveland Ave.	3.4	26-39	0.0	0.0	0.0	0.3
US 301	Billingsley Rd to MD 5	7.8	38-97	0.0	0.0	1.3	1.9

Congested Corridor Section Comparison

A comparison was conducted of the operations of the freeway/expressway and major arterial corridors over the past three years. This was performed for both directions in the AM and PM peak hours. For freeways/expressways severe congestion (TTI >2.0) was defined for the comparison. This showed that motorists on the following freeways/expressways experience severe congestion.

- I-70
- I-83
- I-95
- I-97
- I-270 Mainline
- I-270 Local
- I-495
- I-695
- MD 32
- MD 100
- MD 295
- US 50

The roadways with the most severe congestion in the AM peak hour were I-695 Outer Loop, I-495 Outer Loop and the mainline of I-270 southbound. All of these roadways had over 5 miles of severe congestion. The PM peak hour severe congestion was highest on I-495 Inner Loop, I-695 Inner Loop and MD 295 northbound and I-270 northbound mainline. Motorists on these roadways all experience over 6 miles of severe congestion (Figure 18). The greatest increases in congestion occurred on the following freeway/expressways:

Southbound: I-95 AM Peak Hour

Northbound: I-270 PM Peak Hour

Congestion decreased by the most between 2017 and 2018 on:

I-95 Northbound - PM Peak Hour

I-695 Inner Loop - PM Peak Hour

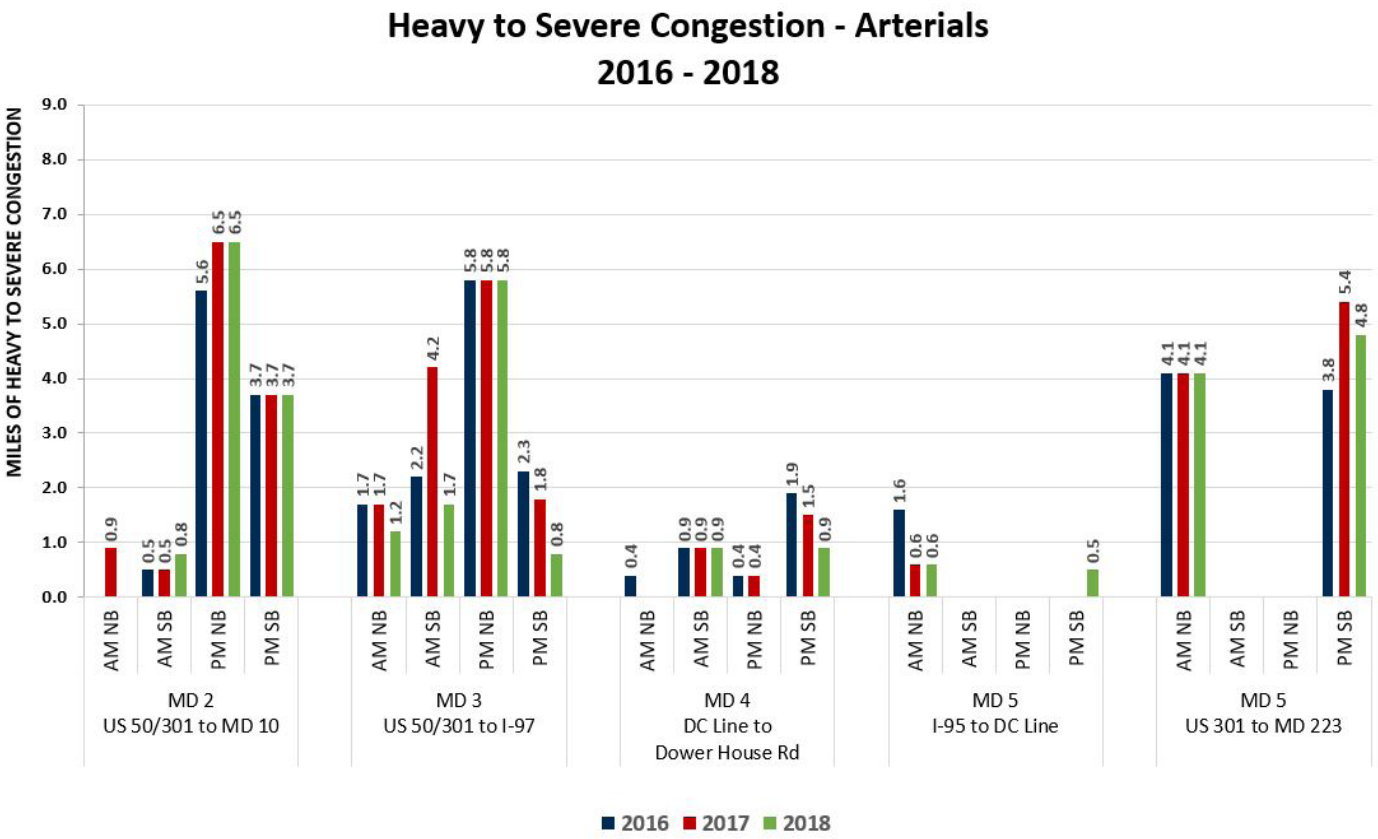
A comparison was made of the 34 selected major arterial corridors for operations when the TTI value was greater than 1.3 (Figure 19). This was based on the last three years of data. There were several corridors where congestion improved between 2017 and 2018 by approximately 1 mile or greater reduction. These include:

- MD 3 Southbound: I-97 to US 50/301 - AM Peak Hour
- MD 355 Southbound: MD 27 to Washington DC Line - AM Peak Hour
- MD 3 Southbound: I-97 to US 50/301 - PM Peak Hour
- MD 45 Northbound: Baltimore City Line to Shawan Road - PM Peak Hour
- MD 45 Southbound: Shawan Road to Baltimore City Line - PM Peak Hour
- MD 140 Northbound: Baltimore City Line to MD 97 - PM Peak Hour
- MD 175 Northbound: MD 32 to US 29 - PM Peak Hour
- MD 193 Westbound: MD 201 to MD 650 - PM Peak Hour
- MD 197 Northbound: US 301 to MD 450 - PM Peak Hour
- MD 355 Southbound: MD 27 to Washington DC Line - PM Peak Hour

The following major arterial corridors experienced an increase of approximately 1 mile or greater in severe congestion:

- MD 24 Northbound: US 40 to US 1 - PM Peak Hour
- MD 355 Northbound: Washington DC Line to MD 27 - PM Peak Hour
- MD 450 Westbound: MD 704 to MD 202 - PM Peak Hour

Figure 18


Heavy to Severe Congestion - Arterials
2016 - 2018
MILES OF HEAVY TO SEVERE CONGESTION
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.9
0.5 0.5 0.8
5.6 6.5 6.5
3.7 3.7 3.7
1.7 1.7 1.2
2.2 4.2 1.7
5.8 5.8 5.8
2.3 1.8 0.8
0.4
0.9 0.9 0.9
0.4 0.4
1.9 1.5 0.9
1.6 0.6 0.6
0.5
4.1 4.1 4.1
3.8 5.4 4.8
AM NB
AM SB
PM NB
PM SB
MD 2
US 50/301 to MD 10
MD 3
US 50/301 to I-97
MD 4
DC Line to
Dower House Rd
MD 5
I-95 to DC Line
MD 5
US 301 to MD 223
2016
2017
2018

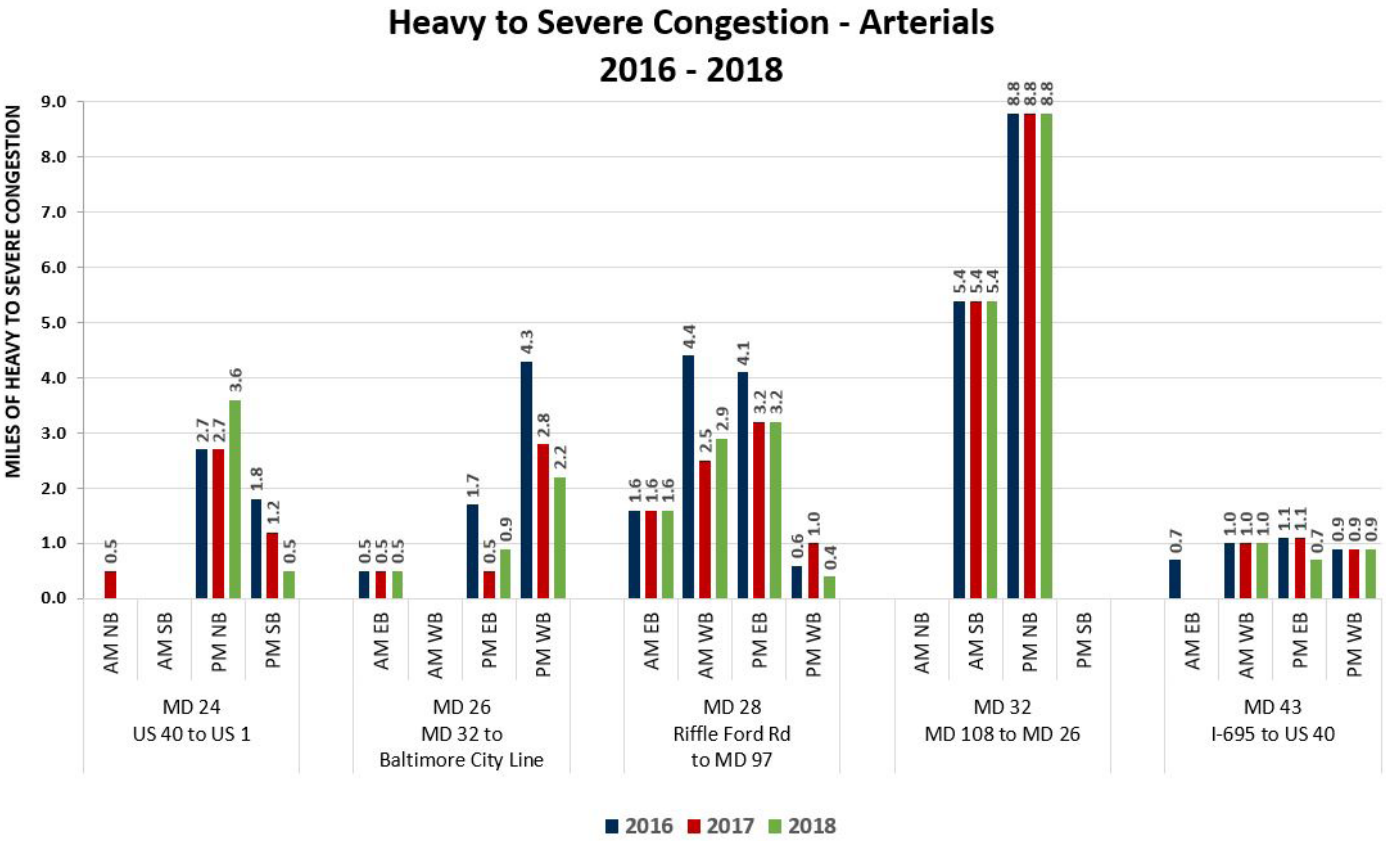
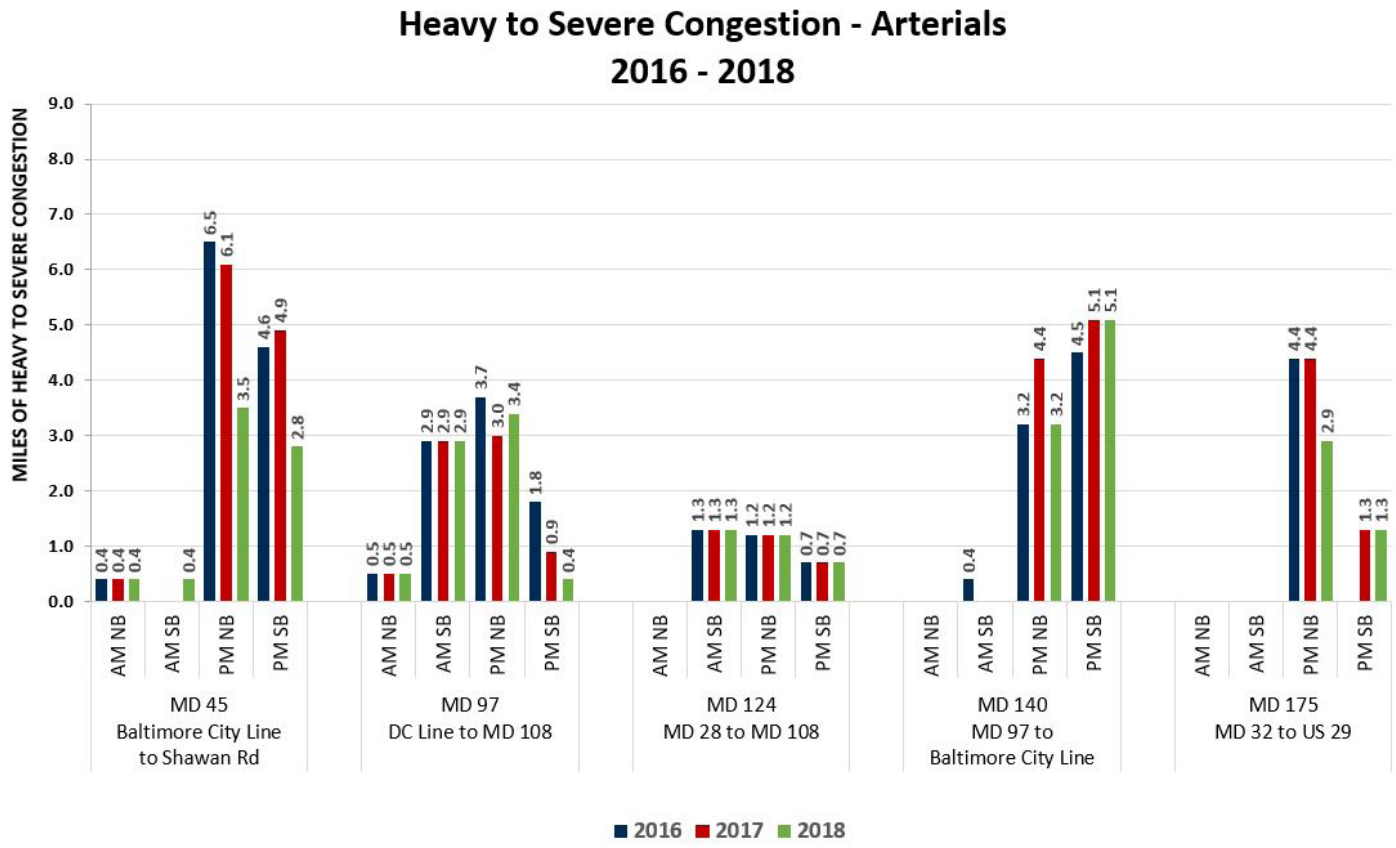

Heavy to Severe Congestion - Arterials
2016 - 2018
MILES OF HEAVY TO SEVERE CONGESTION
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.5
2.7 2.7 3.6
1.8 1.2 0.5
0.5 0.5 0.5
1.7 0.5 0.9
4.3 2.8 2.2
1.6 1.6 1.6
4.4 2.5 2.9
4.1 3.2 3.2
0.6 1.0 0.4
5.4 5.4 5.4
8.8 8.8 8.8
0.7
1.0 1.0 1.0
1.1 1.1 0.7
0.9 0.9 0.9
AM NB
AM SB
PM NB
PM SB
AM EB
AM WB
PM EB
PM WB
MD 24
US 40 to US 1
MD 26
MD 32 to
Baltimore City Line
MD 28
Riffle Ford Rd
to MD 97
MD 32
MD 108 to MD 26
MD 43
I-695 to US 40
2016
2017
2018

Figure 19


Heavy to Severe Congestion - Arterials
2016 - 2018
MILES OF HEAVY TO SEVERE CONGESTION
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.4 0.4 0.4
0.4
6.5 6.1 3.5
4.6 4.9 2.8
0.5 0.5 0.5
2.9 2.9 2.9
3.7 3.0 3.4
1.8 0.9 0.4
1.3 1.3 1.3
1.2 1.2 1.2
0.7 0.7 0.7
0.4
3.2 4.4 3.2
4.5 5.1 5.1
4.4 4.4 2.9
1.3 1.3
AM NB
AM SB
PM NB
PM SB
MD 45
Baltimore City Line
to Shawan Rd
MD 97
DC Line to MD 108
MD 124
MD 28 to MD 108
MD 140
MD 97 to
Baltimore City Line
MD 175
MD 32 to US 29
2016 2017 2018

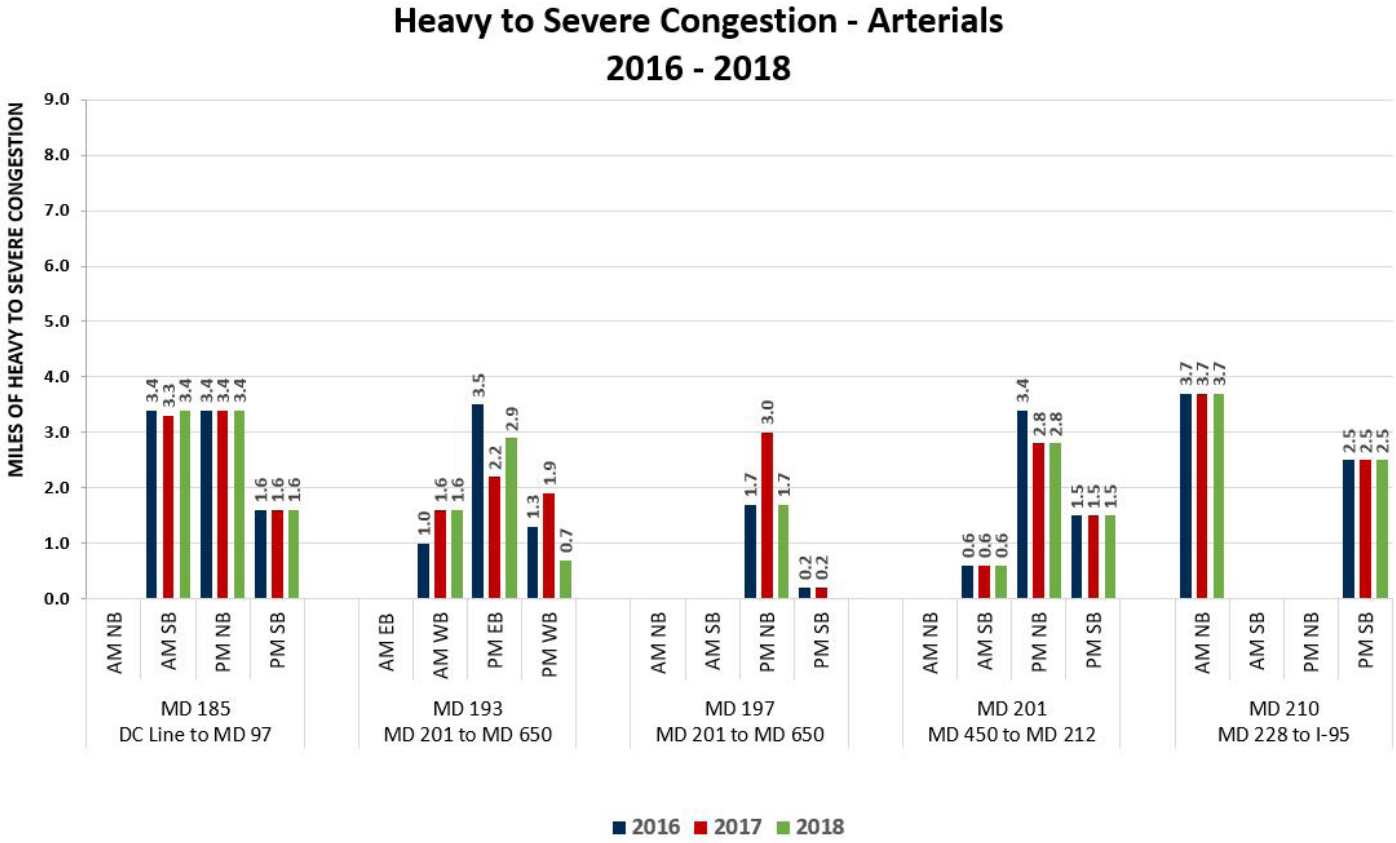
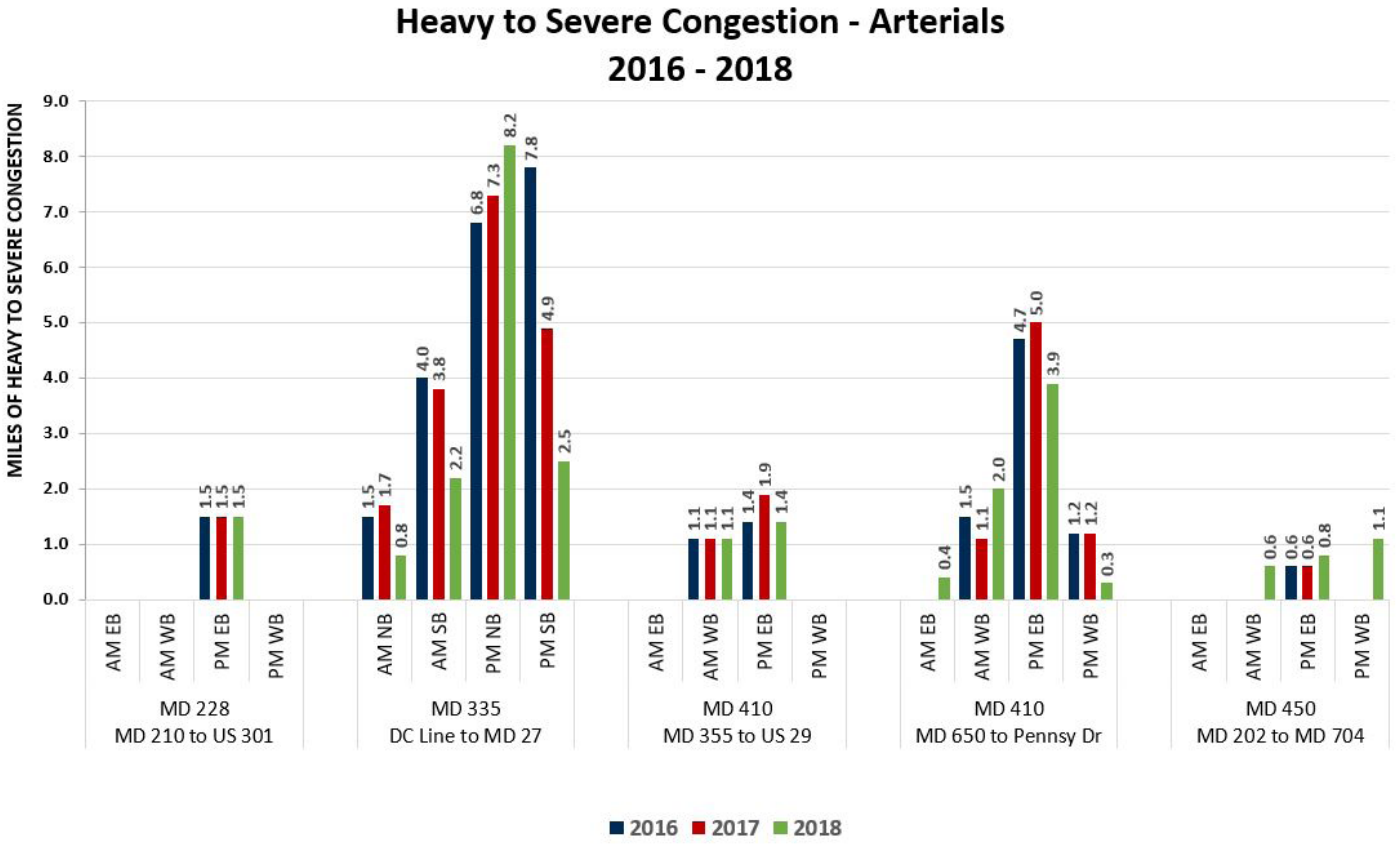

