MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

MARYLAND STATE HIGHWAY MOBILITY REPORT 2022

2022

MARYLAND STATE HIGHWAY MOBILITY REPORT

Eleventh Edition

AUTHORS

Eric Beckett, Austin Foster, Nicole Katsikides, Kaveh Farokhi Sadabadi, Lisa Shemer, Matthew Wolniak

CONTENT CONTRIBUTORS/REVIEWERS

Jordyn Alderman, Matt Baker, Stacy Beckett, Keith Belcher, Patrick Boyle, Tom Costello, Carole Delion, Sepideh Eshragh, Mark Franz, Sarah Gary, Scott Holcomb, Kandese Holford, Sean Lain, Ally Loverde, Kristina Harman, Clyde Munz, Ben Myrick, Abhay Nigam (AC), Michael Osborne,Manoj Pansure, Tara Penders, Brian Schade, Rana Shams

TABLE OF CONTENTS

This page left intentionally blank

EXECUTIVE SUMMARY

After more than a year of COVID lockdown, people began returning to a more normal lifestyle mid-2021. They started dining out, attending sporting events, going to school in person, and returning to the office. The most obvious impact was the increased number of drivers on the road throughout Maryland. Although volumes did not return to 2019 levels, they were up substantially over 2020.

Travel during morning peak hours remained lower than usual, while afternoon peak period travel approached pre-COVID heights. Depending upon the region this also impacts travel, with rural areas experiencing traffic volumes close to those in 2019. However, urban areas experienced a decrease in traffic due to remote work flexibility.

The past two years have been unprecedented, making it imperative to determine if this reduction in travel demand was a blip or a future trend. The Maryland Department of Transportation State Highway Administration (MDOT SHA) will continue to use a performance-based approach to monitor and address critical and shifting mobility trends. These shifts create a need for progressive and cost-effective operations, engineering, and context-sensitive design of the transportation system to ensure a safer and more efficient network.

To achieve this, MDOT SHA continuously monitors existing travel trends, accomplishments, and challenges. This helps establish short and long-term strategies to adapt to changes, develop improvements, and enhance overall organizational excellence.

The 2022 Maryland Mobility Report summarizes our performance, successes, opportunities, and future strategies based on the data collected and events that transpired over the course of the 2021 calendar year.

HIGHLIGHTS	
2021 TRENDS	**'21 VS '20**
Traffic volumes at 56.6 billion VMT	12% ↑
Four interstates carry over 200,000 vehicles per day	1 ↑
Total mileage on freeway system experiencing heavy to severe congestion: 51 miles AM/164 miles PM peak hour	39 AM ↑ 130 PM ↑
Statewide congestion costs were $2.02 billion	$0.21 ↑
66,000 responses to incidents and stranded motorists	5,000 ↑
Eight miles of new sidewalk located in 14 Counties	2 ↓
Twelve capacity improvement projects competed	2 ↑
Three new adaptive signal systems	2 ↓

CONGESTION AND RELIABILITY TRENDS

With increased congestion on Maryland's roadways, MDOT SHA is addressing the challenge of moving people and goods effectively. This includes both recurring congestion along over-capacity roadway sections and non-recurring congestion due to incidents or events. To address these challenges, it is important to first understand the trends and how they affect travelers and freight movement in terms of cost, time, and efficiency. The following is a summary of mobility and reliability trends on the Maryland highway system in 2021.

Vehicle Miles Traveled (VMT)[1]:

- Travel on Maryland roadways increased from 50.6 billion VMT in 2020 to 56.6 billion VMT in 2021, resulting in a 12% increase in travel on all types of roadways.
- Approximately 71% of statewide vehicular travel occurred on MDOT roadways. This percentage stayed the same from 2020.
- All counties experienced at least a 7% growth in VMT, with the highest increase in Anne Arundel, Baltimore, Montgomery, and Prince George's Counties. Each of these counties experienced an increase of more than 500 million VMT.