Heavy to Severe Congestion - Arterials
2016 - 2018
MILES OF HEAVY TO SEVERE CONGESTION
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
3.4 3.3 3.4
3.4 3.4 3.4
1.6 1.6 1.6
1.0 1.6 1.6
3.5 2.2 2.9
1.3 1.9 0.7
1.7 3.0 1.7
0.2 0.2
0.6 0.6 0.6
3.4 2.8 2.8
1.5 1.5 1.5
3.7 3.7 3.7
2.5 2.5 2.5
AM NB
AM SB
PM NB
PM SB
AM EB
AM WB
PM EB
PM WB
MD 185
DC Line to MD 97
MD 193
MD 201 to MD 650
MD 197
MD 201 to MD 650
MD 201
MD 450 to MD 212
MD 210
MD 228 to I-95
2016 2017 2018

Figure 19 - *continued*



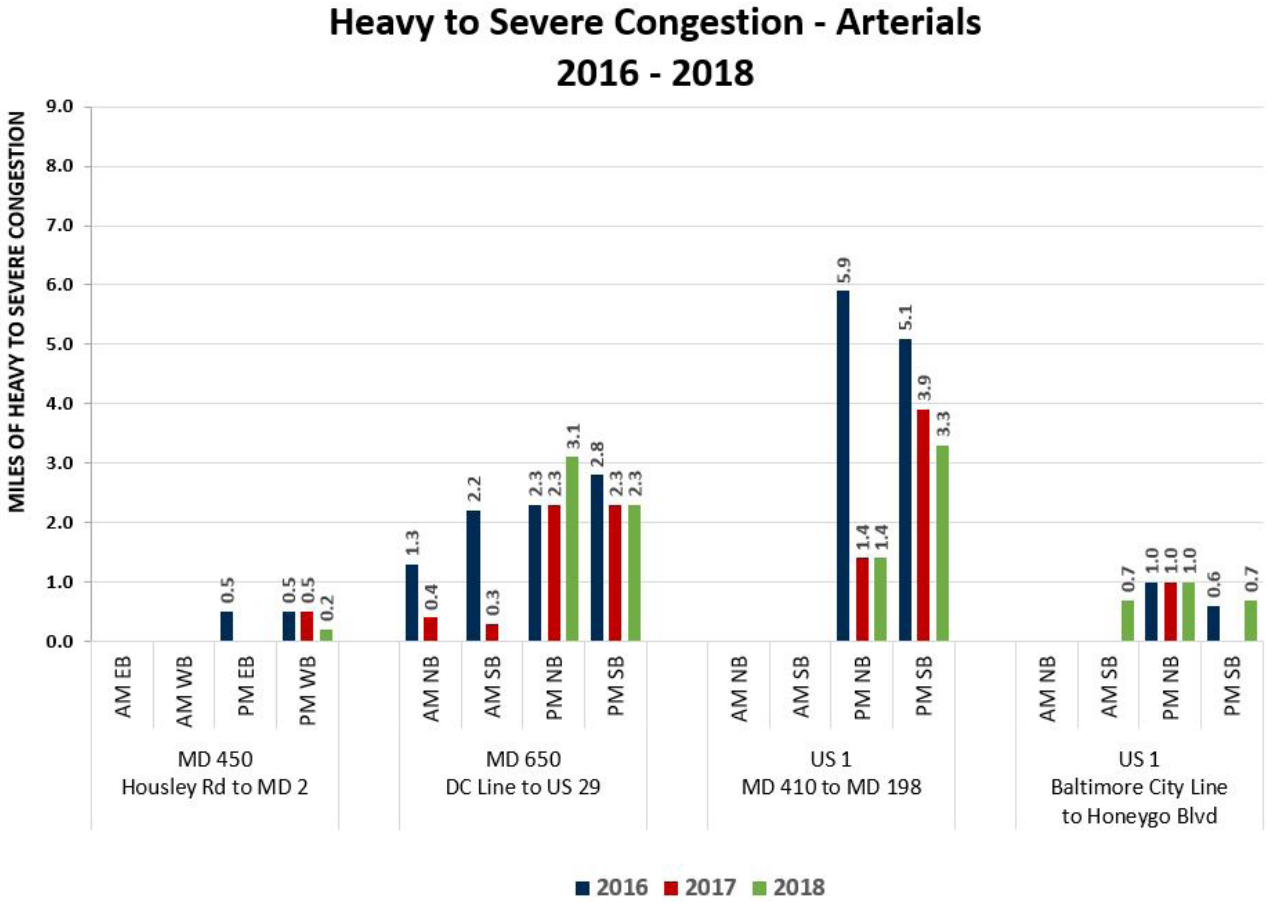
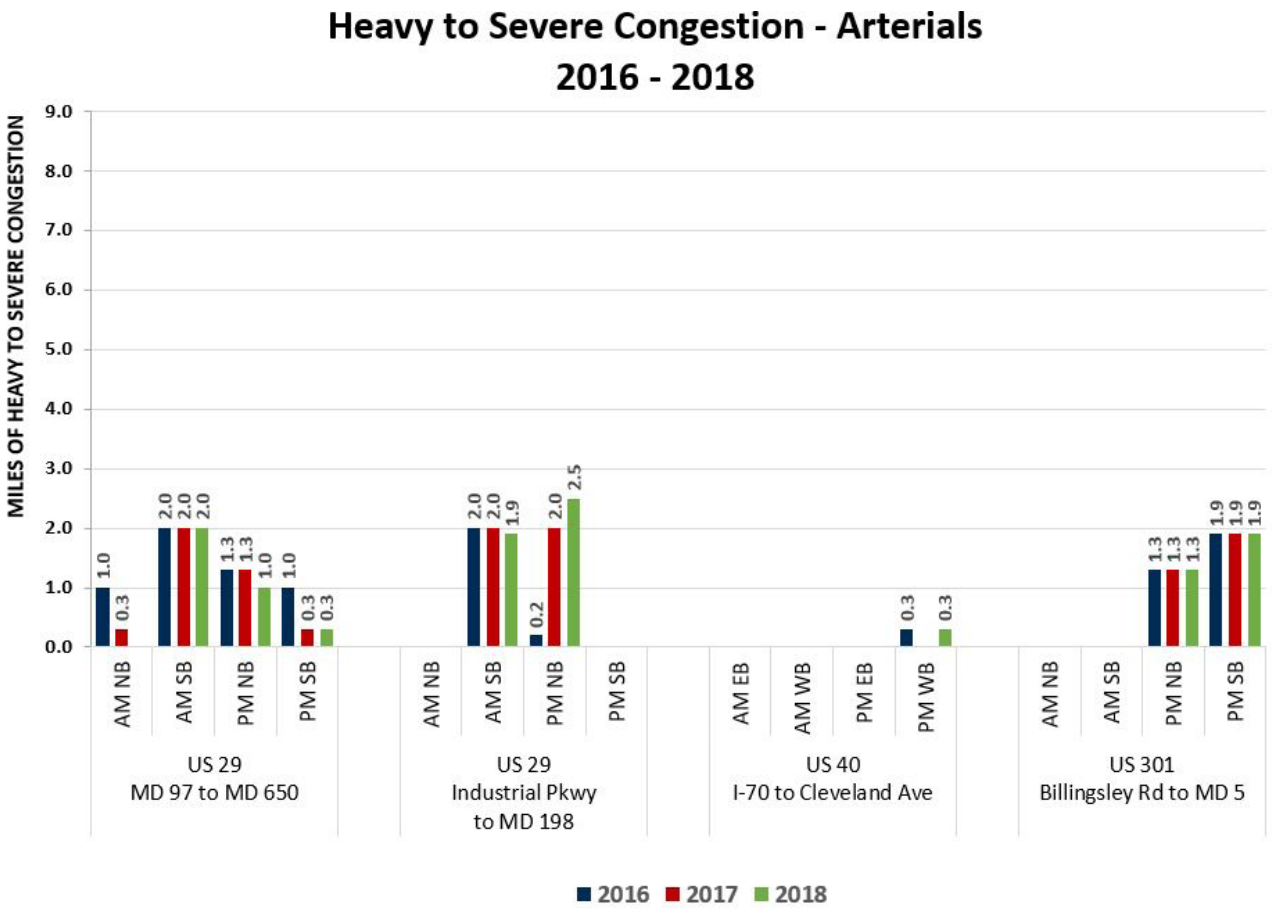


Figure 19 - *continued*



MD 24 @ Marketplace Dr

Intersections

The MDOT SHA monitors traffic at various key intersection locations throughout the year. At a location where motorists have to wait multiple times for a signal to turn green until they make it through an intersection this is referred as level of service (LOS) F. Thirty two (32) intersections counted in the past three years operated in the AM peak hour or PM peak hour at LOS F (Table 18 and 19). Six of these locations failed in both the AM and PM peak hours (highlighted locations).

Table 18

LOS "F" INTERSECTIONS AM PEAK HOUR		
INTERSECTION	COUNTY	VOLUME/CAPACITY (SORTED HIGHEST TO LOWEST)
MD 26 at Lord Baltimore Dr	Baltimore	1.31
MD 5 at Surratts Rd	Prince George's	1.18
MD 210 at Livingston Rd/ Kerby Hill Rd	Prince George's	1.13
MD 202 at Ramp 2 to I-95 NB	Prince George's	1.12
MD 2 at Tarragon La	Anne Arundel	1.11
MD 210 at Wilson Bridge Dr	Prince George's	1.09
MD 175 at MD 170/Piney Orchard Pkwy	Anne Arundel	1.09
MD 4 at Chaneyville Rd	Calvert	1.05
MD 4 at MD 337/Presidential Pkwy	Prince George's	1.04
MD 5 at Auth Way/Simpson Rd	Prince George's	1.03
MD 185 at Aspen Hill Rd	Montgomery	1.02
MD 201 at MD 410	Prince George's	1.01
MD 193 at E. Franklin Ave/Franklin Ave	Montgomery	1.00

Table 19

LOS "F" INTERSECTIONS PM PEAK HOUR		
INTERSECTION	COUNTY	VOLUME/CAPACITY (SORTED HIGHEST TO LOWEST)
MD 2 at MD 524 (Old Town Rd)/Cox Rd	Calvert	1.20
MD 202 at Ramp to I-95 NB	Prince George's	1.12
MD 41 at Putty Hill Rd	Baltimore	1.11
MD 586 at Twinbrook Pkwy	Montgomery	1.11
MD 500 at MD 410/Adelphi Rd	Prince George's	1.10
MD 5 at MD 637 (Naylor Rd)	Prince George's	1.10
MD 201 at MD 410	Prince George's	1.09
US 1 at US 1 Alt/Hamilton St	Prince George's	1.08
I-370/Sam Eig Highway at Fields Rd	Montgomery	1.08
MD 210 at Livingston Rd/Kerby Hill Rd	Prince George's	1.07
MD 193 at Metzerott Rd/Paint Branch Dr	Prince George's	1.07
MD 4 at MD 337/Presidential Pkwy	Prince George's	1.07
MD 355 at Jones Bridge Rd/Center Dr	Montgomery	1.06
US 40 at Rossville Blvd	Baltimore	1.05
MD 193 at Cherrywood La/60th Ave	Prince George's	1.05
MD 637 at Suitland Pkwy	Prince George's	1.04
MD 2 at MD 4 (Sunderland)	Calvert	1.04
MD 212 at MD 410	Prince George's	1.03
MD 3 at Crawford Blvd/Cronson Blvd	Anne Arundel	1.03
MD 214 at Ritchie Rd/Garrett A Morgan Blvd	Prince George's	1.02
MD 26 at Lord Baltimore Dr	Baltimore	1.02
MD 2 at Tarragon La	Anne Arundel	1.02
MD 5 at Flat Iron Rd	St. Mary's	1.01
MD 355 at Tuckerman La (North Intersection)	Montgomery	1.00
MD 26 at Croydon Rd	Baltimore	1.00

Reliability Trends

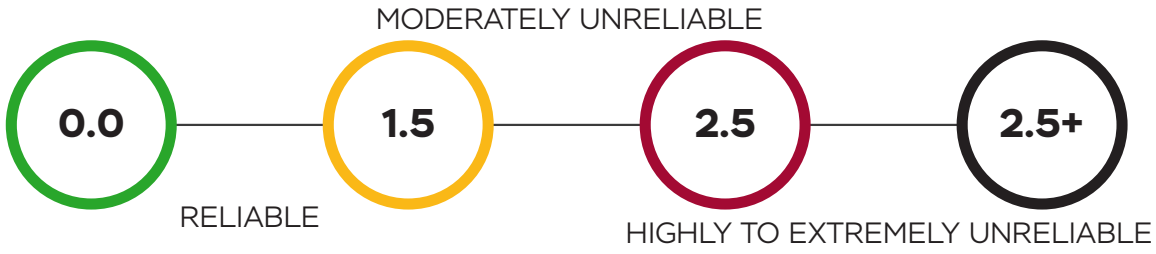
Variability in travel times from day to day shows the unreliability of the system variability often frustrates motorists. This unreliability is caused by events such as incidents, vehicular breakdowns, crashes, weather, or lane reductions through work zones and can impact automobiles, trucks and on-street transit services. For all travelers there is a cost associated with the additional travel time due to the unreliability of the network. These motorists must add a buffer to reach their destination on time which take away from time where they could be accomplishing other tasks. An unreliable system causes an undesirable customer experience for motorists, truck drivers and transit riders.

MDOT SHA recognizes the importance of a reliable transportation system to improve the experience of the motorist and continue to deliver programs and projects to improve system reliability. Improved reliability allows travelers to better plan their trips and daily schedules. The importance of the reliability and the cost associated with it varies by purpose, nature and the importance to that particular motorist. For example, to catch a flight, to have a freight delivery occur on time, or just to be able to attend a child's event may have variable cost implications to that particular person or business.

The MDOT SHA uses the Planning Time Index (PTI) to evaluate trip reliability. The PTI in Maryland equates to the 95th percentile travel time for a section of roadway and is generalized as travel time it would take if a major incident or event occurs. The PTI values for freeways/expressways are categorized into three categories. For example, a PTI of 3.0 means that if it takes 10 minutes to traverse a roadway segment in free flow conditions, a motorist should allow 30 minutes for travel to ensure 95% on time arrival success. There are three levels of reliability (Figure 20).

Figure 20

METRIC: MEASUREMENT OF RELIABILITY (PLANNING TIME INDEX)



Reliability Measures on the Maryland Freeway/ Expressway System

There are three measures for comparison of year to year reliability trends for the AM peak hour (8:00-9:00 AM) and the PM peak hour (5:00-6:00 PM). These are the number of freeway/expressway miles that are highly to extremely unreliable, percent of the total freeway/expressway system that is highly to extremely unreliable, and the percent of the peak hour VMT that is impacted which relates the traffic volumes to the portion of the system that is operating at highly to extremely unreliable conditions. Five hours were evaluated on a statewide basis for reliability as follows:

- Statewide Reliability AM Peak Hour - Figure 21
- Statewide Reliability PM Peak Hour - Figure 22

- Statewide Reliability Summer Friday 6-7 PM - Figure 23
- Statewide Reliability Summer Saturday 11 AM-12 PM - Figure 24
- Statewide Reliability Summer Sunday 5-6 PM - Figure 25

Highly to extremely unreliable conditions for motorists on Maryland's freeway/expressway showed a very slight increase in the number of roadway miles that experience the worst conditions. During the PM peak hour, there was no change in reliability (Table 20).

Table 20

STATEWIDE FREEWAY/ EXPRESSWAY SYSTEM
AVERAGE WEEKDAY AM & PM PEAK HOUR RELIABILITY SUMMARY

HIGHLY TO EXTREMELY UNRELIABLE CONDITIONS	2016		2017		2018		CHANGE FROM 2017 TO 2018	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Number of Roadway Miles	111	200	101	200	107	200	+6	0
Percent of Roadway Miles	7	12	6	12	7	12	+1	0
Percent of Peak Hour VMT Impacted	13	22	13	23	13	22	0	-1

In general, there is a strong correlation between sections of roadway that experience severe congestion and are highly unreliable. Conversely, some sections of roadway operate acceptably on average days but sometimes experience severe congestion. These locations are often influenced by the congestion that is occurring downstream of these sections.

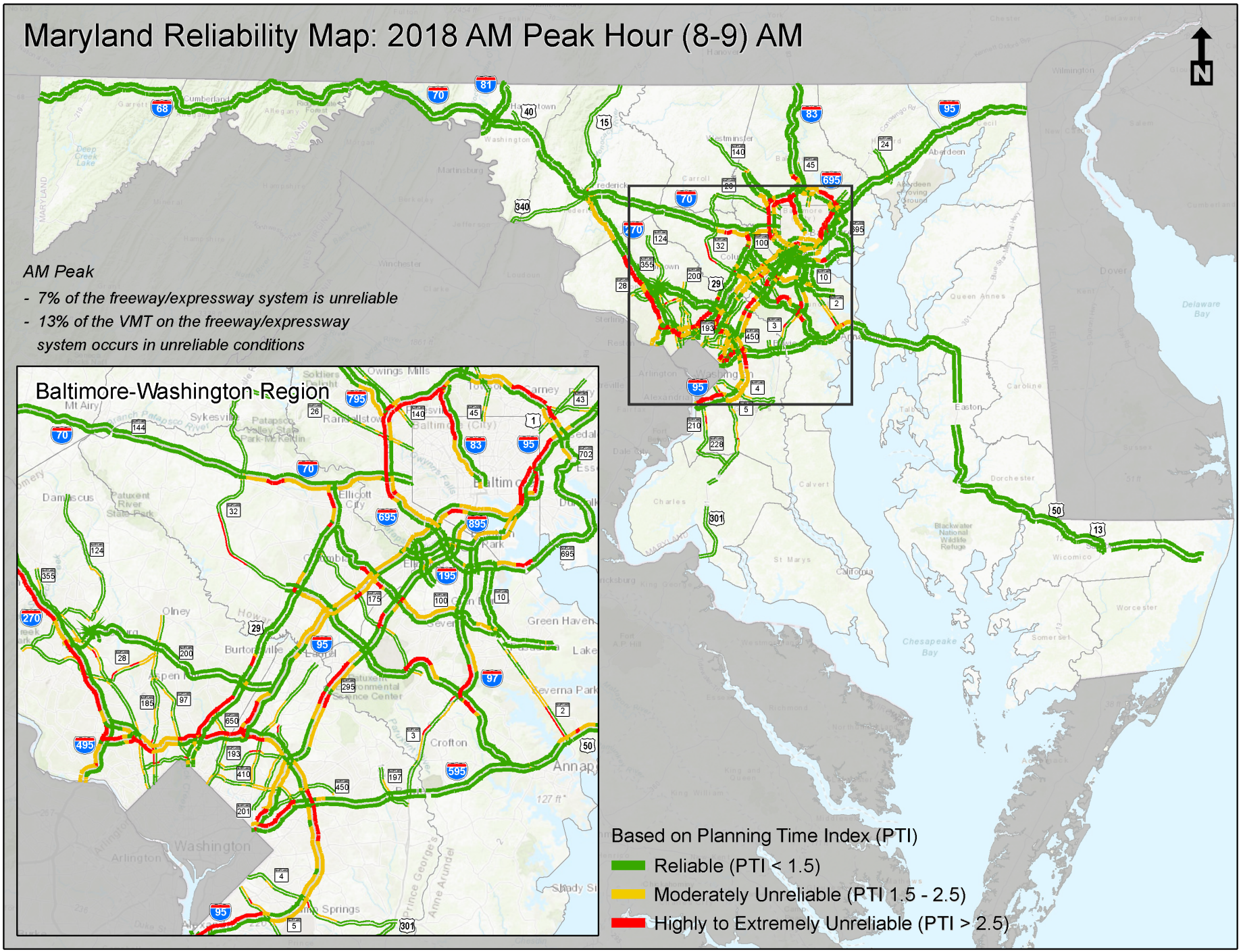
An evaluation was performed comparing PTI values with TTI values. The sections that have the largest difference (PTI value-TTI value) in the AM peak hour were:

- I-95/I-495 Inner Loop from MD 5 to MD 414
- MD 32 Westbound from MD 170 to MD 175
- MD 295 Southbound from MD 450 to US 50
- I-895 Southbound from I-95 to E. Lombard St.
- I-270 Southbound from MD 121 to Father Hurley Blvd.

For the PM peak hour, the sections that showed the largest difference between the PTI value for reliability and the TTI value for congestion were:

- I-495 Outer Loop from MD 187 to I-270 West Spur
- I-895 Northbound from MD 295 to MD 2
- I-95/I-495 Inner Loop from MD 414 to I-295
- US 50 Eastbound from MD 665 to I-70
- US 50 Eastbound from White Hall Rd to Chesapeake Bay Bridge

Figure 21


Maryland Reliability Map: 2018 AM Peak Hour (8-9) AM
AM Peak
- 7% of the freeway/expressway system is unreliable
- 13% of the VMT on the freeway/expressway system occurs in unreliable conditions
Baltimore-Washington Region
Based on Planning Time Index (PTI)
Reliable (PTI < 1.5)
Moderately Unreliable (PTI 1.5 - 2.5)
Highly to Extremely Unreliable (PTI > 2.5)

Maryland Reliability Map: 2018 PM Peak Hour (5-6) PM

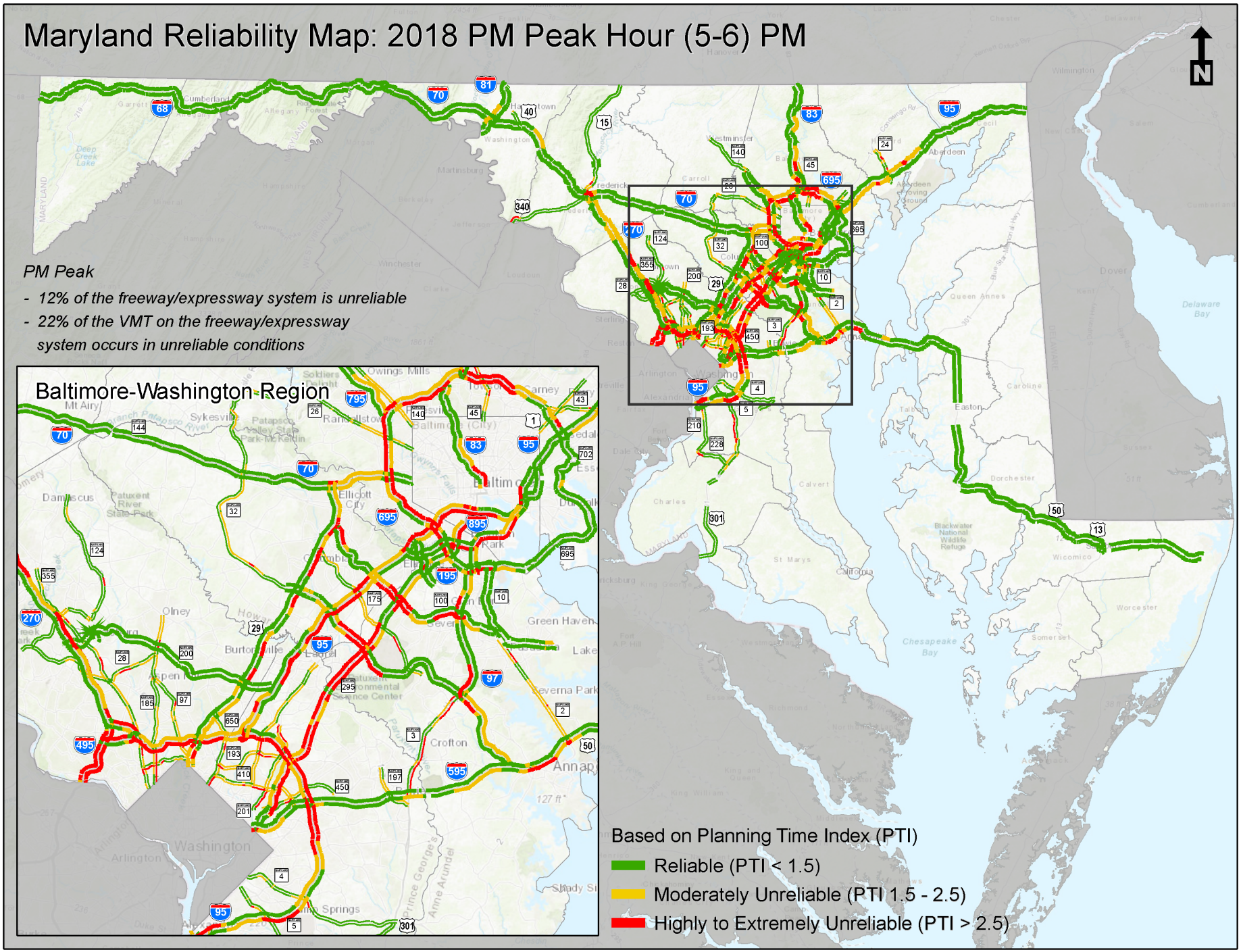
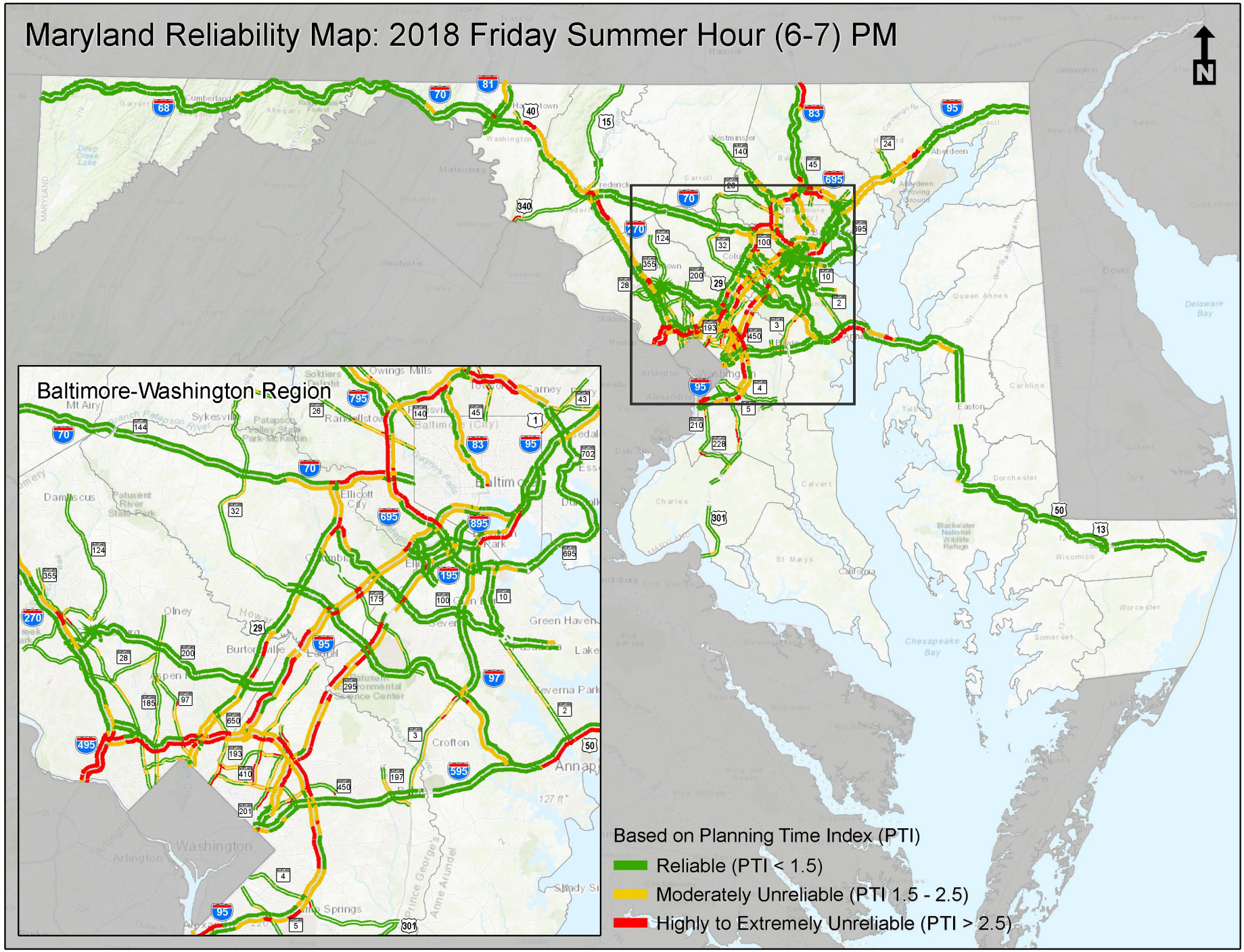


Figure 23


Maryland Reliability Map: 2018 Friday Summer Hour (6-7) PM
N
Baltimore-Washington Region
Based on Planning Time Index (PTI)
Reliable (PTI < 1.5)
Moderately Unreliable (PTI 1.5 - 2.5)
Highly to Extremely Unreliable (PTI > 2.5)

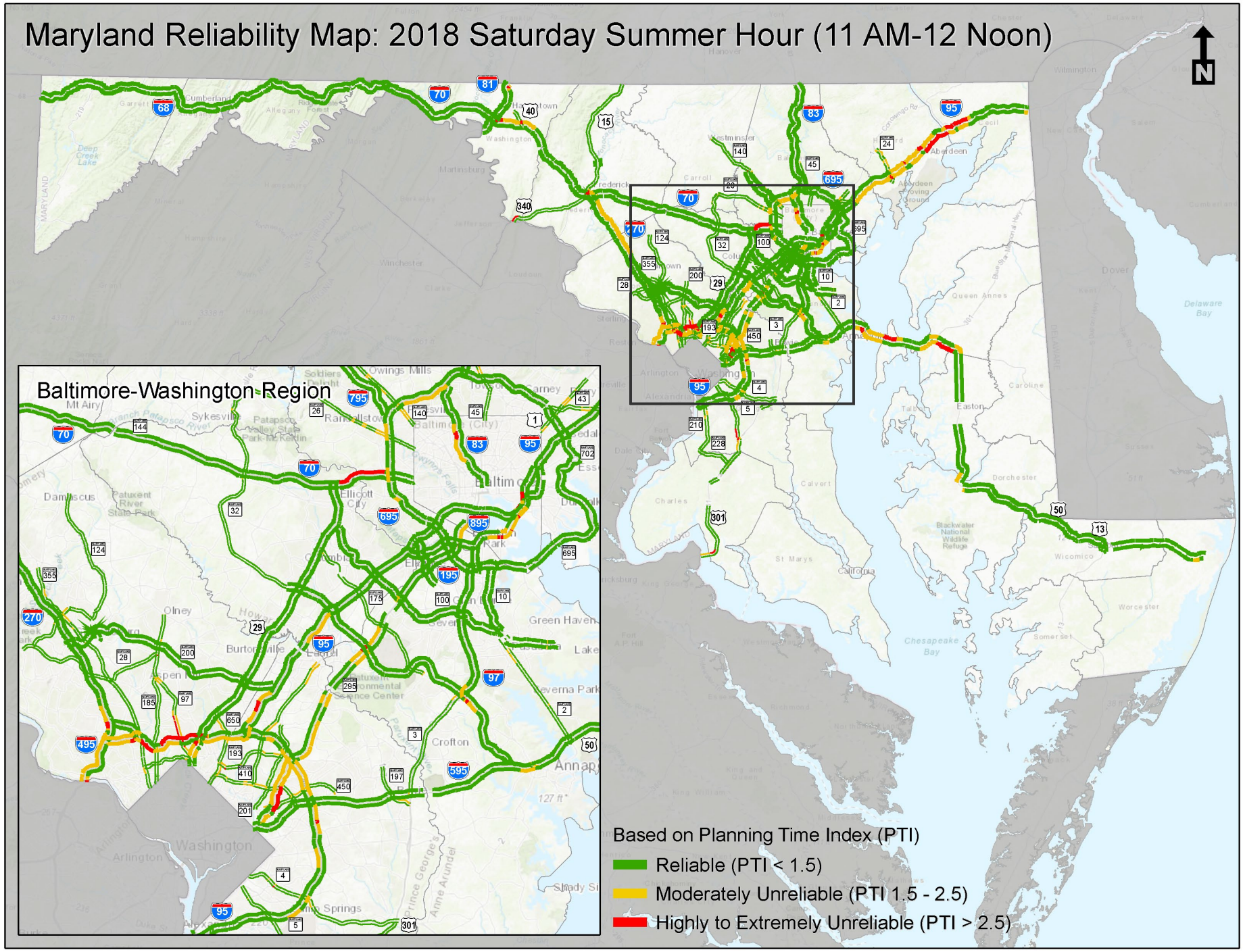
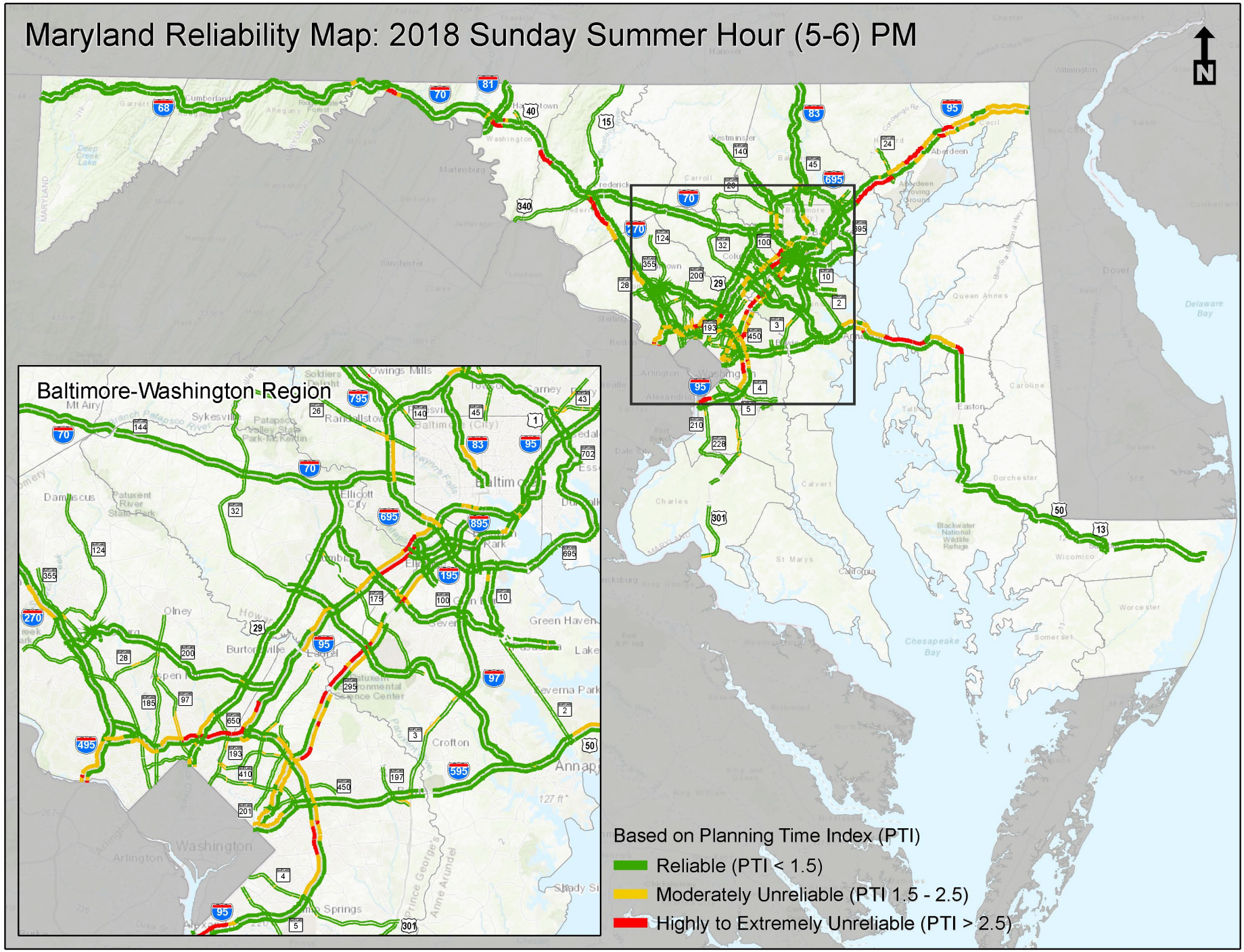

Maryland Reliability Map: 2018 Saturday Summer Hour (11 AM-12 Noon)
N
Baltimore-Washington Region
Based on Planning Time Index (PTI)
Reliable (PTI < 1.5)
Moderately Unreliable (PTI 1.5 - 2.5)
Highly to Extremely Unreliable (PTI > 2.5)

Figure 25


Maryland Reliability Map: 2018 Sunday Summer Hour (5-6) PM
N
Baltimore-Washington Region
Based on Planning Time Index (PTI)
Reliable (PTI < 1.5)
Moderately Unreliable (PTI 1.5 - 2.5)
Highly to Extremely Unreliable (PTI > 2.5)

Truck Data and Trends

Freight and goods movement is crucial to the economy of Maryland. The majority of freight is moved by truck, which rely on a well connected and maintained roadway system. This includes along the Interstates that act as both local origins and destinations and as through routes such as I-68, I-70, I-81 and I-95. In fact, MDOT roadways are used to haul 84% of truck freight. The total truck freight value in 2018 was estimated to be $304 million. In order to evaluate truck freight movement, MDOT SHA performs traffic data collection that includes identifying the number of trucks that utilize a particular roadway. These counts are conducted on a three year cycle. Several sections of I-95 have the highest volume of trucks in Maryland (Table 21). The highest percentage of trucks on a section of road range up to 32% (Table 22).

Highest Truck Volume Locations

Table 21

HIGHEST TRUCK VOLUME		
	LOCATION	AVERAGE DAILY TRUCK VOLUME
1	I-95 North of I-695	31,300
2	I-95 North of MD 32	25,100
3	I-95/I-495 North of US 50	24,600
4	I-95 North of MD 100	24,500
5	I-95 North of MD 24	24,300

Highest Truck Percentage Locations

Table 22

HIGHEST TRUCK PERCENTAGE LOCATIONS		
	LOCATION	TRUCK %
1	MD 159 – South of US 40	32%
2	MD 313 – South of US 301	29%
3	I-81 – South of Pennsylvania State Line	28%
4	I-81- South of US 11	28%
5	MD 550 – North of MD 26	27%

Sections of I-81, I-95 and I-695 have over 20,000 trucks per day.

Overnight Truck Parking Survey

Truck parking along roadways is a key safety concern for truck drivers and other motorists. This is especially a concern at night when truck drivers need to rest. Truck parking at rest areas and other commercial truck stops provide locations to reduce the potential for crashes between parked trucks and moving vehicles. Parking along shoulders of highways and at entrance/exit ramps can create a hazard. An annual survey is performed twice a night for three nights at 11 PM and 4 AM on the major routes mainly along the National Highway Freight Network to identify the number of trucks and location. The trucks in private lots were counted but not included in the results of the survey. The highest volume roadways for truck parking were I-95, I-70, US 301 and I-68 (Figure 26). This figure shows the traffic parking along those roadways averaged over the six survey period and during the peak time. The overall results of the survey including the routes and locations where the highest number of trucks were parked were identified (Table 23).