Annual Average Daily Traffic (AADT)[2]:

The highest daily volume locations for freeway/expressway and arterial sections include:

HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) FREEWAY/EXPRESSWAY SECTIONS		
ROUTE	LIMITS	2021 AADT (THOUSANDS)
I-495	Virginia Line to I-270 West Spur	205-232
I-495	I-270 East Spur to I-95	191-232
I-695	I-95 (South) to I-70	169-218
I-270	I-270 Split to MD 117	195-217
I-95/ I-495	MD 4 to I-95	193-215

HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) ARTERIAL SECTIONS		
ROUTE	LIMITS	2021 AADT (THOUSANDS)
US 301	Charles County Line to MD 5	103
MD 5	US 301 to MD 223	64-81
MD 210	Ft Washington Rd to I-95/I-495	68-80
MD 3	US 50/301 to I-97/MD 32	69-79
MD 185	MD 410 to I-495	74

1 - See definition pg. 15

2 - See definition pg. 14

FREEWAYS

The percentage of freeway/expressway miles that experienced heavy to severe congestion in the AM peak hour increased from 1% (12 miles) in 2020 to 3% (51 miles) in 2021. The percentage of freeway/expressway miles that experienced heavy to severe congestion in the PM peak hour increased from 2% (34 miles) to 10% (164 miles) in 2021.

Roadway sections with higher volumes and greater VMT on the freeway/expressway system experience greater congestion. In 2021, 6% of the AM peak hour and 19% of the PM peak hour VMT occurred in congested conditions. In 2020, these values were 2% and 4% in the AM and PM peak hour, respectively.

From 2020 to 2021, freeway/expressway congestion costs increased from $0.74 billion to $1.03 billion in total annual cost. This was an increase of $0.29 billion. The cost includes auto delay, truck delay, wasted fuel and emissions.

ARTERIALS

The percentage of arterial miles that experienced heavy to severe congestion in the AM peak hour increased from 1% (8 miles) in 2020 to 10% (57 miles) in 2021. The percentage of arterial miles that experienced heavy to severe congestion in the PM peak hour increased from 15% (89 miles) to 34% (203 miles) in 2021.

Total congestion costs for freeway/expressways and arterials are estimated at $2.1 billion—an increase of $0.21 billion compared to 2020.

INTERSECTIONS

Intersection analysis of traffic count data from the last four years determined that 35 state highway intersections operated at a failing level of service (LOS F)[3], including five intersections which failed during both the AM and PM peak hours. On a summer weekend, there are two additional failing intersections on the Eastern Shore.

The most congested freeway/expressway (three to eight mile) and arterial (two to five mile) corridor sections for AM and PM peak hours (in descending order) are as follows:

2021 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS (AVERAGE WEEKDAY)[4]

AM PEAK HOUR (8-9 AM)	PM PEAK HOUR (5-6 PM)
I-495 Outer Loop – MD 650 to MD 97	I-695 Inner Loop – MD 139 to Providence Road
I-695 Outer Loop – MD 43 to Cromwell Bridge Rd	I-495 Inner Loop – MD 355 to MD 97
I-695 Inner Loop – MD 129 to I-83	MD 295 Southbound – MD 175 to MD 198
I-695 Outer Loop – I-795 to US 40	MD 295 Northbound – MD 450 to I-95/I-495
US 50 Westbound – MD 410 to MD 295	I-495 Inner Loop – Virginia Line to I-270 West Spur
I-95/I-495 Inner Loop – I-95 to MD 201	MD 295 Northbound – MD 198 to MD 175
MD 295 Southbound – Arundel Mills Boulevard to MD 32	I-695 Inner Loop – US 1 to MD 144
I-270 West Spur Southbound – I-270 to I-495	I-270 Northbound – MD 117 to Middlebrook Road
I-270 Southbound – MD 27 to MD 124	I-95/I-495 Outer Loop – MD 450 to MD 201
MD 295 Southbound – MD 197 to Powder Mill Road	I-95/I-495 Inner Loop – I-95 to MD 201

3 - See definition pg. 43

2021 MOST CONGESTED ARTERIAL SECTIONS (AVERAGE WEEKDAY)[4]	
AM PEAK HOUR (8-9 AM)	PM PEAK HOUR (5-6 PM)
MD 185 Southbound – I-495 to MD 191	US 301 Southbound – MD 381 to McKendree Road/ Cedarville Road
MD 97 Southbound – MD 586 to 16th Street/MD 390	MD 210 Southbound – South of MD 414 to Palmer Road
US 29 Southbound – MD 650 to I-495	MD 185 Northbound – D.C. Line to Jones Bridge Road
MD 190 Eastbound – I-495 to Goldsboro Road/MD 614	MD 2 Northbound – College Parkway to Robinson Road/ Leelyn Drive
MD 355 Northbound – Grosvenor Lane to Randolph Road	MD 45 Southbound – Ridgely Road to Joppa Road
MD 189 Southbound – Wootton Parkway to Glen Road	MD 3 Northbound – MD 450 to MD 424
US 301 Southbound – Short Cut Road to MD 5	MD 355 Northbound – MD 191 to Cedar Lane
MD 28 Westbound – I-270 to MD 119	MD 3 Northbound – Waugh Chapel Road to I-97/MD 32
MD 32 Eastbound – I-70 to Triadelphia Road	MD 5 Southbound – MD 223 to Brandywine Road
MD 190 Westbound – MD 188 to MD 191	MD 97 Northbound – 16th Street/MD 390 to MD 586

4 - See mapping pg 27, 29, 31 and 33 for locations

Summer weekend traffic results in congested conditions in several areas which normally operate at an acceptable level, such as the I-95 northeast corridor, on the Eastern Shore and in western Maryland. For the Friday 4-5 PM, Saturday 1-2 PM, and Sunday 2-3 PM hours, the following locations were identified as the most congested freeway or arterial sections:

- US 50 Eastbound – MD 179 to Chesapeake Bay Bridge
- US 340 Westbound – MD 180 to the Virginia Line
- MD 90 Eastbound – MD 589 to MD 528
- US 50/301 Westbound – Castle Marina Dr to MD 18

CONGESTION REDUCTION ACCOMPLISHMENTS

Various policies, programs and projects have been established to address congestion and improve mobility and reliability. These methods provide benefits for motorists and multi-modal users to yield a safe and modern transportation system. MDOT achieved user cost savings by reducing delays, fuel consumption, and emissions. These combined efforts resulted in more than $2 billion in annual user savings. The following are summaries of MDOT mobility improvement accomplishments.

CHART

The Coordinated Highways Action Response Team (CHART) program cleared more than 29,000 incidents and assisted more than 36,000 stranded motorists on Maryland roadways. Forty-seven traffic signal timings were reviewed in seven systems. Traffic signal retiming resulted in more than $4 million in annual user savings and will continue to provide recurring benefits for years.

2021 USER SAVINGS DUE TO MDOT CONGESTION MANAGEMENT	
CHART	$1,875 Million
Traffic Signal Timing Reviews	$4 Million
Capital Projects	$101 Million
Park and Ride Programs	$38 Million
TOTAL	**$2,018 Million**

MAJOR MOBILITY IMPROVEMENT PROJECTS UNDER CONSTRUCTION OR RECENTLY COMPLETED
MD 32 Dualization from Linden Church Rd to I-70
US 301 Nice Bridge dualization
MD 97 Brookeville Bypass
MD 4 at Suitland Parkway Interchange Construction
MD 210 at Livingston Rd Interchange Construction

CAPITAL PROJECTS

The following capital projects were completed:

- Intersection improvements at MD 26 and Old Annapolis Rd/Water Street Rd, US 1 and Kit Kat Rd, MD 27 and Gillis Falls Rd/Harrisville Road, and MD 32 and Bennett Rd/Johnsville Rd.
- Six roadway widening projects to improve mobility: Widening I-695 from US 40 to MD 144, MD 175 from Reece Rd to Disney Rd, MD 272 from south of US 40 to Rogers Rd, US 219 from I-68 to Old Salisbury Rd, MD 355 from Brink Rd to south of Greenridge Dr and MD 140 from Garrison View Rd to north of Painters Mill Rd.
- A new interchange project was constructed at MD 5 and MD 373. The I-95/495 at MD 214 was reconstructed.

These projects resulted in $101 million in annual user savings.

IMPROVED MOBILITY ACCOMPLISHMENTS

- Pedestrian and bicycle projects are a major emphasis for MDOT SHA. These projects were completed as part of other roadway improvements or as stand-alone projects. MDOT SHA projects constructed more than eight miles of new sidewalks located in 14 counties. This includes an approximate six-mile increase in directional miles for marked bicycle facilities.
- Statewide, approximately 71% of all sidewalks are ADA compliant.
- The I-270 and US 50 corridors provide high occupancy vehicle (HOV) lanes to encourage ride sharing and increased person throughout. The I-270 HOV lanes saved motorists up to five minutes in travel time over the other lanes.
- Approximately 3,100 commuters on an average weekday use an MDOT SHA lot or MDTA park-and-ride lot to connect to transit or ride with other commuters. These 112 lots are operated in 21 counties. They provide an annual user savings of approximately $38 million.
- The Intercounty Connector (MD 200) Managed Facility AADT between I-370 and I-95 is approximately 49,500 vehicles per day, which is 10,000 vehicles higher than in 2020. The I-95 express toll lanes average more than 22,000 vehicles per day, with as many as 3,000 motorists using them in one hour.