Figure 26

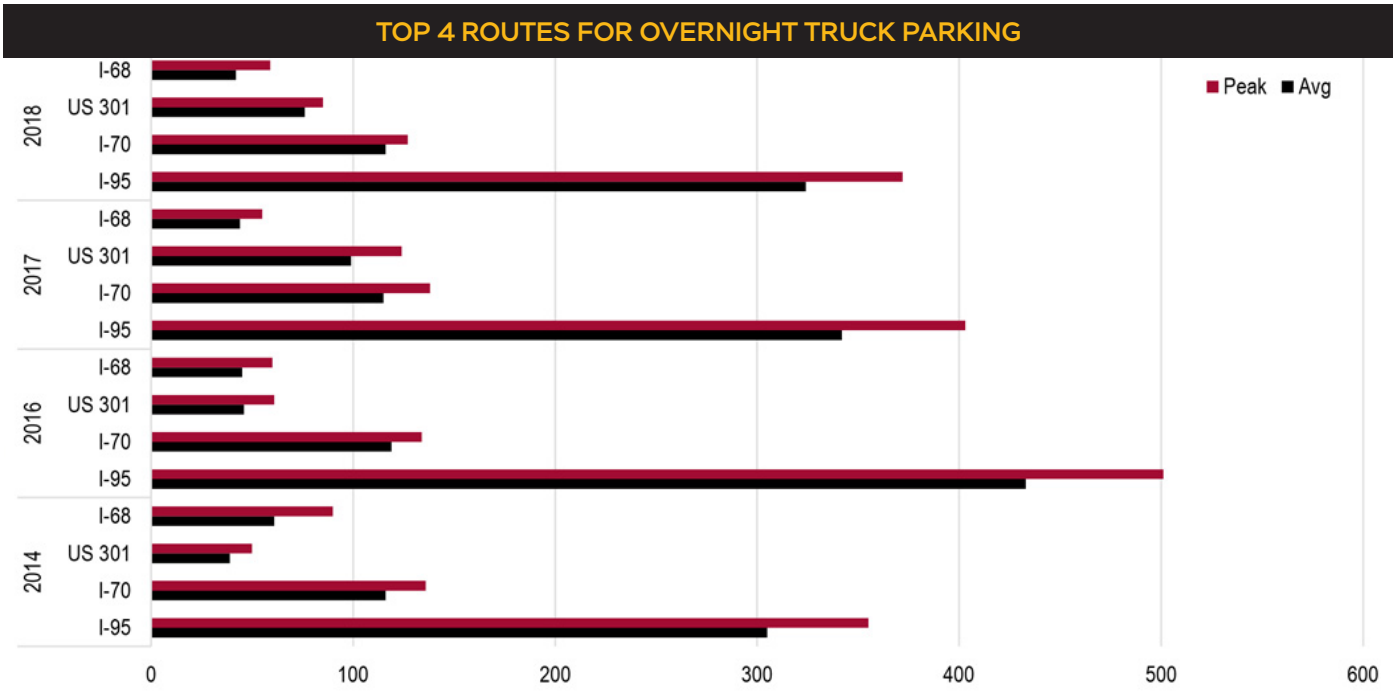
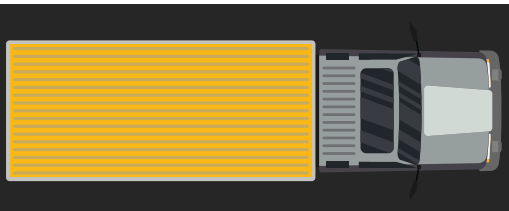


Table 23

HIGHEST NUMBER OF TRUCKS PARKED STATEWIDE		
LOCATION	2017	2018
Highest Number of Trucks Parked Statewide	796	734
Highest on Any Roadway (I-95)	403	372
Highest Average on Any Roadway (I-95)	342	324
HIGHEST LOCATIONS	2017	2018
I-95 Southbound Welcome Center	95	101
I-95 Northbound Welcome Center	64	61
Maryland House Travel Plaza	93	52



Average truck parking at public lots was 400 lower than 2017. Conversely, private lots showed an increase of approximately 600 trucks.

Truck Congestion

The American Transportation Research Institute (ATRI) as part of the efforts to monitor freight performance identifies the 'The Nations Top Truck Bottlenecks'. The ATRI analysis determines the worse bottlenecks by identifying a 'total freight congestion value' in a process which includes determining free flow speed, the average truck speed deviation from the free flow speed, a hourly freight congestion based on the speed and on the volume, and the cumulative 24 hour freight congestion values. The locations in Maryland and their national rank are shown below. [Source: American Transportation Research Institution]

Worse Bottlenecks at Freeways/Expressways with Other Roadways

Bottlenecks are identified through the University of Maryland CATT Lab Vehicle Probe Project (VPP) Suite using minute to minute speeds available across the system to determine congestion patterns. Each roadway segment is analyzed to determine when and where speed drop below 60% of the free flow speed, the duration this occurs, length of the queuing and the frequency. The top 5 locations in Maryland not associated with the intersection of two interstate roadways were:

1. I-495 @ MD 97
2. I-495 @ Edmondson Avenue
3. I-270 @ MD 109
4. I-97 @ MD 178
5. I-270 @ Middlebrook Rd

Freight Congestion Costs

ATRI estimated congestion cost to the trucking industry nationally through its Cost of Congestion to the Trucking Industry: 2018 Update. The congestion cost is based on the total cost and the cost per mile in each state that are part of the National Highway System (NHS). The results were mixed for Maryland area. The study ranked the District of Columbia number 1 and Maryland number 3 in the cost per segment mile and the Washington DC area number 6 in total congestion cost for trucking for a metropolitan area. However, overall congestion cost saw a drop in Maryland and the Baltimore area.

Maryland had the 5th largest decrease in congestion cost with the Baltimore Metropolitan area having the largest decrease in the country.

Maryland Freight Congestion Costs

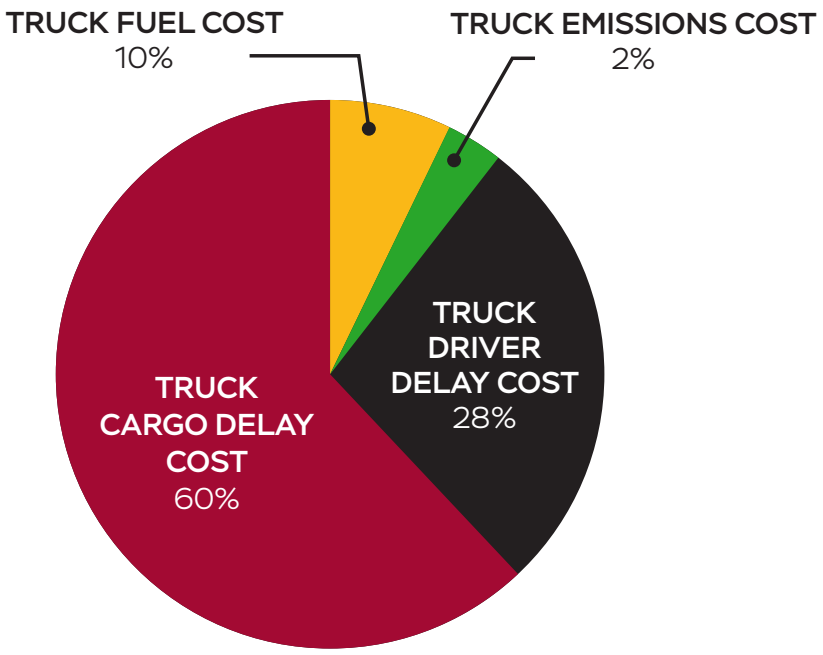
Freight operators experience congestion costs due to truck driver delay, truck cargo delay, additional fuel cost and emission cost along the freeway/expressway system (Table 24 and Figure 27).

Table 24

2018 FREIGHT CONGESTION COSTS ON MARYLAND'S FREEWAY/EXPRESSWAY SYSTEM	
CONGESTION ELEMENT	COST IN MILLIONS
Truck Cargo Delay	$127
Truck Driver Delay	$59
Truck Fuel	$21
Truck Emissions	$5
TOTAL	$212

Figure 27

2018 FREIGHT CONGESTION COSTS ON MARYLAND'S FREEWAY/EXPRESSWAY SYSTEM
$212 million



Truck Travel Time Reliability Index

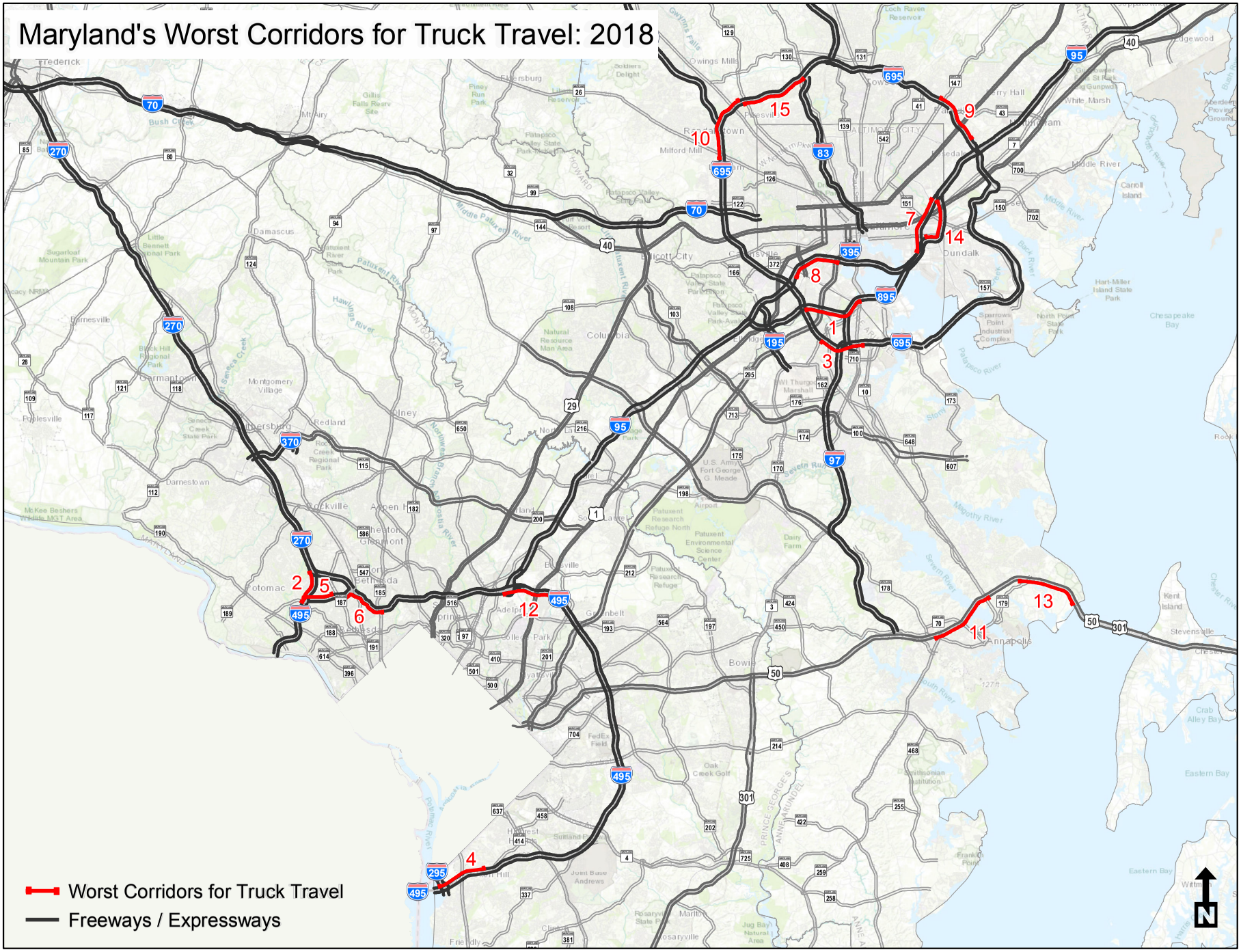
The Truck Travel Time Reliability Index (TTTR) represents the 95th percentile travel time divided by the 50th percentile travel time for each segment. The TTTR is calculated for five time periods with the maximum value used to determine the final system performance. Each individual segment TTTR value was combined to develop the limits of the Most Unreliable Corridors on the Interstate system for trucks (Table 25 and Figure 28). The higher the TTTR value the worse the operations are for trucks in that segment.

Table 25

2018 TOP 15 WORST CORRIDORS FOR TRUCK TRAVEL					
RANK	ROUTE/DIRECTION	LIMITS	COUNTY	MILEAGE	TTTR MAX VALUE
1	I-895 Northbound	I-695 to MD 2	Baltimore/ Anne Arundel/Balt. City	3.5	6.5
2	I-270 West Spur Southbound	I-270 Split to I-495	Montgomery	2.1	5.8
3	I-695 Outer Loop	MD 170 to MD 10	Anne Arundel	3.3	4.9
4	I-495 Inner Loop	MD 414 to I-295	Prince George's	3.4	4.9
5	I-495 Outer Loop	MD 187 to MD 190	Montgomery	3.0	4.9
6	I-495 Inner Loop	MD 187 to MD 185	Montgomery	3.1	4.6
7	I-895 Southbound	Moravia Road to Holabird Rd	Balt. City	3.4	4.6
8	I-95 Northbound	I-695 to MD 295	Balt. City	3.3	4.5
9	I-695 Outer Loop	I-95 to MD 147	Baltimore	3.1	4.3
10	I-695 Outer Loop	MD 129 to MD 26	Baltimore	3.6	4.2
11	US 50 Eastbound	MD 665 to MD 2	Anne Arundel	3.9	4.2
12	I-495 Inner Loop	MD 212 to Greenbelt METRO Center	Prince George's	3.2	4.2
13	US 50 Eastbound	Buschs Frontage Rd to Bay Bridge	Anne Arundel	3.6	3.9
14	I-95 Southbound	I-895 to O'Donnell St.	Balt. City	3.3	3.8
15	I-695 Inner Loop	MD 129 to I-83	Baltimore	3.3	3.8

Congestion cost for trucks decreased by $75 million between 2017 and 2018.

Figure 28


Maryland's Worst Corridors for Truck Travel: 2018
1
2
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12
13
14
15
Worst Corridors for Truck Travel
Freeways / Expressways
N

MDOT SHA'S MOBILITY PROJECTS

MD 147 @ Glen Arm - Mt Vista Rd

Capital Projects

MDOT SHA employs a variety of projects and programs to address congestion and reliability issues. One of the programs is to provide for increased capacity and safety improvements at locations throughout the state. These projects are identified through a performance based approach and range from interchange construction to providing turn lanes at intersections. These projects often include pedestrian and bicycle network enhancements. Twelve (12) improvement projects were completed in calendar year 2018 to provide for congestion relief, improve safety and enhance traffic operations. All projects are reviewed from a practical design standpoint to ensure the proposed project is addressing just the defined purpose and need.

Each of the twelve improvement projects were analyzed to determine the benefits they provide to the traveling public. The benefits are related to reduction in delay incurred by motorists and commercial vehicles, fuel savings and the safety benefit resulting from the improvement, and the benefit provided by the increased reliability of the system (Table 26).

Table 26

MOBILITY PROJECTS OPENING YEAR BENEFITS					
ROUTE	LIMITS	COUNTY	CONGESTION & FUEL SAVINGS	SAFETY SAVINGS	ANNUAL COST SAVINGS
			$ (Thousands)		
US 50/301	Severn River Bridge EB	Anne Arundel	19,200	398	19,598
I-95	I-95 ETL to Ft McHenry Tunnel	Balt. City	3,619	645	4,264
MD 147	Glen Arm Road/Mt. Vista Road	Baltimore	4,159	171	4,330
MD 482	Gorsuch Road to Cape Horn Road	Carroll	25	337	362
MD 213	Frenchtown Road	Cecil	5	55	60
MD 281	Muddy Lane	Cecil	11	461	472
US 15	Monocacy Blvd	Frederick	75,567	714	76,281
MD 22	MD 132 to MD 462	Harford	3,443	330	3,773
MD 97	Burntwoods Road	Howard	14	91	105
MD 234	MD 242	St. Mary's	297	82	379
MD 413	Tulls Corner Road	Somerset	4	17	21
US 113	North of Massey Branch to Five Mile Branch Road	Worcester	95	186	281
Total			106,439	3,487	109,926

2018 Mobility Projects provide $110 million in annual user cost savings in the opening year or approximately $9 million per project on average.

Past Project Benefits

Six locations where projects were constructed to improve operations were analyzed to quantify the travel time savings after the roadway improvements. The use of vehicle probe data allows for a comparison between traffic operations before the projects were constructed with after-construction 2018 data to determine the mobility benefits.

- I-95 Express Toll Lanes – I-895 to MD 43
- MD 295 – I-195 to I-695
- I-95 – MD 212 to MD 198
- I-695 – MD 41 to MD 43
- I-695 – US 1 to MD 372
- US 29 Northbound – MD 32 to MD 175

The Travel Time Index (TTI) was utilized for the comparisons between 2011 base year before construction started data with the 2018 data (Table 27). The year 2011 represented the oldest year INRIX data was analyzed for the TTI.

Table 27

CONGESTION IMPROVEMENT BY COMPLETED PROJECTS						
ROUTE/DIRECTION	LIMITS	LENGTH (MILES)	COUNTY	2011 TTI	2018 TTI	% REDUCTION IN DELAY
MD 295 AM SB	I-695 to W. Nursery Rd	1.1	Anne Arundel	1.45	1.09	+25
MD 295 PM NB	I-195 to I-695	2.6	Anne Arundel	1.73	1.08	+38
I-95 AM SB	MD 43 to S of I-695	4.3	Baltimore	1.72	1.01	+41
I-95 PM NB	US 40 to MD 43	6.9	Baltimore	1.32	1.04	+21
I-695 Inner Loop PM	I-895 to I-95	1.6	Baltimore	1.31	1.09	+17
I-695 Inner Loop PM	MD 41 to MD 147	1.8	Baltimore	1.49	1.35	+9
US 29 NB PM	S of MD 32 to N of Broken Land Parkway	2.3	Howard	1.97	1.09	+45
I-95 SB AM	MD 212 to I-495	3.1	Prince George's	1.77	1.52	+14

Pedestrian Projects

A major emphasis of MDOT SHA is to improve pedestrian facilities. This occurs through projects associated with roadway improvements or as standalone projects through various funding sources. Pedestrian facility improvements could include filling in sidewalk gaps, upgrading sidewalks in poor condition, off road trails, countdown signals, HAWK signals, pedestrian signals and ADA facilities such as ramps, audible pedestrian signals and count down signals. It is anticipated that between fiscal year 2018 and 2023, MDOT will provide $75 million for the reconstruction and completion of new sidewalks. In 2018, new sidewalks were constructed in 14 counties (Table 28).

Table 28

NEW SIDEWALK LOCATIONS		
ROUTE	LIMITS	COUNTY
MD 168	Weldman Ave to Raynor Ave	Anne Arundel
MD 175	at Vanguard Rd/Gaines Mill Rd	Anne Arundel
MD 2	MD 648 to Arnold Rd	Anne Arundel
MD 253	MD 2 to MD 214	Anne Arundel
MD 435	Herbert Sachs Blvd to Annapolis St	Anne Arundel
MD 450	at Holly Ave	Anne Arundel
MD 713	MD 175 to Stone Castle Dr	Anne Arundel
MD 122	at Colonial Rd	Baltimore
MD 122	at Cooks Ln	Baltimore
MD 122	at Ingleside Ave	Baltimore
MD 122	at Perimeter Dr	Baltimore
MD 122	at Whitehead Rd	Baltimore
MD 147	at Placid Ave	Baltimore
MD 542	Loch Hill Rd to Yakona Rd	Baltimore
US 40	at Campbell Blvd	Baltimore
MD 231	at Prince Frederick Blvd	Calvert
MD 324	Railroad Ave to MD 331	Caroline
MD 331	Fooks Ave to West of MD 324	Caroline
MD 331	MD 324 to North of Payne Rd	Caroline
MD 30 Bus	North Woods Trail to Ralph Ave	Carroll
MD 140	Wilson Ave to Grand Dr	Carroll
US 50	Woods Rd to Crusader Rd	Dorchester
MD 140	Armstrong Ln to Timbermill Rd	Frederick

Table 28 - continued

ROUTE	LIMITS	COUNTY
MD 17	B Street to Center St	Frederick
MD 26	at Monocacy Blvd	Frederick
MD 85	at Crestwood Blvd/Shockley Dr	Frederick
MD 22	at MD 462 (Paradise Rd)	Harford
MD 22	I-95 off ramp to Paradise Rd	Harford
MD 22	at MD 543 (Fountain Green Rd)	Harford
MD 7	at MD 24	Harford
MD 108	South of Guilford Rd	Howard
MD 108	at Ten Oaks Rd	Howard
MD 144	Westmount Parkway to Old Ellicott Circle	Howard
MD 216	at South Maple Lawn Blvd	Howard
US 1	at Port Capital Dr	Howard
US 1	at Wilbert Ln	Howard
MD 108	at Willow Ln	Montgomery
MD 117	Kingsview Rd to Hopkins Rd	Montgomery
MD 28	at Riffle Ford Rd	Montgomery
MD 410	at New Hampshire Ave	Montgomery
MD 650	MD 198 to Old MD 198	Montgomery
MD 4	MD 458 (Silver Hill Rd) to Forestville Rd	Prince George's
MD 410	at Editors Park Dr	Prince George's
MD 337	at Suitland Rd	Prince George's
MD 978A	Hall Station Rd to Railroad	Prince George's
US 1	Cherokee St to I-495	Prince George's
MD 246	East Run Blvd to MD 237	St. Mary's
MD 5	at Clarks Rest Dr	St. Mary's
MD 944	Airport View Dr to Clarkes Landing Rd	St. Mary's
MD 65	at Col Henry K Douglas Dr	Washington
MD 65	E Oak Ridge Dr to Doub Way	Washington
MD 528	16th St to 30th St	Worcester

There were 8.6 miles of new sidewalks constructed in 2018 by MDOT SHA.

69% of sidewalks are ADA compliant along Maryland Routes.

Bicycle Projects

In 2018, Complete Streets legislation was passed to promote design features that accommodate and facilitate safe and convenient access and mobility by all users. The MDOT SHA strives to improve bicycle safety and accessibility while also looking for opportunities to provide additional services such as bike share. Upgrades to a roadway could include bicycle facilities such as on-street bike lanes, signing, pavement markings and improvements at intersections. Standalone bicycle facilities such as separated bike paths are also part of bicycle upgrade projects. Presently, 367 directional miles have been improved for bicycle access along with almost 20 miles of shared lanes by MDOT SHA. Selected bicycle facility upgrades took place throughout the state (Table 29).

Table 29

SELECTED BIKE FACILITY UPGRADE LOCATIONS IN 2018

ROUTE	LIMITS	COUNTY	IMPROVEMENT
MD 2	at Owensville Sudley Rd.	Anne Arundel	0.4 miles of bike lanes in each direction
MD 45	Corbett Rd. to Gifford Ln.	Baltimore	0.8 miles of bike lanes in each direction
US 40	MD 222 to West of MD 272	Cecil	6.8 miles of bike lanes in each direction
MD 213	at Frenchtown Rd.	Cecil	0.8 miles of bike lanes in each direction
MD 190	MD 614 to Washington DC Line	Montgomery	1.3 miles of bike lanes in each direction
MD 704	Hill Rd. to Greenleaf Rd.	Prince George's	1.2 miles of bike lane in each direction
MD 528	62nd St. to 26th St.	Worcester	Sharrows on multiple locations

2018 SYSTEM UPGRADES

31 miles of additional marked bike facilities

>11 mile increase in bike facilities within three miles of transit

Freight Projects

Freight projects are divided into two categories. The first category are roadway projects that enhance overall mobility which provides improvements for freight operators. The second category is projects that are directly related to improving trucking operations. Both types of projects are important to address the ever growing movement of goods by truck due to the increase in distribution centers and home delivery of products. The goal of all projects is to balance the mobility of truckers while keeping other users of the network safe including motorists/bicyclists/pedestrians.

There are several on-going projects to move freight more efficiently and safely. Two of the major programs are associated with the MDOT SHA's Motor Carrier Division. The first is MDOT SHA's Maryland One Permit System. This allows for the state to process applications more efficiently for large shipments. Previously, permit approval could take hours or days depending upon the request. In 2018, the Maryland One Permit System provided the following results:

- 81% of permits processed within minutes
- Superload permits (120,000 to 200,000 pounds) issued within 2 days
- Megaloads permits (up to 1,000,000 pounds) requires coordination between numerous agencies and take a longer period of time to be processed

The second program is the construction and maintenance of Virtual Weigh Stations (VWS). Virtual weigh stations utilize technology through a system of sensors and cameras to record commercial motor vehicles traveling at highway speed. The VWS can record speed, height, weight and every axle without requiring a vehicle to stop. This system improves mobility and assist in limiting damage to roads and bridges caused by overweight trucks. There are 16 active VWS sites with 4 more proposed to be operational in 2019 (Figure 29).

Four sites became active in 2018 at the I-95 Susquehanna River Bridge Tydings Memorial Bridge, I-81, I-95 (Ft. McHenry Tunnel) and I-695 (Bear Creek).

Another area of concern for freight operations is overnight truck parking. Truck parking at Rest Areas and Welcome Centers provide for safe locations to reduce the potential for crashes between parked trucks and moving vehicles while parking along shoulders or entrance/exit ramps can create a safety hazard to other motorists and truck drivers. MDOT SHA's Freight Planning Program is working on these issues. Truck parking locations are depicted in Figure 31. Presently the following initiatives are underway to increase truck parking.

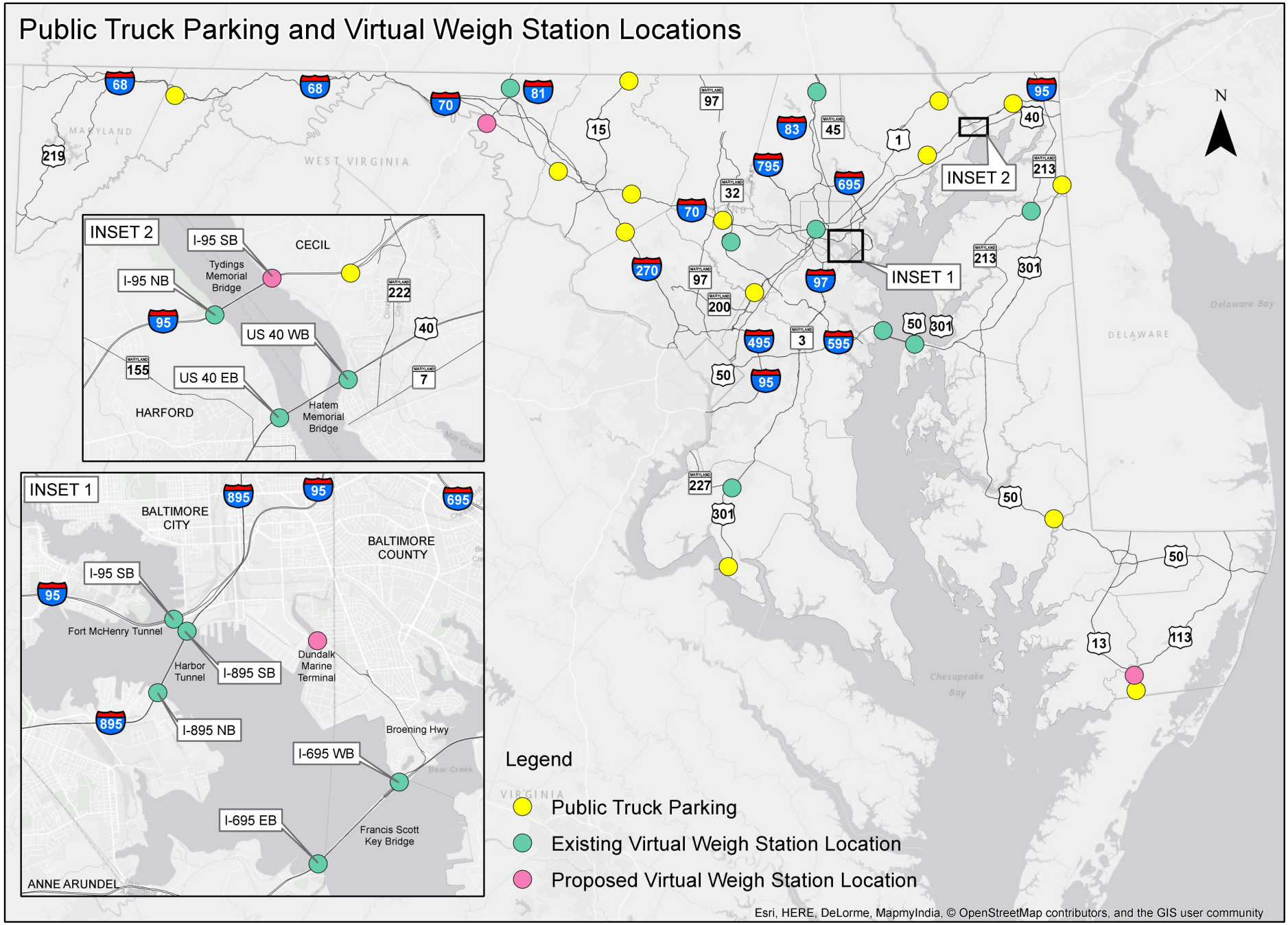
OVERNIGHT TRUCK PARKING EXPANSION

I-70 Westbound Welcome Center Frederick County -
Up to 10 added spaces under design

I-70 Eastbound Welcome Center Frederick County -
Up to 10 added spaces under design

I-95/I-495 Prince George's County -
Planning studies on-going

Figure 29


Public Truck Parking and Virtual Weigh Station Locations
INSET 2
I-95 SB
Tydings Memorial Bridge
CECIL
I-95 NB
US 40 WB
US 40 EB
HARFORD
Hatem Memorial Bridge
INSET 1
BALTIMORE CITY
BALTIMORE COUNTY
I-95 SB
Fort McHenry Tunnel
Harbor Tunnel
I-895 SB
I-895 NB
Dundalk Marine Terminal
Broening Hwy
I-695 WB
I-695 EB
Francis Scott Key Bridge
ANNE ARUNDEL
INSET 1
INSET 2
N
Legend
Public Truck Parking
Existing Virtual Weigh Station Location
Proposed Virtual Weigh Station Location
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Railroad Grade Crossing Projects

Rail at-grade crossings with highways can present a safety issue for all transportation users. Each year MDOT SHA provides safety improvements to at-grade railroad crossings. These include installing new flashing light signals (with or without gates), updating the components at existing active warning devices and improving crossing surfaces. In 2018, there were two locations where improvements were completed. These were at:

- Gill Avenue - Carroll County
- Shiloh Avenue - Carroll County

Gill Ave @ RR Crossing

There are 633 public at-grade and 22 separate pedestrian crossings of railroads in Maryland.

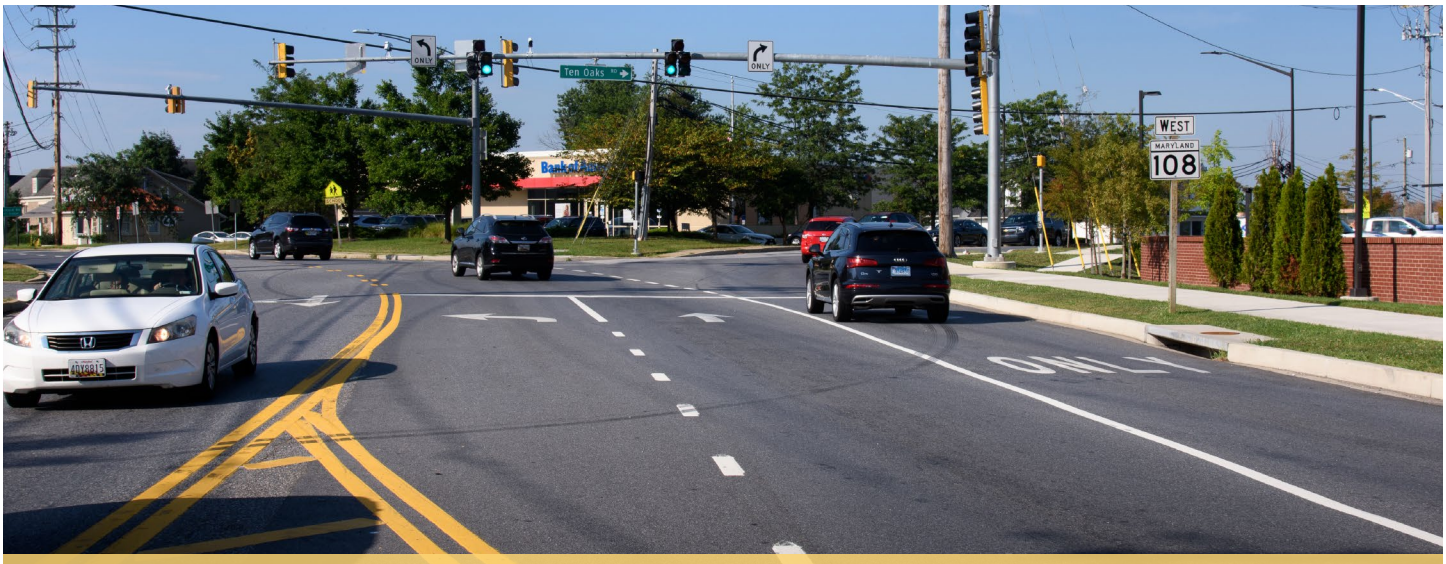
65

Developer Projects

Often developers are required to mitigate the additional volume of traffic from new residential, commercial, warehouse and office developments. In 2018, these improvements range from minor to major intersection modifications to interchange improvements to access improvements such as acceleration and deceleration lanes (Table 30). MDOT SHA works with through a joint process with developers to offset the traffic impacts with improvements that are beneficial corridor wide and not limited to motorists going to/from the development. Without these improvements, operational issues can result. For example, failing intersections or traffic from turn lanes can cause queuing into through lanes can cause safety issues.

Table 30

SELECTED DEVELOPER IMPROVEMENT PROJECTS			
ROUTE	LIMITS	COUNTY	IMPROVEMENT
MD 3	MD 175	Anne Arundel	Deceleration and acceleration lane additions
MD 3	MD 450; Crawford/ Cronson Blvd	Anne Arundel	Turn lane additions and modifications
MD 256	MD 468	Anne Arundel	Turn lane and deceleration lane addition
MD 80	Campus Dr to Pontius Ct	Frederick	Widening
MD 355	West of Timber Green Dr to Lew Wallace St.	Frederick	Widening
MD 108	Ten Oaks Rd	Howard	Turn lane addition
MD 216	West of South Maple Lawn Blvd to MD 216 Dualization	Howard	Widening



MD 108 @ Ten Oaks Rd Turn Lane Addition

MDOT PROGRAMS TO IMPROVE MOBILITY

2018 RESULTS

I-270 NB @ Shady Grove Rd

Transportation Systems Management and Operations - CHART

The MDOT SHA has established various programs to address mobility. These programs provide relief to improve traffic flow and reduce congestion through a variety of methods including reducing the demand on the roadway and making better use of the existing pavement. Specifically, this includes the use of Transportation Systems Management and Operations (TSMO) through the Coordinated Highway Action Response Team (CHART) systems to respond to incidents quicker, improving signal progression, providing park and ride lots, high occupancy vehicle lanes, reversible lanes, and constructing managed lane facilities and express toll lanes.

The MDOT SHA utilizes the CHART which is a multi-agency effort to improve mobility, reliability and safety by addressing incidents or non-recurring congestion. Non-recurring congestion could include crashes, vehicle breakdowns, work zones, special events and weather events. These non-recurring congestion events effect mobility safety and reliability of the roadway system. Mobility and reliability are influenced by the time motorists are waiting for the incident to clear. Safety is impacted by secondary incidents or those crashes that occur by the sudden slowing of traffic caused by the original incident. The CHART program identifies incidents quicker, allows emergency personnel to be altered and minimizes time motorists spend in congestion thereby saving motorists money.

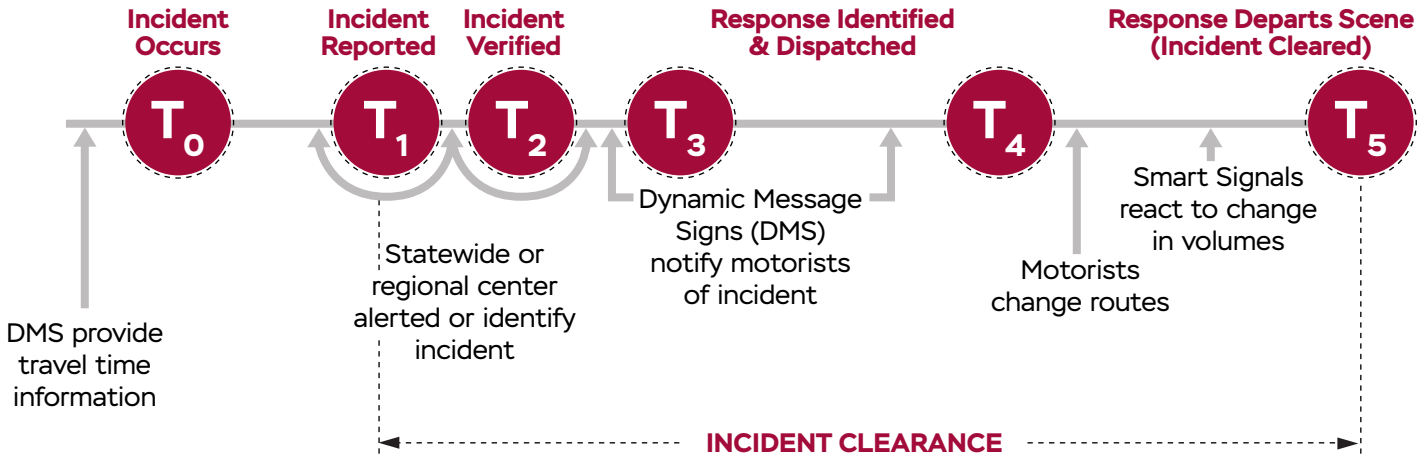


CHART is involved in the following activities to address non-recurring congestion.

- Emergency Preparedness
- Emergency Weather Operations
- Incident Management
- Traffic Management
- Traffic and Roadway Monitoring
- Traffic Information

CHART has many different resources dedicated to traffic management including:

- Emergency Traffic Patrols
- Emergency Response Units
- Freeway Incident Traffic Management Plans and Response Trailers
- ITS Equipment
- Clear the Road Policy and Move It Law
- Information Exchange Network Clearinghouse

Data is collected from a wide variety of ITS equipment that are strategically located throughout the State. Travel time information is made available based on the analysis of INRIX probe speed data and displayed on more than 200 DMS. The Maryland 511 Travel Information Service continues to provide useful, high-quality, and timely travel information. Presently CHART and MDTA have access to:

- 88+ CCTV Cameras
- 300+ Speed Detectors
- 200+ Dynamic Message Signs (DMS)
- 60+ Roadway Weather Information Systems (RWIS)
- 50+ Traveler Advisory Radio
- 15+ Variable Toll Rate Signs

The information from these devices is coordinated through the Statewide Operations Center and three strategically located Traffic Operations Centers at:

- Hanover (Statewide Operations Center)
- College Park
- Essex
- Frederick

One of the most recognizable resources of CHART is the Emergency Traffic Patrols (ETPs). These ETPs assist drivers when their vehicles become disabled or when involved in a crash. These ETPs are assigned to high volume/high incident routes to boost the efficiency of the emergency response program. Areas served by ETP locations include:

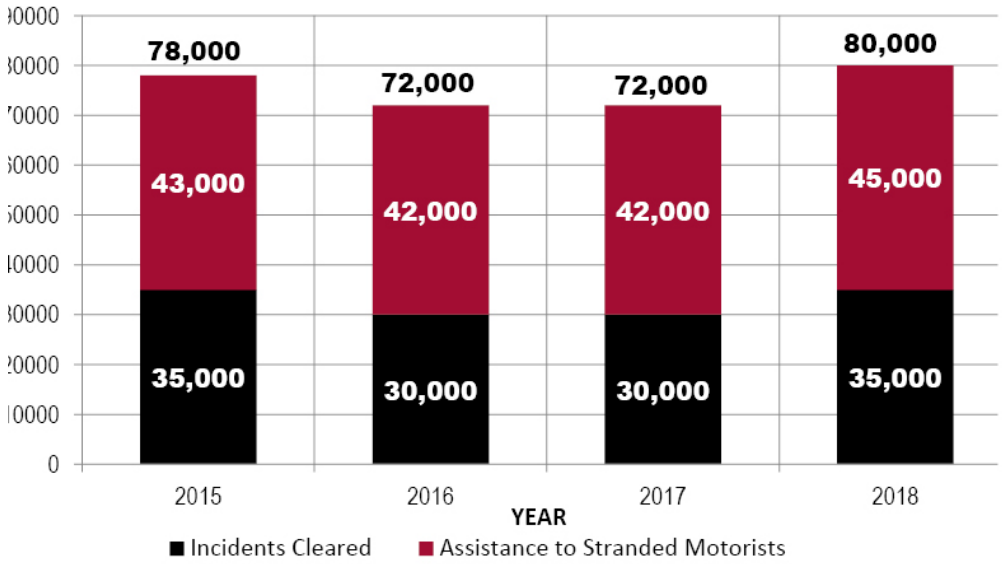
- Annapolis, Baltimore, Frederick and Washington (Full Time)
- Eastern Shore (Summer)

I-97 SB N of US 50/301

The ETPs responded to over 80,000 service calls for support to address motorists and emergency response agency needs along the highway. This was the highest level recorded to date. This included responding to 45,000 incidents along Maryland roadways and 35,000 times providing assistance to motorists (Figure 30). In the last four years ETPs have responded to over 70,000 events each year.

Figure 30

EMERGENCY TRAFFIC PATROL RESPONSES



US 50/301 near Bay Dale Dr

The cost associated with the delay to motorists increases the longer an incident remains on the roadway. The delay includes the amount of time it takes to respond to an incident and the length of time to clear the incident. CHART services reduce the amount of delay and ultimately provides for an annual user cost savings. The average duration of an incident and annual vehicle of delay savings for the last four years are identified (Figure 31 and 32).

Figure 31

AVERAGE INCIDENT DURATION

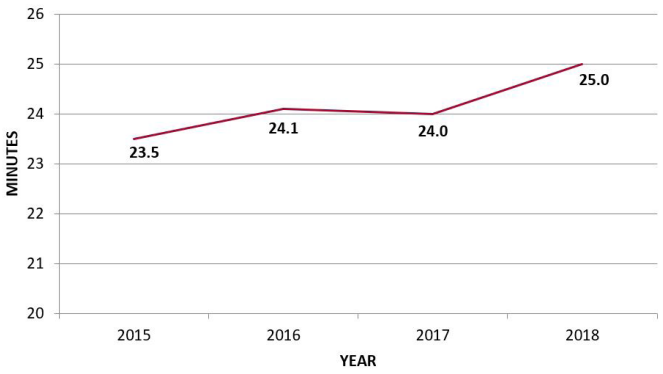
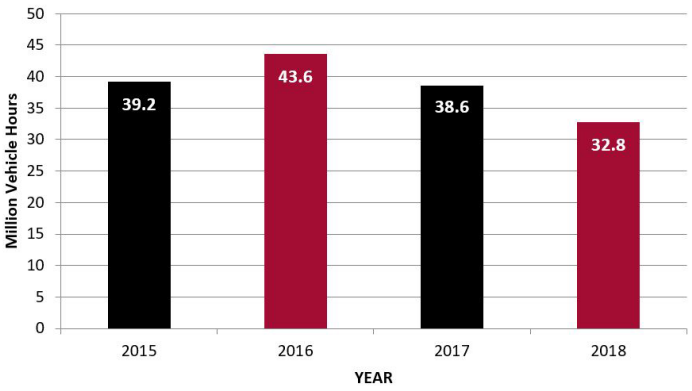


Figure 32

ANNUAL VEHICLE HOURS OF DELAY SAVINGS



In 2018, the annual user cost savings to Maryland travelers amounted to $1.31 billion dollars (Figure 33). Annual user cost savings includes reduction in delay, savings in fuel and emissions.