FREIGHT MOVEMENT

- Two new virtual weigh stations along US 301 at the Nice Bridge are scheduled for completion. The state is in the process of instrumenting the site on US 213 in Galena.
- Various projects on the National Highway Freight Network through the FAST ACT Freight Formula Fund are under construction. These include bridge reconstruction at I-70 at MD 65/ CSX Hagerstown Branch, I-695 at Putty Hill Road, I-70 at I-81, and the MD 150/MD 151 bridges along Sparrows Point Boulevard.
- Improved one at-grade railroad crossing to increase safety in Baltimore County at Mt Wilson Lane, along with implementing passive signing upgrades at Norfolk Southern Railroad crossings.

TRANSPORTATION SYSTEMS MANAGEMENT & OPERATIONS (TSMO)

- The I-270 integrated corridor management southbound ramp metering project was opened to provide travel time savings for mainline operations.
- The 30% design for I-70/US 29/US 40/MD 144/MD 99 (TSMO System 1) included traffic monitoring and queue warning and dynamic speed advisories.

MDOT SHA/MDTA TSMO ONGOING PROJECTS
SMART adaptive traffic signals along various arterial corridors
I-95 Managed Lane Project
I-695 part time shoulder use from I-70 to MD 43
US 1 ITS deployment

MARYLAND
MOBILITY STATISTICS

I-695 at Windsor Mill Rd

INTRODUCTION

As COVID-19 impacts to traffic gradually decreased throughout 2021, volumes steadily increased from 2020 lows. Although 2021 yielded higher travel levels than 2020, travel levels remained less than 2019. To determine the impact on mobility caused by increased travel in 2021, the Maryland Department of Transportation State Highway Administration (MDOT SHA) has provided a comprehensive review of performance and mobility trends.

The 2022 Maryland Mobility Report summarizes results and accomplishments during the 2021 calendar year. This annual report reviews Maryland's mobility strategies, projects, programs, and initiatives using a goal-oriented, performance-based approach that focuses on *What is Happening, What is MDOT SHA Doing, and What are the Outcomes?*

The Maryland Mobility Report illustrates:

- The agency's data-driven methodologies to identify and address congestion issues
- The agency's transportation investments to promote safe, efficient, and reliable movement of goods and services
- The importance of monitoring existing travel trends and the procedures used to identify successes, challenges, and strategies to improve transportation services

Highlights of the 2021 Maryland Mobility Report include:

- Traffic volume trends
- Pedestrian and bicycle projects and programs
- Roadway and freight characteristics
- Most congested freeway/expressway and arterial sections during a normal weekday and summer weekend
- Freeway/expressway and arterial performance year-to-year comparisons
- Projects completed in 2021 and their benefits
- Programs to address mobility and their results
- Transportation Systems Management and Operations (TSMO) activities

The Maryland Mobility Report is a joint effort of the MDOT SHA's Office of Planning and Preliminary Engineering (MDOT SHA OPPE) and the Office of Transportation Mobility and Operations (MDOT SHA OTMO).

TRANSPORTATION INFRASTRUCTURE

The ability to move goods and people from place to place is vital to Maryland's economy. Each part of the state is uniquely characteristic—from the rugged Appalachian Mountains in the West, to the dense urban areas at the center, to the Atlantic Ocean on the east. As such, residents and travelers from different areas require many different transportation needs.