Figure 33

ANNUAL USER COST SAVINGS BY CHART

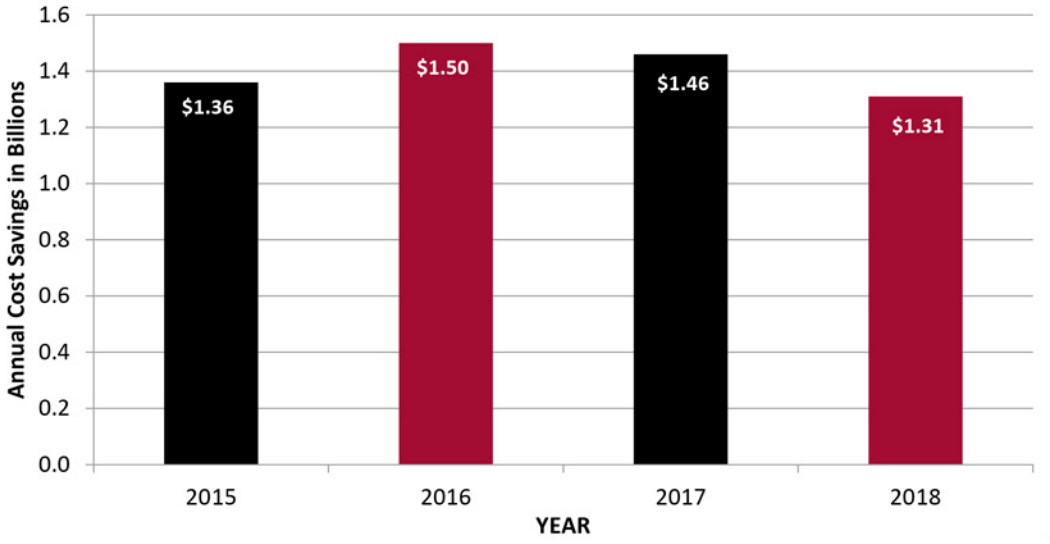


CHART services provided an annual benefit of $ 1.31 billion and reduced delay by 32.8 million hours.

Signal Operations

One of the most cost effective methods to reduce delay and improve mobility in addressing recurring and non-recurring congestion is to optimize traffic signal timing to provide better movement for motorists. Signal timing improvements can reduce delay, decrease emissions and provide for a more walkable environment. Individual signals that are adjacent to each other are often grouped together into a signal system that allow motorists to progress along an entire corridor more efficiently. Overall, MDOT SHA is responsible for:

- 1,571 Traffic Signals
- 259 Signal Systems

In 2018, the timings for 146 signals in 18 systems along with 52 other intersections were reviewed. Other areas addressed with signal operation efforts are modifications to timings, testing new signals, modifying phasing, reviewing proposed developer signals, supporting new innovations such as ramp metering and integrating the Purple Line transit project into the network.

The overall Improvements for the 18 systems were:

- Over 860,000 Hours of Delay Reduction
- 16% Reduction in delay
- Saved over 140,000 Gallons of fuel
- Annual User Savings was $32.7 million with a benefit/cost ratio of 70:1

Table 31 details the systems improved and the delay savings these improvements provided.

Table 31

2018 NETWORK DELAY SAVINGS FOR MDOT/SHA SIGNAL SYSTEMS UPGRADES

ROUTE	LIMITS	COUNTY	NO. OF SIGNALS	DELAY SAVINGS (VEH-HRS)
MD 414	Livingston Rd to 28th Ave/MD 5	Prince George's	14	605,000
MD 108	Great Star Dr to Guilford Rd	Howard	6	105,000
MD 2	Annapolis Harbor Center Dr to Tarragon Ln	Anne Arundel	4	44,000
MD 3	MD 450 to St Stephens Church Rd	Anne Arundel	12	23,000
MD 22	Technology Dr to US 40	Harford	14	21,000
MD 26	Johnsville Rd to Monroe Ave, MD 32 - MacBeth Way to Johnsville Rd	Carroll	11	19,000
MD 45	York Rd Plaza to Bosley Ave	Baltimore	18	12,000
MD 198	US 1 NB to 8th St, US 1 - Bowie Rd to North Laurel Rd	Howard/ Prince George's	15	9,000
MD 2/4	MD 524 (Old Town Rd)/Cox Rd to Ponds Wood Rd	Calvert	3	8,000
MD 140	MD 91 to Dede Rd	Carroll	2	6,000
MD 5	MD 246 to MD 471	St. Mary's	2	5,000
MD 212	Cherry Hill Rd to Beltsville Dr	Prince George's	4	3,000
US 220	MD 53 to MD 636	Allegany	2	3,000
MD 193	Walker Dr to Rhode Island Ave	Prince George's	14	0
MD 212	MD 501/Chillum Rd to Sargent Rd	Prince George's	4	0
MD 170	Betson Ave to MD 32 Ramps	Anne Arundel	3	N/A
MD 175	Reece Road to Odenton Shopping Center	Anne Arundel	9	N/A
US 1 Alt	Selma Ave to Lansdowne Rd	Baltimore	9	N/A
	TOTAL		146	863,000

The highest overall delay reduction by percentage were:

- MD 108 – Great Star Dr to Guilford Rd (31%)
- MD 414 – Livingston Rd to MD 5/ 28th Ave (31%)
- MD 2 – Cox Rd. to Pond Woods Rd. (15%)
- MD 2 – Annapolis Harbor Center Dr. to Tarragon Ln. (12%)

Transit Signal Priority

A method to improve on time transit operations is to implement transit signal priority (TSP) at signalized intersections. TSP allows transit vehicles to jump in front of the queue or extend the green time before the particular approach turns yellow to improve their travel speed and on-time performance.

Active System

- MD 355 – Lakeforest Mall to Medical Center METRO Station - 30 signals
- In 2018, buses operating on the corridor made over 475,000 TSP requests at signalized intersections

Underway (Expected to be Operational in 2020)

- US 29 – Burtonsville to Silver Spring METRO - 15 signals
- Support Flash Bus Rapid Transit Service

MD 7 Rossville to MD 588

Smart/Adaptive Signal Systems

MDOT SHA is upgrading signal systems to deploy cutting edge Smart/adaptive signal technology to support real-time signal timing adjustments. Smart signals respond to real-time traffic conditions by maximizing the green time for the major roadway, while taking into account operation of the minor street. Linking the Smart signals at multiple intersections along a major roadway corridor can improve normal traffic flow, and dynamically respond to non-recurring congestion such as from special events or incidents. Adaptive corridors differ from standard signal timings improvements by allowing for timing modifications to occur instantly as traffic changes. MDOT SHA deployed adaptive signals on seven (7) corridors. Six more corridors are anticipated to be operational in 2019 (Table 32).

Table 32

ADAPTIVE SIGNAL IMPLEMENTATION CORRIDORS				
ROUTE	LIMITS	COUNTY	STATUS	# OF SIGNALS
MD 2	Hammonds Ln to 11th Ave	Anne Arundel	Completed	4
MD 3	MD 450 to St. Stephens Church Rd	Anne Arundel/ Prince George's	2019	12
MD 2	Annapolis Harbor Center Dr to Tarragon Ln	Anne Arundel	2019	4
MD 139	Kenilworth Ave to I-695 Outer Loop	Baltimore	Completed	3
US 40	Coleridge Rd to Nuwood Dr	Baltimore	Completed	11
MD 7	MD 588 to Rossville Blvd	Baltimore	2019	5
US 1 Business/ MD 24	US 1-Tollgate Rd to Atwood Rd; MD 24- Singer Rd to Boulton Rd	Harford	Completed	14
MD 22	Technology Way to North Rogers St/ US 40 Ramp	Harford	2019	8
US 1/ MD 175	US 1 – Montgomery Rd to Md 175; MD 175 I-95 to Pocomoke Rd	Howard	Completed	16
US 301	Pointer Ridge Dr to Governor's Bridge Rd	Prince George's	Completed	6
MD 198	Sweitzer Rd to Old Gunpowder Rd	Prince George's	Completed	2
MD 202	I-95/I-495 Ramp to Arena Dr	Prince George's	2019	5
US 13 Business	Winner Blvd to Centre Rd	Wicomico	2019	5

Park and Ride Lots

MDOT SHA and MDTA operate 106 park and ride lots in 20 counties. Additional park and ride locations are operated by transit and local agencies. These sites serve as vital parking for carpooling and transit services. MDOT Park and Ride lots also provide safe emergency event parking locations for trucks. The lots provide over 13,300 spaces and lots range from less than 10 spaces to over 800. The largest lots are located along MD 5 in the Waldorf area of Charles County and along MD 665 at Riva Road in Annapolis.

MDOT SHA performed biannual surveys of all facilities to assess utilization. Overall, 6,700 motorists on the average survey day utilized the park and ride lots (Figure 34). In 2018, the following locations showed the largest increase in parking demand:

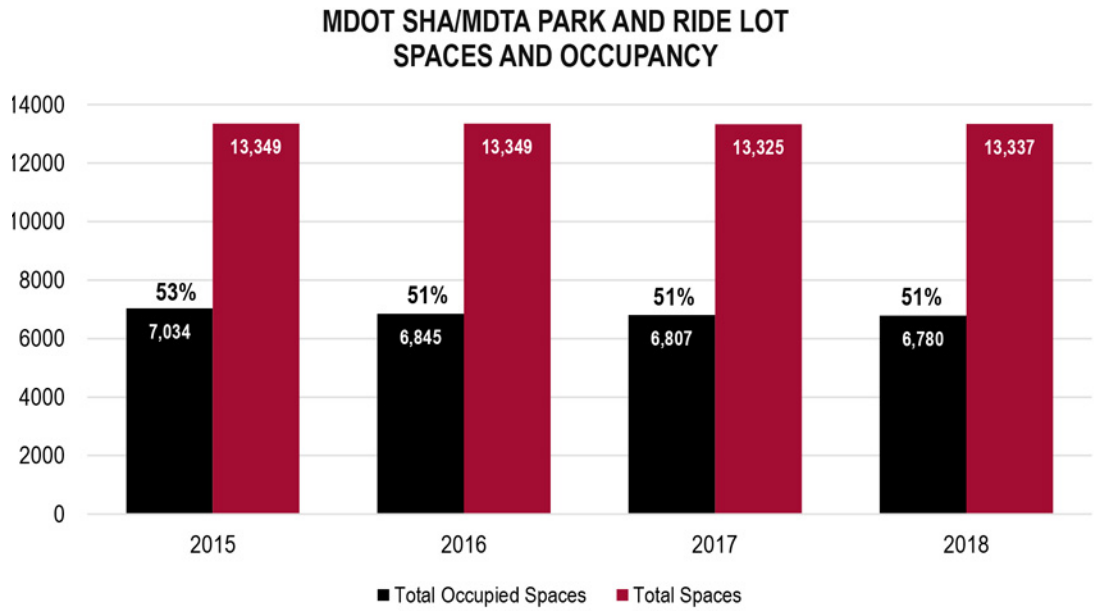
- MD 210 at MD 373 (59)
- I-95 at I-495 (39)
- I-270 at MD 124 (36)
- US 29 at MD 216 (33)
- I-95 at MD 166 (32)

The surveys showed at two lots there were more people parking than the designated number of spaces. This was at:

- MD 2/4 at MD 262
- US 340 at Mt Zion Road (West Lot)

MDOT SHA opened a new lot in 2018 at the US 301 at MD 304 and another lot at US 15/Monocacy Boulevard will open in 2019. In addition, MDOT SHA is actively designing new and expanded lots to add 400 spaces in future years.

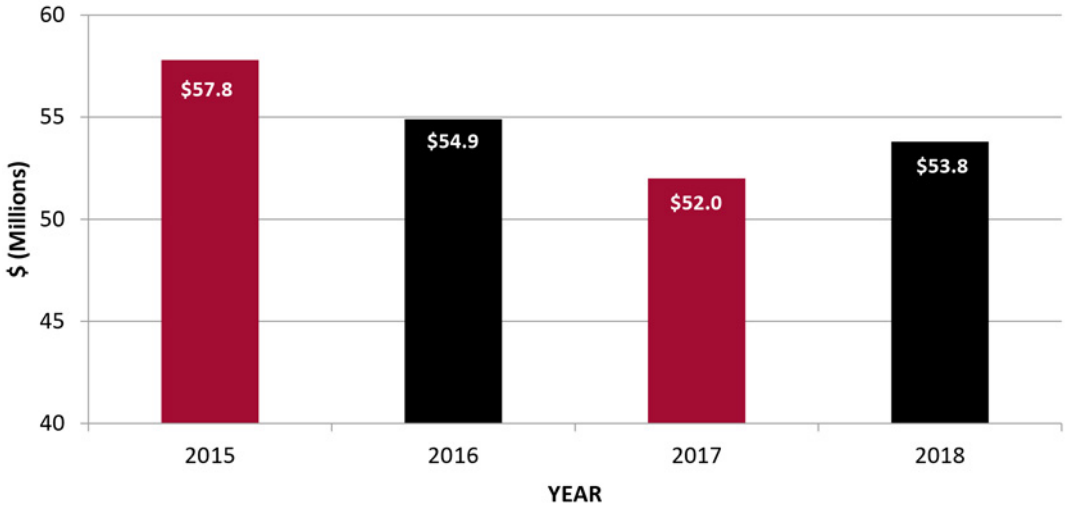
Figure 34



By persons parking at these lots, this reduces the VMT and provides an average cost per mile benefit of almost $54 million (Figure 35). This benefit increased slightly over 2017 due to an increased price for gasoline.

Figure 35

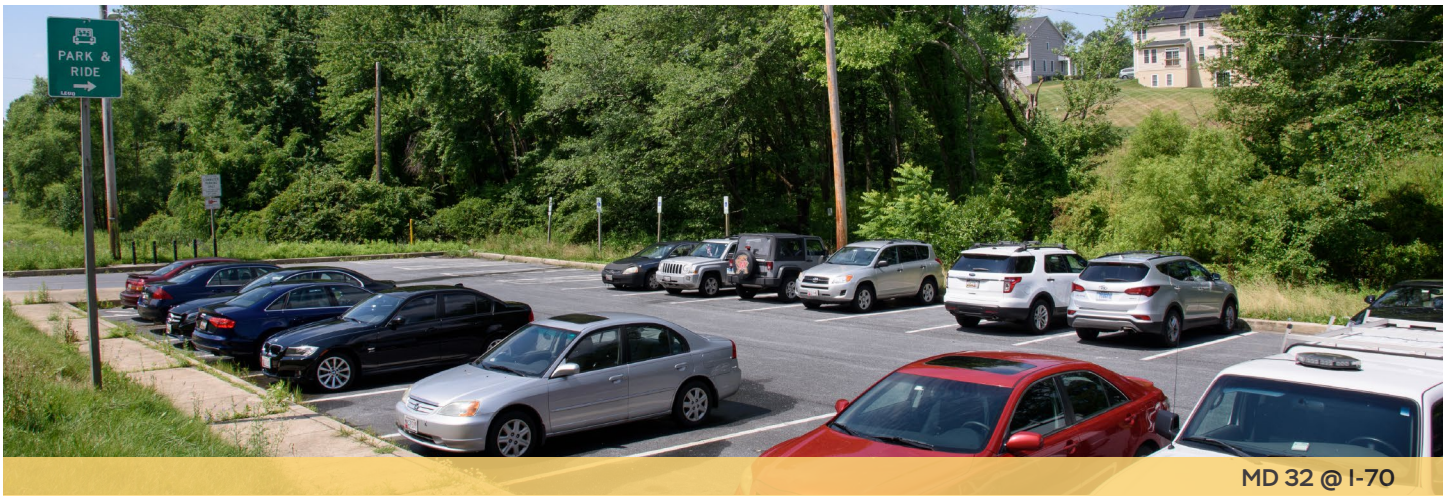
MDOT SHA/MDTA PARK & RIDE
ANNUAL COST SAVINGS TO MOTORISTS (MILLIONS)



In 2018, MDOT SHA is working with MDOT'S Commuter Connection team to outfit lots with signage for Guaranteed Ride Home to improve usage at park and ride lots. MDOT SHA is also widening existing lot entrances for MTA commuter bus accommodations. In 2019, a park and ride entrance at Waysons Corner will be designed for such widening.

In addition to MDOT SHA and MDTA, the MDOT MTA and the Washington Metropolitan Area Transit Authority (WMATA) operate lots to support their transit operations. The MDOT MTA lots supply connections to light rail, MARC, Baltimore METRO and bus service while WMATA provides service to the Washington METRO. In 2018, the following usage was recorded on an average day.

- WMATA - 25,500 persons per day
- MDOT MTA - Over 21,000 persons per day



MD 32 @ I-70

MDOT SHA and MDTA Park and Ride lots usage was relatively flat from 2017 to 2018 with 6,700 motorists per day parking.

High Occupancy Vehicles (HOV) Lanes

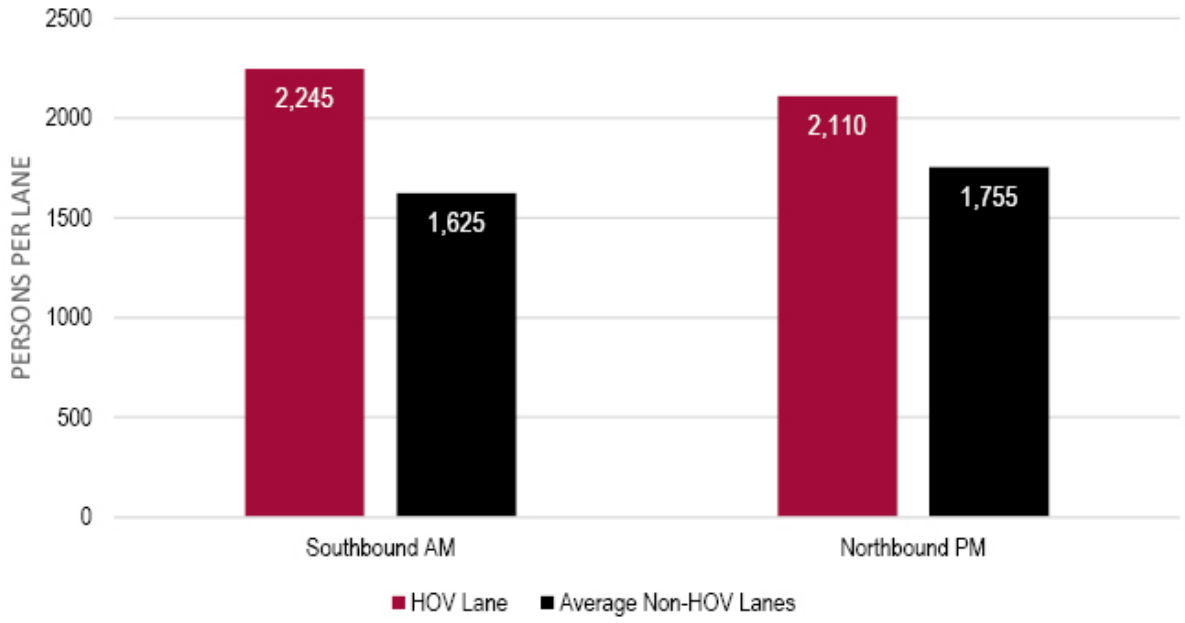
High occupancy vehicle lanes are a method to encourage carpooling and increase the number of persons (person throughput) that use a roadway without expanding the number of lanes. These lanes provide a travel time advantage savings to multi-occupant vehicles. Maryland has three corridors served by HOV lanes. Only vehicles with two or more occupants, transit vehicles, motorcycles or plug-in electric vehicles may use these lanes during the directional operating hours listed below.

- I-270 Southbound – North of I-370 to North of I-495 (East and West Spurs) [6:00 to 9:00 AM]
- I-270 Northbound – North of I-495 (East and West Spur) to MD 121 [3:30 to 6:30 PM]
- US 50 Eastbound and Westbound- West of US 301 to east of I-95/I-495 [All Day]

Studies were performed along I-270 and US 50 to evaluate the performance of the HOV lanes. This was accomplished by performing vehicle occupancy counts at multiple sites and performing travel time studies using GPS. Person throughput evaluates the total number of people moved in each lane versus the total number of vehicles. On I-270, the HOV lanes transport approximately 400 to 600 additional people compared to an average non-HOV lane based on MDOT SHA vehicle occupancy counts (Figure 36).

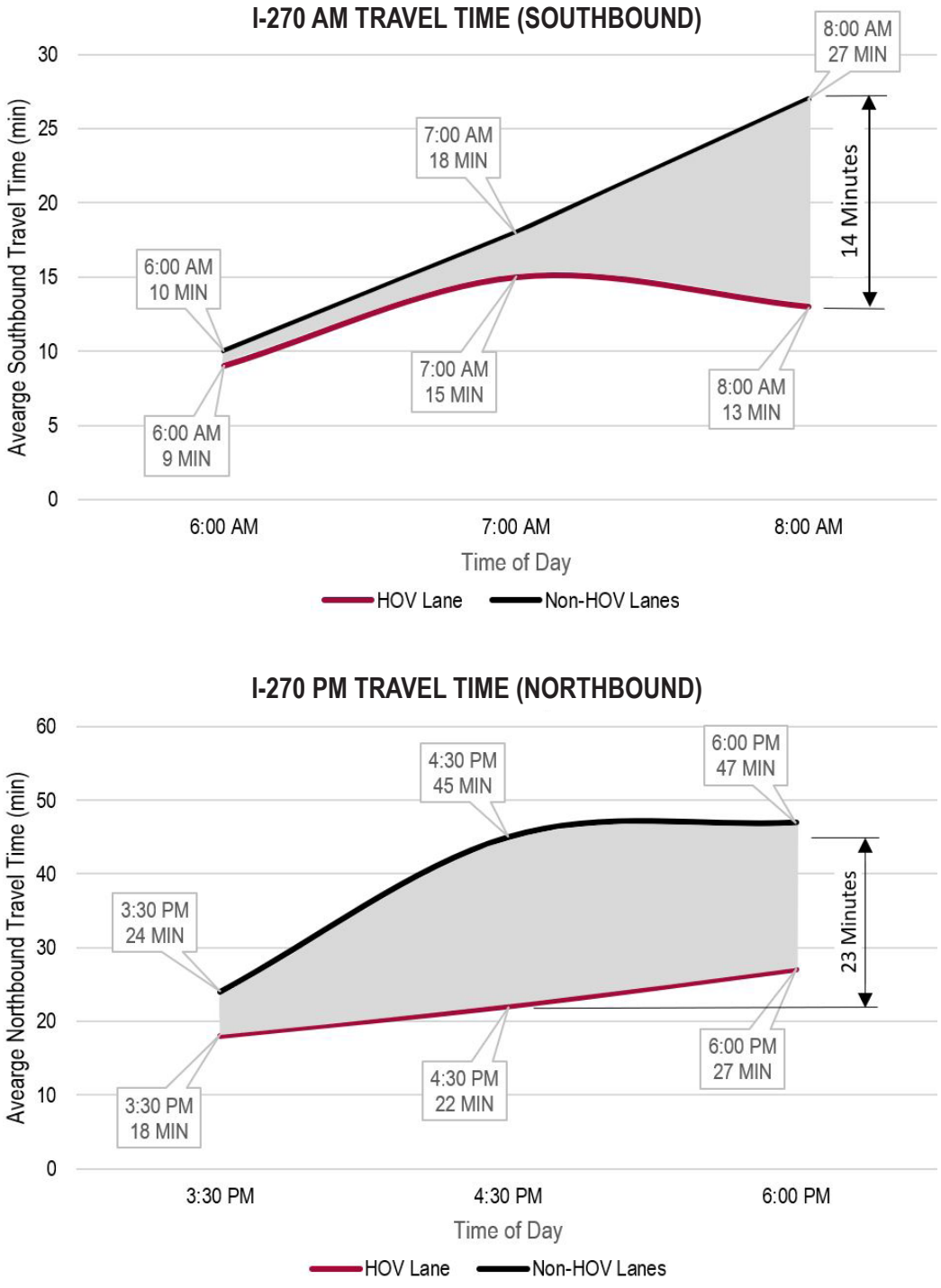
Figure 36

I-270 PERSON THROUGHOUT PER LANE PER HOUR



The surveys conducted by MDOT SHA determined the travel time in the HOV lanes versus the general purpose lanes or other travel lanes. Travel time savings depend upon the time of days as shown for I-270 Southbound in the AM peak period and I-270 Northbound in the PM peak period. The travel time savings ranges from a one minute up to 23 minutes (Figure 37).

Figure 37



The travel time savings on I-270 in the HOV lane amounted to as much as 14 minutes in the AM peak period (6 minutes on average) and 23 minutes in the PM peak period (16 minutes on average).

Reversible Lanes

Reversible lanes are an Active Transportation Demand Management (ATDM) Strategy to make for a more efficient use of the existing pavement. By using reversible lanes this allows for one or more lanes of a roadway to be converted from one direction to the opposite direction depending on the time of day. There are four reversible lane locations along MDOT roadways (Table 33).

Table 33

REVERSIBLE LANE LOCATIONS ALONG MDOT ROADWAYS			
LOCATION	LIMITS	COUNTY	LENGTH (MILES)
US 50/US 301	Chesapeake Bay Bridge	Anne Arundel/ Queen Anne's	4.5
MD 177	MD 100 to West of South Carolina Ave	Anne Arundel	1.6
US 29	Sligo Creek Pkwy to MD 97	Montgomery	1.0
MD 97	I-495 to MD 390	Montgomery	0.5

The MD 177, US 29 and MD 97 reversible lanes are operated to improve the standard AM and PM peak period commuting traffic flows. The most recognizable and most utilized is the five lane Chesapeake Bay Bridge (US 50/301). On the Chesapeake Bay Bridge the lanes are reversed through the use of overhead lane signing in the PM peak period and during the summer on Saturday morning and Friday evenings. This allows for the two eastbound and three westbound lanes to be converted to three eastbound and two westbound lanes. The traffic volumes for motorists using the reversible lanes range from approximately 300 to 1,600 vehicles per hour (Table 34).

Table 34

AM (PM) VOLUMES				
LOCATION	AM (PM) VOLUME TRAVELING IN NON-REVERSIBLE LANES IN PEAK DIRECTION (VEHICLES PER HOUR)	NUMBER OF NON-REVERSIBLE LANES AM (PM) PERIOD	AM (PM) VOLUME TRAVELING IN REVERSIBLE LANE(S) IN PEAK DIRECTION (VEHICLES PER HOUR)	NUMBER OF REVERSIBLE LANES AM (PM) PERIOD
US 29	1,300 (1,100)	2 (2)	1,000 (1,075)	2 (2)
US 50/301	N/A (3,200)[I]	N/A (2)	N/A (1,600)[I]	N/A (1)
MD 97	2,425 (2,425)	3 (3)	525 (725)	1 (1)
MD 177	875 (1,075)	1 (1)	300 (275)	1 (1)

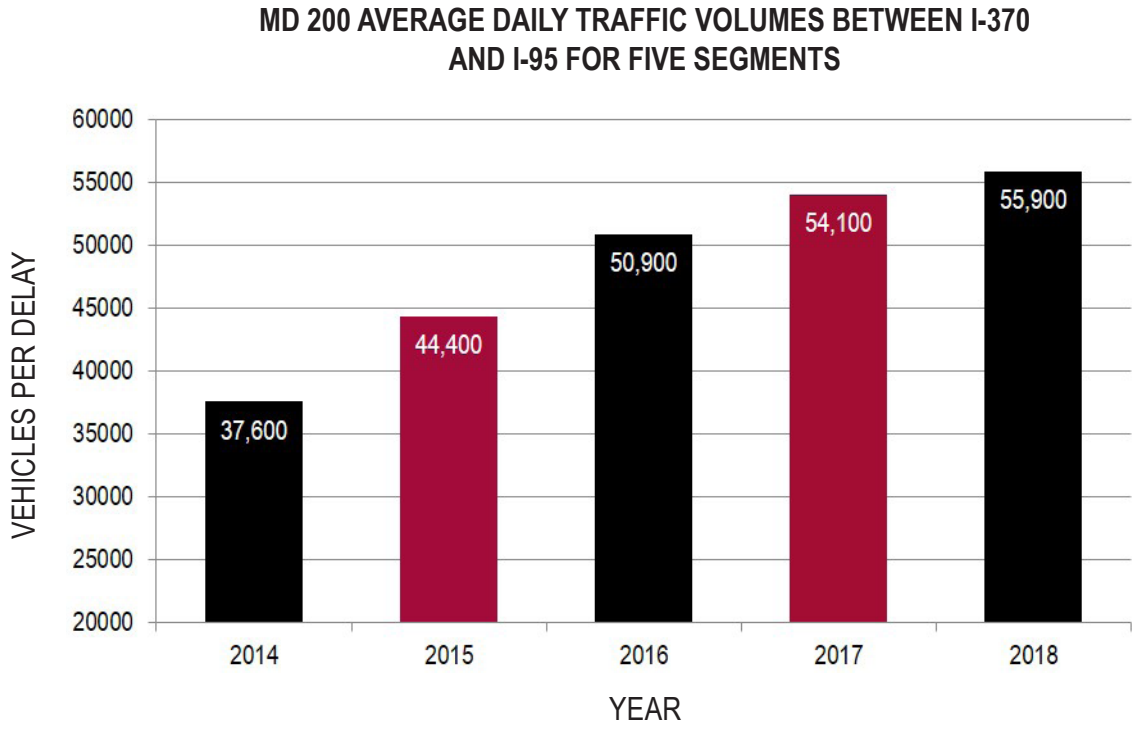
I - Volumes represent Saturday peak hour

Managed Lane Facilities and Express Toll Lanes

Managed lanes involve a number of strategies to ensure traffic on a facility or separated lanes operate at acceptable speeds without experiencing delays. Managed lanes could include high occupancy vehicle lanes, truck lanes or various tolling strategies. In Maryland, these projects were developed to improve traffic operations by utilizing tolls.

In the last five years, Maryland has introduced two innovative projects to improve mobility. The first project is MD 200 (Intercounty Connector) which was the first all electronic toll collection facility in Maryland where tolls are collected at highway speed either with E-ZPass® or through video tolling. Toll rates vary by the time of day. MD 200 extends from I-370 in Montgomery County to US 1 in Prince George's County approximately 19 miles. Traffic volumes on MD 200 average almost 56,000 vehicles per day between I-370 and I-95 (Figure 38).

Figure 38

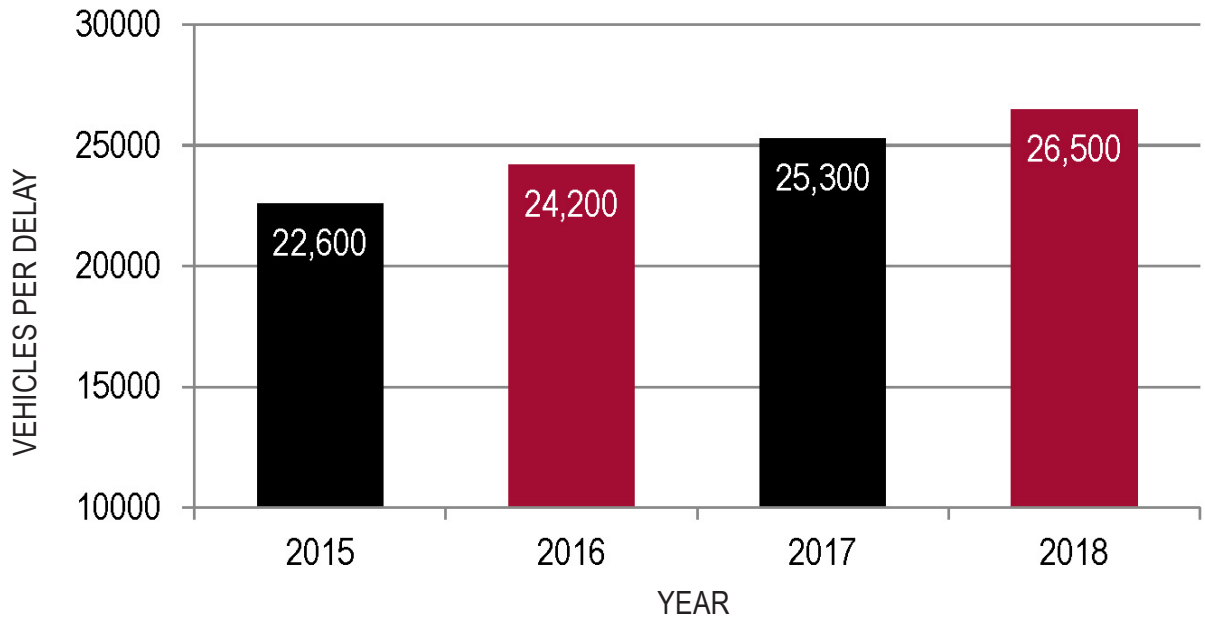


Traffic Volumes have increased by almost 50% on MD 200 in five years since it opened.

The second project was the I-95 express toll lane project from south of I-895 in Baltimore City to north of MD 43 in Baltimore County. Motorists have the option of utilizing the four free general purpose lanes or paying a toll using E-ZPass® to travel in the free flow express toll lanes. Transit vehicles may use the express toll lanes at all times for free. This improves transit time reliability to better meet schedules for routes in the corridor. In 2018, approximately 26,500 motorists per day use the express toll lanes an increase of 5% over 2017 (Figure 39).

Figure 39

I-95 EXPRESS TOLL LANE AVERAGE DAILY TRAFFIC VOLUMES



I-95 Express Toll Lanes

Peak usage of the I-95 ETL's exceed 3,500 vehicles in one hour and 45,000 vehicles in one day.

MOBILITY INITIATIVES

MD 187 @ Cedar Ln

Bicycle and Pedestrian

MDOT SHA balances the needs of all users of the transportation system by working to improve the overall experience for private and commercial drivers, transit providers, pedestrians, and bicyclists. These strategic investments, framed by the Complete Streets policy and Practical Design policy, improve safety, accessibility, and mobility. In addition to incorporating bicycle and pedestrian facilities into MDOT SHA roadway projects, MDOT SHA awards various grants for the planning, design, and construction of bicycle and pedestrian facilities on non-state-owned facilities.

Programs

Several funding programs are available through MDOT and other agencies to implement the planning, design and construction of bicycle and pedestrian facilities throughout the State. Programs range from enforcement campaigns to increase the safe usage of existing facilities, student/pedestrian/bicycle safety education, and engineering solutions such as the construction of sidewalks, trails, cycle tracks, curb ramps and signing and marking upgrades. These initiatives provide funding in the following programs (2018-2023 $ in millions).

- Bicycle Retrofit Program ($15.7)
- Maryland Bikeways Program ($12.1)
- New Sidewalk Construction for Pedestrian Access ($31.1)
- Recreational Trails Program ($5.6)
- Sidewalk Reconstruction for Pedestrian Access ($43.4)
- Transportation Alternatives Program and Safe Routes to School ($49.5)
- Primary / Secondary Program ($9.5)
- Urban Reconstruction Program ($6.5)
- Maryland Transit Administration ($1.0)
- Bikeshare program ($0.8)
- Maryland Highway Safety Office Bicycle Programs ($0.2)
- Other State/Federal grant programs include the Community Legacy Program, Program Open Space, Maryland heritage Areas Program, Community Parks and playgrounds, BUILD, Rivers, Trails and Conservation Assistance Program, Federal Lands Access Program, the Transportation Land use Connections Program

Bicycle and pedestrian project funding for the next 5 years amounts to approximately $175 million.

Bicycle and Pedestrian Master Plan

The 2040 Maryland Bicycle and Pedestrian Master Plan 2019 Update was developed by MDOT to offer solutions to Maryland's current challenges regarding bicycle/pedestrian facilities and safety. The 2040 Maryland Bicycle and Pedestrian Plan Update documents the 2018 review of existing conditions, development of strategies and objectives and key initiatives to encourage increase bicycle and pedestrian usage. The major goals of the plan include:

- Improve Safety
- Provide Connected Networks
- Develop Data Driven Tools for Analysis and Planning
- Form Partnerships
- Encourage Economic Development

One of the most critical issues that MDOT SHA is involved in is to enhance safety for bicyclists and pedestrians. In 2018, there were 133 pedestrian and six (6) bicyclists fatalities. In order to reduce the number of fatalities and injuries, the plan identifies the following strategies:

- Install bicycle improvements such as marked bike lanes
- Perform Pedestrian Road Safety Audits
- Perform Educational Outreach with programs such as "A Cyclist Maybe Someone You Know"
- Evaluate Innovative Treatments such as green pavement, cycle tracks and bicycle signal heads
- Promote use of connected vehicle technology and technology for emergency response personnel to prevent and reduce severity of collisions
- Implement Legislation and Training

A sample of MDOT and local agency initiatives to improve the safety and mobility of bicyclists and pedestrians include:

- Installed 36 Bike Racks at MTA Rail Stations
- Retrofitted 30 MARC Cars to accommodate full-size bicycles
- Increased the number of Bike Share Locations at Transit Stations
- Completed 24 County Bike and Pedestrian Plans
- Designated 12 new Bike and Pedestrian Priority Areas
- Completed Three Bike and Pedestrian Priority Areas
- Bicycle Task Force established 39 recommendations to improve bicycle safety
- Updated Design Guidelines
- Initiated new Crosswalk Legislation and during 2019 adopted Vision Zero Legislation

Transit Oriented Development (TOD)

The State of Maryland has encouraged development near transit stations as an important part of Maryland's strategy to address traffic congestion, environmental issues, and sprawl. The State of Maryland had defined Transit-Oriented Development (TOD) as a place of relatively higher density that includes a mix of residential, employment, shopping, and civic uses designed to encourage multi-modal access to the station area. The MDOT has actively sought to promote TOD as a tool to support economic development, to promote transit ridership, and to maximize the efficient use of transportation infrastructure and has designated 16 TOD along the major fixed rail transit lines of the Baltimore/Washington, D.C. region (Figure 40).

Locations (Transit Service Provided)

- Aberdeen (MARC)
- Owings Mills (Baltimore METRO)
- Reisterstown (Baltimore METRO)
- State Center (Baltimore METRO)
- Westport (Baltimore Light Rail)
- Savage (MARC)
- Odenton (MARC)
- Laurel (MARC)
- Shady Grove (Washington METRO)
- Twinbrook (Washington METRO)
- White Flint (Washington METRO)
- Wheaton (Washington METRO)
- Greenbelt (Washington METRO)
- New Carrolton (Washington METRO)
- Branch Avenue (Washington METRO)
- Naylor Road (Washington METRO)

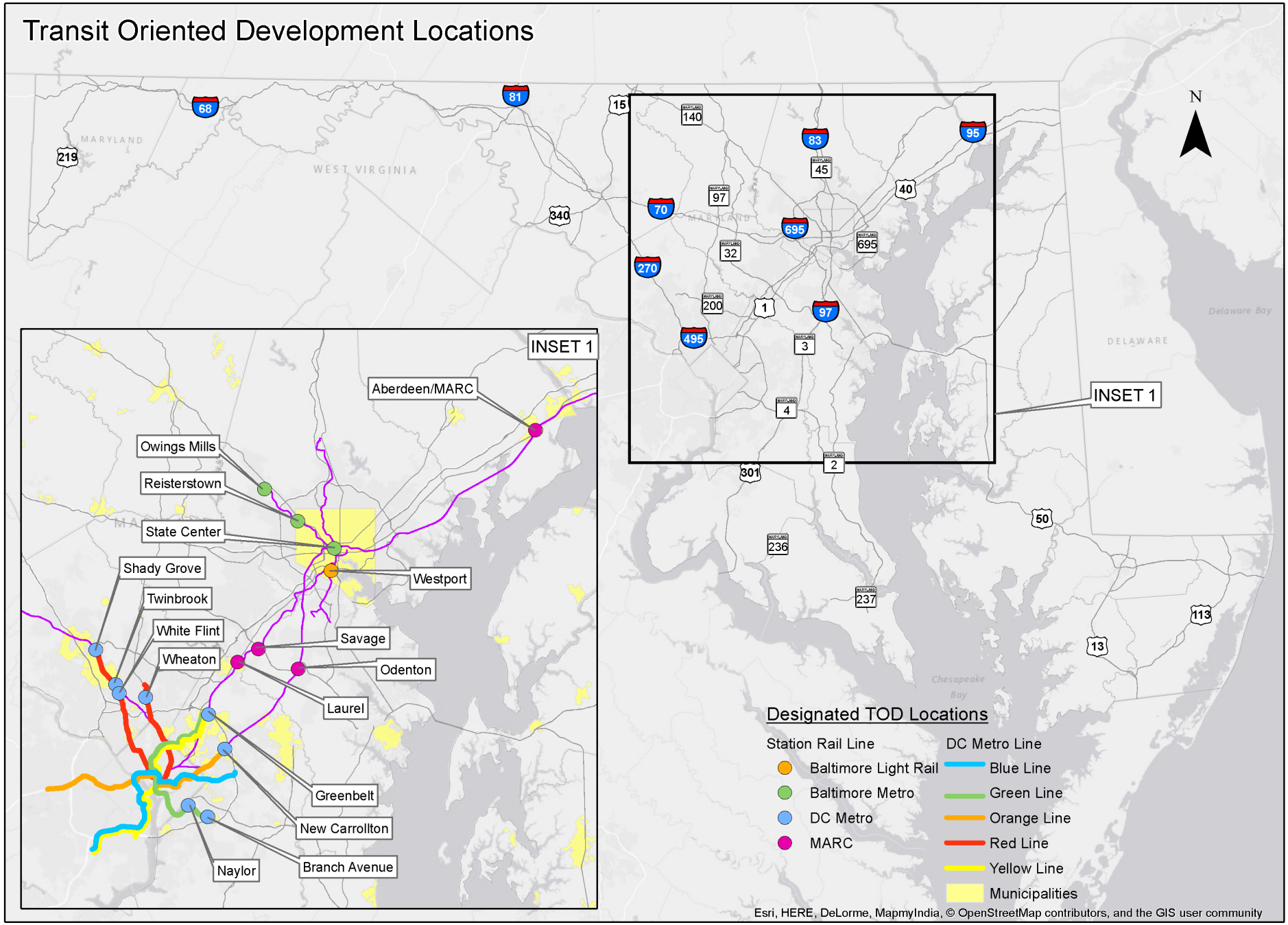
The level of development at each of the 16 sites varies throughout the State. Certain locations are much more active with on-going construction while other sites are waiting the right opportunities. The most active sites included a combination of retail, residential, and office uses (Table 35).

Table 35

ACTIVE DEVELOPMENT AT TODS		
TOD LOCATION	MULTI-MODAL CONNECTION	DEVELOPMENT STATUS
Metro Centre @ Owings Mills	MDOT MTA-METRO	235 room Hotel, 4,500 SF of retail space and 114 residential units under construction. 230 unit residential building in the design phase.
Annapolis Junction/ Savage	MARC	Residential, retail and office buildings are completed and being leased.
New Carrollton	WMATA-METRO	200,000 SF Kaiser Permante Office Building recently opened
White Flint	WMATA-METRO	340,000 SF retail 2,000 residential apartments

TOD Sites are located in Six Counties and Baltimore City.