Therefore, MDOT SHA provides a multi-modal infrastructure network that supports safe and effective access and mobility for all types of statewide transportation **(Figure 1)**. Examples include:

- Mass transit service is provided through subways, commuter rail, light rail, and buses operated by MDOT Maryland Transit Administration (MDOT MTA), the Washington Metropolitan Area Transit Authority (WMATA), and local transit operators. Regional train service is provided by Amtrak in the Northeast Corridor. The MARC system provides service along the Brunswick, Penn, and Camden lines.
- There are numerous bicycle and walking facilities across the state, ranging from a series of off-road trails such as the Capital Crescent Trail, Chesapeake, and Ohio Canal Towpath sidewalks, and bike lanes along highways.
- Baltimore-Washington Thurgood Marshall International Airport (BWI) saw a major increase in passenger travel in 2021, with 18.9 million passenger arrivals and departures. This was an increase of 7.7 million passengers over 2020. The airport set a new record for cargo—up by 4% over last year—with 619 million pounds transported.
- The Helen Delich Bentley Port of Baltimore is a cornerstone to Maryland's economic success, handling more than 43.6 million tons of cargo valued at $61.3 billion in 2021.
- Maryland has a vast roadway network that contains approximately 31,700 miles of surface transportation infrastructure.

ROADWAYS

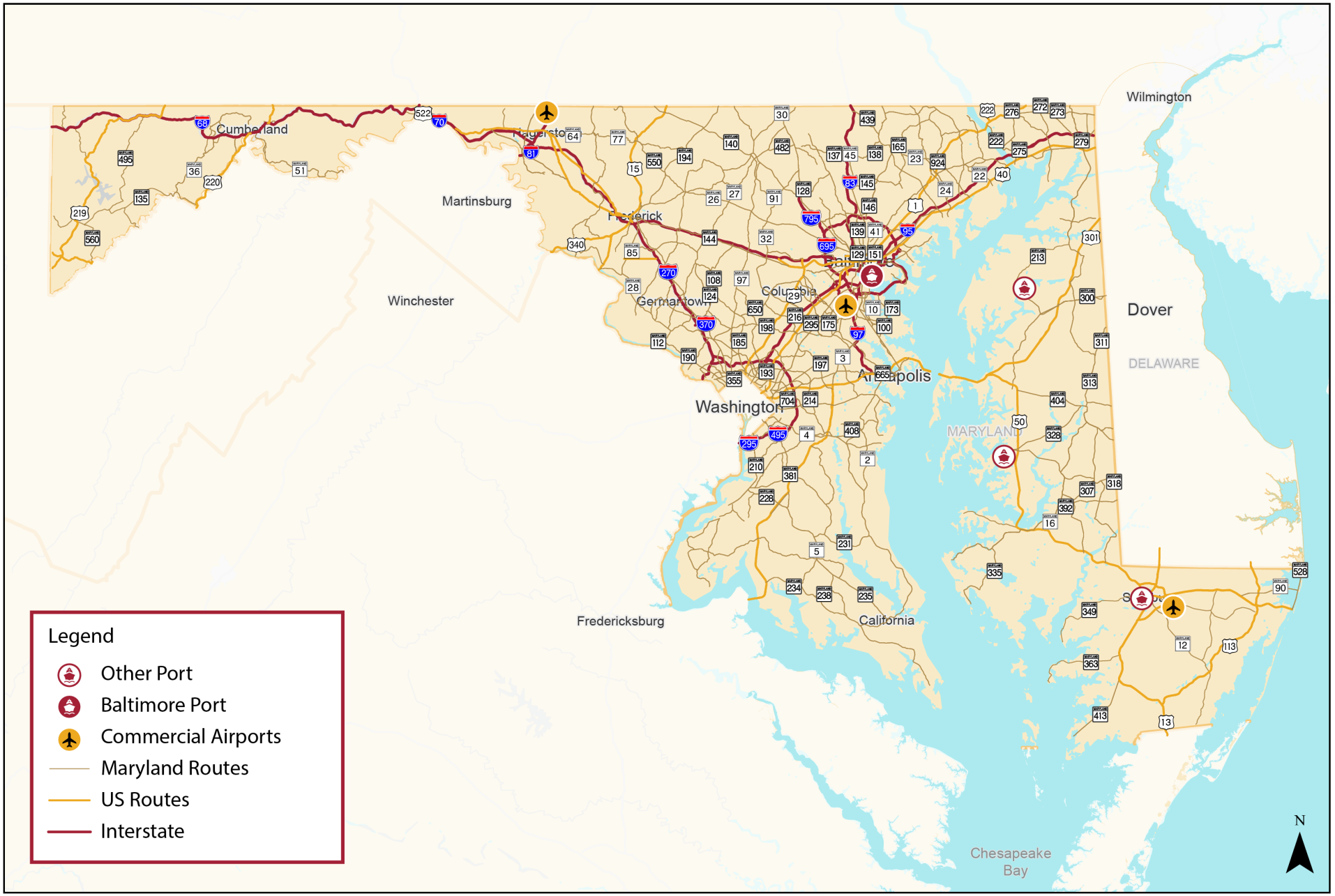
Known as the *National Road*, US 40 was the first federally-funded road built in Maryland. From that original dirt path, Maryland has expanded its roadway network to provide motorists with the ability to travel statewide. MDOT operates the state's major roadway facilities. The MDOT SHA maintains interstates, US routes, and numbered Maryland routes, with the exception of interstate routes through Baltimore City, and portions maintained by the Maryland Transportation Authority (MDTA) including all toll facilities. Roadways are classified based on the role they play in moving vehicles throughout a network of highways. This classification system identifies a road's primary use, ranging from freeways to local streets **(Table 1)**.

Table 1

ROADWAY FUNCTIONAL CLASSIFICATION	
CLASSIFICATION	FUNCTION
Freeways/Expressways	Controlled access facilities with limited points of ingress/egress. These facilities are designed for long distance travel at higher speeds.
Arterials	Highest functioning roads normally with traffic signals. These roadways serve as interconnections between major corridors and are used for long-distance trips.
Collectors	Gather traffic from local roads and funnels to an arterial system. Serves both land access and traffic circulation.
Locals	Provide direct access to adjacent land use and does not carry through traffic.

Maryland Statewide Infrastructure

Figure 1



MDOT maintains the majority of Interstate, US, and Maryland routes. These facilities have the highest average number of lanes per mile **(Table 2)**. Typically, the highest average number of lanes per mile correlates to the highest volumes and the most congestion.

Table 2

MILEAGE STATISTICS					
ROAD TYPE	ROADWAY MILES	PERCENTAGE OF ROADWAY MILES	MAINLINE LANE MILES[1]	AVERAGE NUMBER OF LANES/MILE	OWNERSHIP
Interstate Routes	488	2%	2,848	5.8	MDOT SHA, MDTA, Baltimore City
US Routes	760	2%	2,710	3.6	MDOT SHA, MDTA, Baltimore City
Maryland Routes	4,213	13%	10,589	2.5	MDOT SHA, MDTA
Other Roadways	26,011	83%	53,275	2.1	Counties, Municipalities

1 - Mainline Lane Miles = Roadway Miles x Number of Lanes
Note: Does not include ramp and service road mileage

MD 528

Maryland has more than 31,000 roadway miles.

MAJOR STRUCTURES – BRIDGES AND TUNNELS

Maryland has numerous rivers feeding into the Chesapeake Bay, creating the need to travel across these waterways. As a result, Maryland has constructed more than 5,000 bridges over waterways, roads, and railroads, most of which are owned by MDOT SHA. Some of these are major signature structures. There are also two tunnels in Maryland operated by MDTA **(Table 3 and Figure 2)**. The eight-lane, 1.4-mile, Fort McHenry Tunnel allows I-95-traffic to pass under the Patapsco River. The I-895 Harbor Tunnel is a four-lane, 1.4-mile-long facility that runs parallel to the Fort McHenry Tunnel.

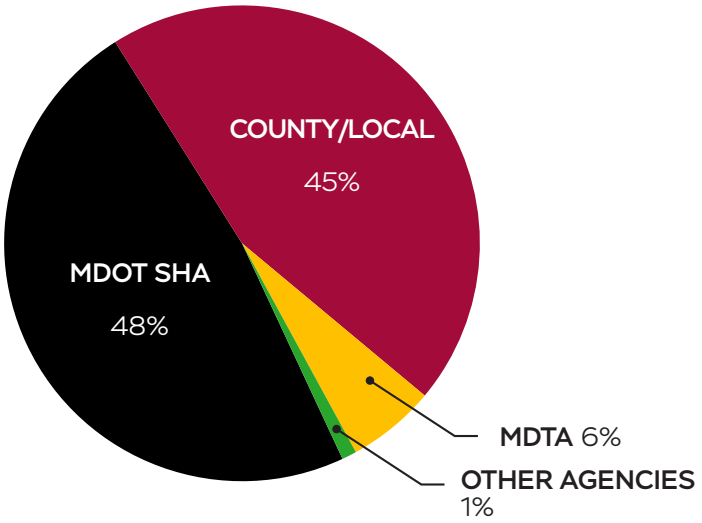
MARYLAND'S SIGNATURE BRIDGES AND TUNNELS		
American Legion Bridge (I-495)	Fort McHenry Tunnel (I-95)	Harbor Tunnel (I-895)
Harry Nice Bridge (US 301)	Hatem Bridge (US 40)	Key Bridge (MD 695)
Thomas Johnson Memorial Bridge (MD 4)	Tydings Memorial Bridge (I-95)	William Preston Lane Memorial (Bay) Bridge (US 50/301)
Woodrow Wilson Memorial Bridge (I-95/I-495)		