Figure 40


Transit Oriented Development Locations
INSET 1
Aberdeen/MARC
Owings Mills
Reisterstown
State Center
Shady Grove
Twinbrook
White Flint
Wheaton
Westport
Savage
Odenton
Laurel
Greenbelt
New Carrollton
Branch Avenue
Naylor
INSET 1
N
MARYLAND
WEST VIRGINIA
DELAWARE
Delaware Bay
Chesapeake Bay
Designated TOD Locations
Station Rail Line
Baltimore Light Rail
Baltimore Metro
DC Metro
MARC
DC Metro Line
Blue Line
Green Line
Orange Line
Red Line
Yellow Line
Municipalities
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Freight

MDOT supports the safe movement of freight through Maryland regardless of whether it moves by plane, boat, rail, truck, or van. MDOT SHA is leading the nation to understand the magnitude of freight related issues and deliver solutions. The effort begins with the establishment of a designated system of roadways that are conducive to larger vehicles and minimize the interaction between long distance truck trips and local traffic/ bicyclists/pedestrians. The Fast Act as part of MAP-21 legislation established the National Highway Freight Network (NHFN). The NHFN consists of:

- Interstates
- MD 695 and sections of US 50, US 301, MD 100 and MD 295
- Connections to Intermodal Facilities

Under the Fast Act, MDOT was required to designate Critical Urban and Rural Freight Corridors. After reviewing the federal criteria, the State designated:

- 73 miles in urban areas
- 149 miles in rural areas (1.1 miles of US 219 was added in 2019)

In addition, the Maryland Multimodal Freight Network was established to improve intermodal movements and enhance freight mobility and connections. The system consists of:

- Federal and State Freight Routes
- Connections to Intermodal freight Facilities
- Strategic Highway Network (STRAHNET) for Department of Defense Domestic Operations

The freight networks encompass roadways from Western Maryland to Eastern Shore (Figure 41).

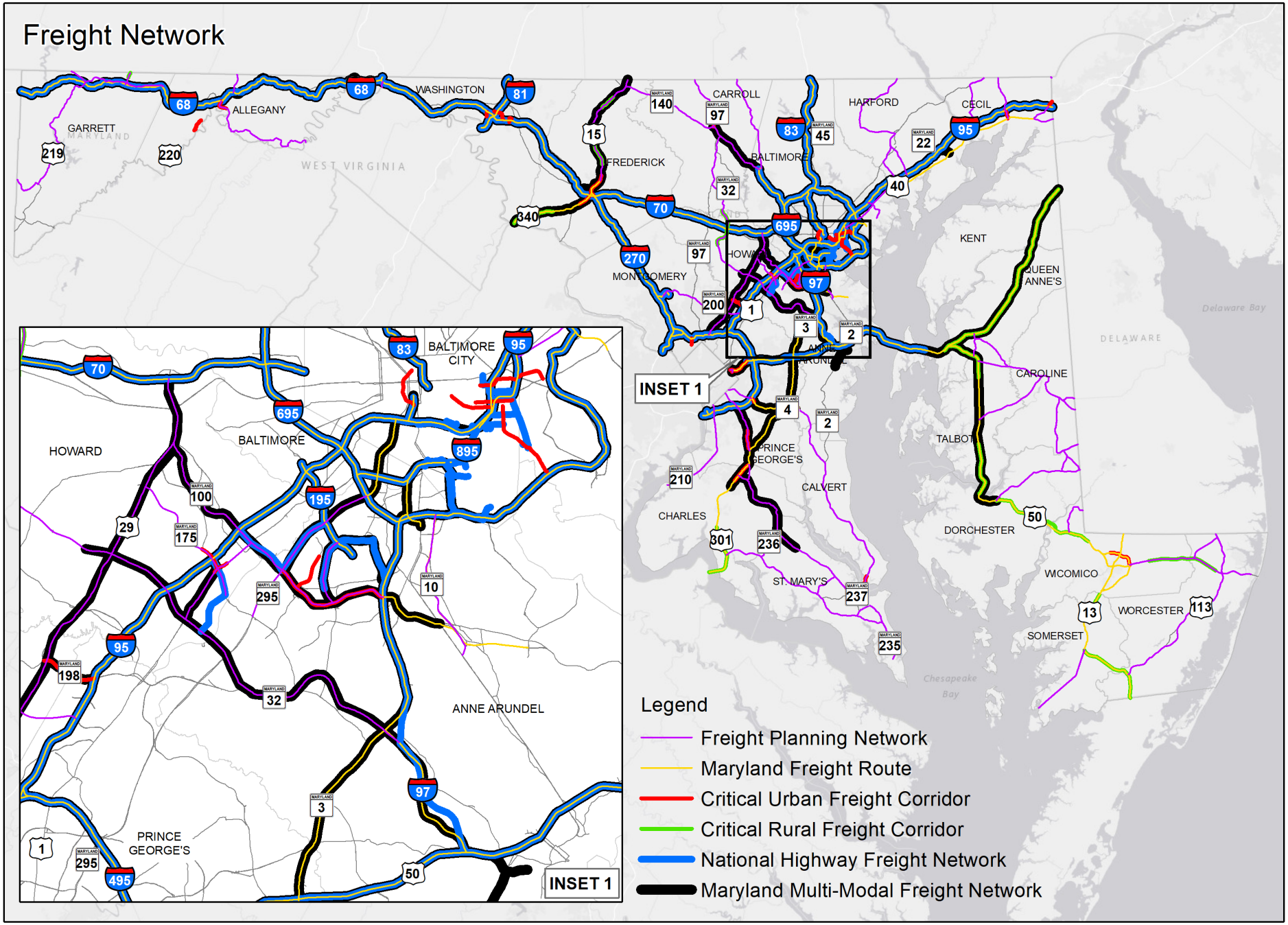
In order to address the continued growth in freight movement on Maryland roadways various projects and planning efforts are on-going. Among the projects include:

- Truck Driver Parking Studies
- Expansion of Virtual Weigh Stations
- Operational Maryland One Hauling Permit System
- Commercial Vehicle Information Systems and Networks (CVISN)

On-Going planning efforts include:

- Development of a Maryland Statewide Truck Parking Study that will evaluate existing parking including gaps in the system, determine parking demand and opportunities and identify funding including innovation options such as P3's and grants.
- Implementation of Strategic Goods Movement Plan
- Creation of Transportation Systems Management and Operations concept of operations for freight movement
- Update of Maryland Freight Story Map to provide a visual overview of the Strategic Goods Movement Plan
- Advanced Data Viewer for planning purposes
- Multimodal freight coordination
- State Freight Advisory Committee meetings and collaboration

Figure 41


Freight Network
GARRETT
ALLEGANY
WASHINGTON
FREDERICK
CARROLL
HARFORD
CECIL
BALTIMORE
KENT
QUEEN ANNE'S
MONTGOMERY
HOWARD
CALVERT
CHARLES
PRINCE GEORGE'S
ST. MARY'S
TALBOT
CAROLINE
DORCHESTER
WICOMICO
WORCESTER
SOMERSET
DELAWARE
WEST VIRGINIA
Delaware Bay
Chesapeake Bay
INSET 1
BALTIMORE CITY
ANNE ARUNDEL
Legend
Freight Planning Network
Maryland Freight Route
Critical Urban Freight Corridor
Critical Rural Freight Corridor
National Highway Freight Network
Maryland Multi-Modal Freight Network

Transportation Systems Management and Operations (TSMO)

Transportation Systems Management and Operations (TSMO) is an integrated approach to effectively manage and operate existing facilities and systems to maximize their full service potential. In order to accomplish this, all aspects of a project ranging from planning and engineering to operations and maintenance are involved with the goal of improving the security, safety, and reliability of the transportation system. MDOT's TSMO program is managing a "System if Systems" through modern innovative solutions (focused on managing the system as a whole), which combine traffic management strategies, technologies, roadway improvements and partnerships to take advantage of the network, optimize traffic flow, and improve safety. The overall goals of the program are:

GOAL 1

BUSINESS PROCESSES & COLLABORATION

GOAL 2

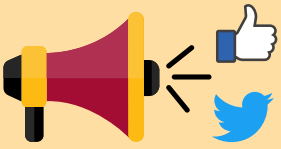
SYSTEMS & TECHNOLOGY

GOAL 3

DATA ANALYSIS & PERFORMANCE MANAGEMENT

GOAL 4

CUSTOMER EXPERIENCE & ENGAGEMENT



In order to achieve the goals of the program, various strategies are utilized by MDOT SHA to actively manage the multimodal transportation network. These TSMO strategies include:

Homeland Security Preparedness

Transit Priority/Integration

Connected and Automated Vehicle Technology

Work Zone Management

Emergency Response

Road Weather Management

Traffic Incident Management

Traffic Signal Coordination

Maintenance Fleet Management

Electronic Payment/Toll Collection

Freeway/Arterial Management

Freight Management

A key aspect of TSMO is better utilization of the existing system. In order to accomplish this, technology plays a crucial role by meeting customers' needs for providing real-time travel information and advancing the ability of MDOT SHA to react quickly to trends and changes in travel patterns. The data technology that supports TSMO are:

Real Time Applications

Archived Data Applications

Inhouse-tools with support from the University of Maryland CATT Lab

MDOT Common Operating Picture

There are various TSMO methods that can be incorporated in projects. Priorities were established and identified as follows:

- Improving coordination during incident management
- Decreasing incident duration and delay
- Allowing traveling public to make better informed decisions
- Offering active traffic management and integrated corridor management solutions
- Enhancing coordination between MDOT SHA and local signal operators to optimize signal timings
- Managing traffic and increase safety for work zones and special events

In 2018, various initiatives were undertaken, and several completed. These include from an administration, planning, design and construction standpoint to develop the foundation and initiate these principles into active projects. They assist in optimizing the capacity of the system and improve performance by reducing delay and incidents and providing for cost savings to motorists. Among the accomplishments include:

Appointed Deputy Director to oversee the execution of the TSMO Implementation Plan.

Developed a TSMO Strategic Action Plan.

Studied 230 miles of corridors which could provide $3 billion in potential user savings.

Prepared documents for the advertisement of the I-695 hard shoulder running contract.

Developed TSMO steering committees.

Formalized policies and guidance for TSMO as part of the overall MDOT SHA.

Completed or started construction of the SMART Signals adaptive signal system program in several corridors.

Awarded contract for the general engineering consultant for the Traffic Relief Plan involving a public-private partnership for the I-270 improvements.

Continued construction of the I-270 Innovation Congestion Management project which includes infrastructure upgrades, intelligent transportation solutions and technology deployment such as ramp metering.

Connected and Automated Vehicles (CAV)

Connected vehicles are capable of interpreting and relating information over one or more communication channels between two or more vehicles or between a vehicle and a roadside communication device. Automated vehicles are vehicles that can perform at least one aspect of the driving task without direct driver input. Industry terms relating to this field include vehicle to infrastructure (V2I) communication or vehicle to everything (V2X) communication through cellular networks and dedicated short range communication wireless spectrum.

The 2018 MDOT SHA CAV accomplishments include a centralized program for CAV initiatives, coordination with the Statewide Maryland CAV Working Group and national involvement in CAV activities. These accomplishments are for the MDOT SHA CAV program only, which is internal to MDOT SHA. There is also a Maryland Statewide CAV Working Group that advances statewide CAV initiatives, but this section does not reflect statewide accomplishments from that group. For more information on the Maryland Statewide CAV Working Group please visit http://mdot.maryland.gov/MarylandCAV. Since CAV initiatives are relatively new many accomplishments overlapped into the 2019 calendar year including:

Organizational Management of CAV

New positions within MDOT SHA to advance CAV within the agency, including a Deputy Director for TSMO & CATS, new Division Chief of ITS Communications, and a new Connected and Automated Transportation Systems (CATS) Division within the Office of CHART and ITS Deployment.

TSMO
MARYLAND TRANSPORTATION SYSTEMS MANAGEMENT & OPERATIONS

MDOT SHA CAV Working Group with representatives from various Offices and Districts meets bi-monthly.

CAV Strategic Action Plan

RELEASED
DEC 2017

WITH 35 RECOMMENDED ACTIONS

Progress made on 26 of those recommended actions in 2018!

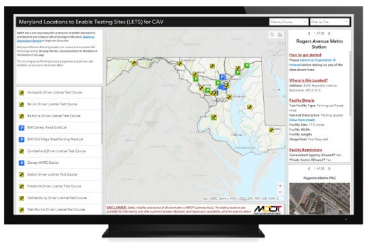
In 2018 staff made progress on 26 of the recommended 35 actions from the 2017 MDOT SHA CAV Strategic Action Plan and pursued new initiatives in 2019. The plan's website has also been updated to highlight some of our accomplishments: https://arcg.is/1uKWLW.

US 1 Innovative Technology Deployment Corridor

Completed a comprehensive requirements document for a proposed connected vehicle pilot along US 1 with recommended ITS solutions to support incident and traffic management. MDOT SHA plans on deploying DSRC to pilot SPaT and BSM with Connected Vehicle technologies at approximately 20 intersections in Howard County.

Supporting CAV Testing Within the State

Office of Planning and Preliminary Engineering (OPPE) maintains the Maryland Locations for Enabling Testing Sites (LETS) web mapping application.



Applied for and received a $40,000 State Transportation Innovation Council (STIC) Grant to deploy Connected Vehicle technology for pedestrian safety.

Developed a Data Governance document on the creation and management of MAP messages, which was shared with our University of Maryland and Econolite partners. This chapter follows a Draft CAV Data Governance Chapter also created for MDOT SHA to support connected vehicles within the agency.

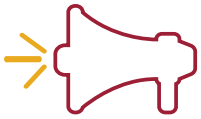
Communication and Outreach Initiatives

Developed an internal staff site and CAV blog to provide education and outreach along with internal collaboration tools to MDOT staff only.

Developed a scope for Scenario Planning for CAVs.

Engagement in national conferences that highlight technology and operational enhancements, sponsored by groups such as the ITE or ITS America

Developed education flyers showcasing the MDOT SHA CAV program for the purpose of the ITS Maryland Annual Meeting and future conferences.



MDOT SHA also presented or attended 12 conferences or meetings in the 2019 calendar year, a significant portion of which were sponsored by national groups (e.g. ITS America, TRB, etc.)

Planning Tools and Materials Related to CAVs

Developed interactive CAV Public Policy in the US Story Map to track monthly legislative actions related to CAV across the country.

Developed Rough Order of Magnitude (ROM) estimates for CAV technology and fiber deployment to be incorporated in each of MDOT SHA's CTP Projects.

Developed an online CAV Technology Deployment Dashboard that catalogs nearly 11,000 potential locations where CAV devices could support safety and operations.

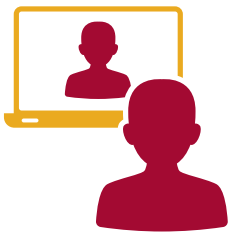
Developed Call for Projects Template to solicit ideas for CAV projects across the agency

The Office of Planning and Preliminary Engineering (OPPE) performed a preliminary CAV VISSIM analysis of two major corridors in Maryland, with various assumptions and high-level statewide regional demand model sensitivity scenario runs.

Training Initiatives

MDOT SHA co-hosted the FHWA Connected Vehicle 201 training.

MDOT SHA co-hosted the FHWA Introduction to ARC-IT Architecture workshop.



The CATS Division held the first ever agency-wide webinar lunch and learn on CAVs, with over 120 attendees.

MDOT SHA also released a CAV 101 Training Application for MDOT SHA employees to increase awareness for basic CAV 101 information, following similar topics to the Lunch and Learn. The training is meant to allow anyone to learn on their own time and at their own pace.

Coordination With MDOT CAV Working Group

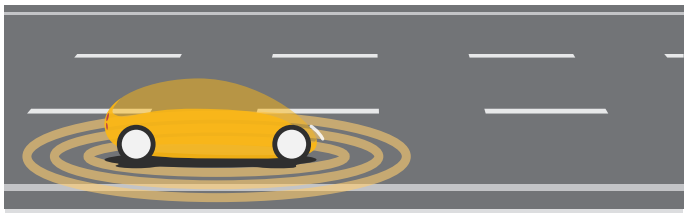
Ongoing participation in MDOT CAV Working Group, CAV Technical and Policy Subgroup, and CAV Freight Subgroup.

MDOT SHA staff worked in concert with other MDOT TBUs to provide comments to 9 Federal Request for Comments (RFCs) or Information related to CAV initiatives so far.

National Involvement In CAV Activities

- Cooperative Automated Transportation (CAT) Coalition
- Connected Vehicle Pooled Fund Study
- Dedicated Short Range Communications (DSRC) Community of Interest
- Worked with Intelligent Transportation Society (ITS) of America and the I-95 Corridor Coalition

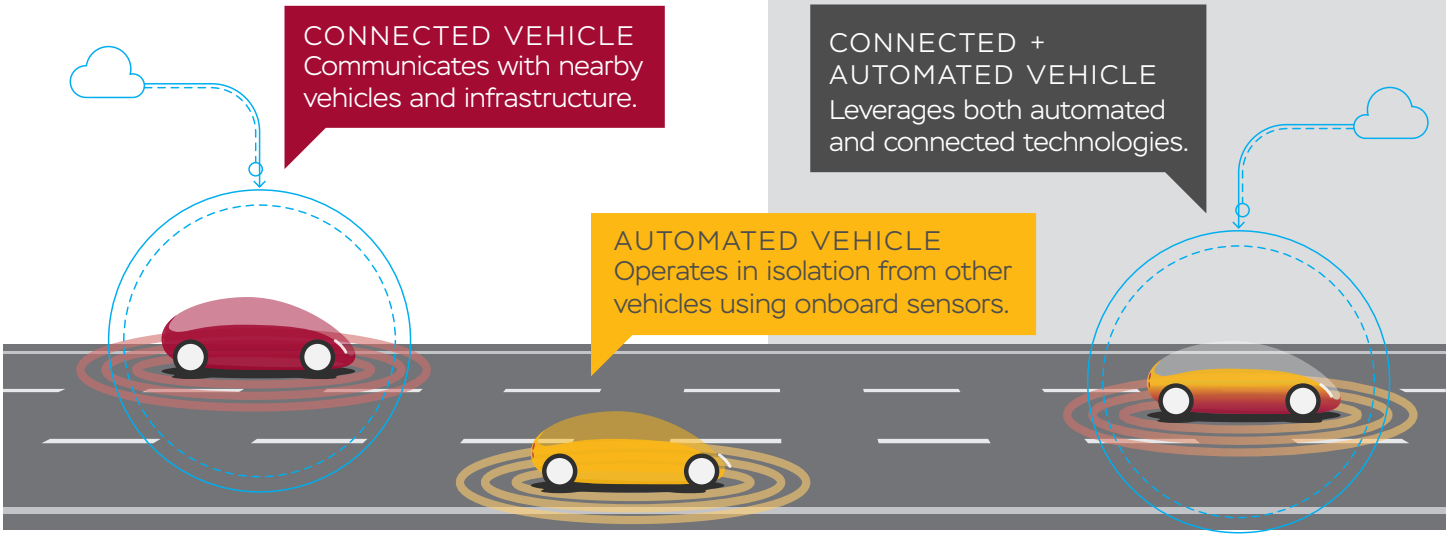
The Office of Traffic and Safety (OOTS) has recently engaged in the National Committee for Uniform Traffic Control Devices (NCUTCD) where a CAV working group has formed to address signs, markings, and traffic impacts.



The Road Ahead

In preparation for the successful implementation and adoption of Connected and Automated Vehicles (CAV), the MDOT SHA outlined some planning efforts going forward to explore. The upcoming efforts include:

- ✓ Development of Maryland's Highly Automated Vehicle (HAV) Readiness
- ✓ Development of an MDOT SHA Workforce Impact Assessment
- ✓ Completion of the MDOT SHA Strategic Telecommunications Plan and Fiber Map
- ✓ Development of a Revised MDOT SHA CAV Strategic Action Plan
- ✓ Development of a CAV Solutions "Toolbox" for MDOT SHA Planning Staff



Mobility on Demand

The advent of providing alternative forms of transportation has led to various companies developing new business models. An alternative to using your own vehicle to move from one place to another is through shared mobility on demand services. The range of alternative modes to supplement traditional model include bicycles, electric bikes, scooters, car sharing and ride sharing services. In Maryland, the following services exist:

- Uber – Throughout most of Maryland; Ride Sharing Service
- Lyft- Baltimore, Towson, Frederick, Gaithersburg, Hagerstown, Ocean City and Salisbury; Ride Sharing Service
- Zip Cars – Throughout the Baltimore -Washington area; Ride Sharing Vehicles
- Lime – Baltimore City, Montgomery County including Silver Spring; Scooters
- Bird – Baltimore City; Scooters
- Jump – Baltimore City; Electronic Bikes and Scooters
- Spin – Baltimore City, Salisbury; Scooters and Bicycles
- Zagster – Thurgood Marshall Baltimore Washington International Airport
- Montgomery County, Howard County and Annapolis – Bike Sharing Service

Based on voluntary information from rideshare companies, the following are the most requested locations for service:

- Baltimore Washington International Thurgood Marshall Airport
- MGM National Harbor
- Uptown Towson
- BWI Airport Rail Station
- Owings Mills METRO Station
- Eastover Shopping Center
- Suitland Metro Station
- Various locations in Baltimore City

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

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Governor

BOYD K. RUTHERFORD
Lt. Governor

GREGORY I. SLATER
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