Table 3

MARYLAND BRIDGES BY OWNERSHIP	
OWNER	NUMBER OF BRIDGES
MDOT SHA	2,565
County/Local	2,416
MDTA	358
Other Agencies (Federal, Railroad, Other State Agencies)	26

Figure 2

BRIDGE OWNERSHIP BY AGENCY



TRAFFIC VOLUMES

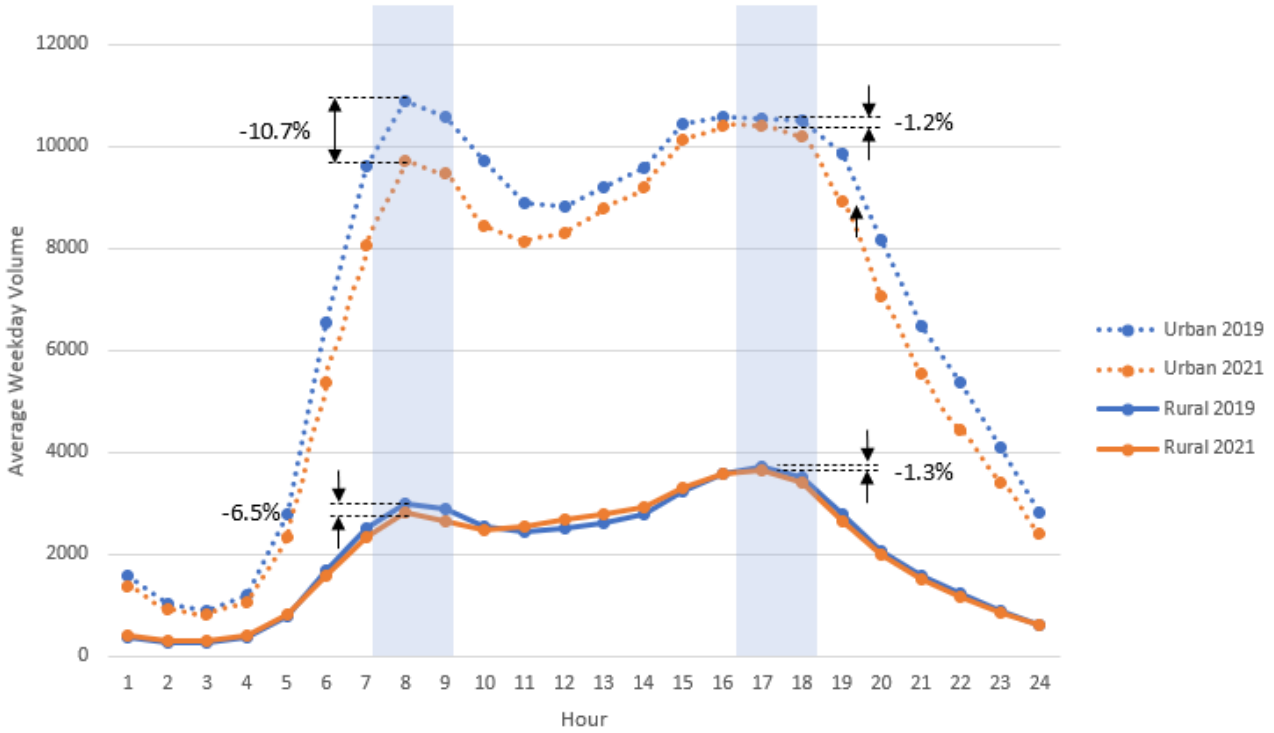
MDOT SHA monitors traffic using 87 automated traffic recorder stations (ATR) along freeways/expressways, arterials, and collector roadways—24 hours a day, 365 days a year. This allows MDOT SHA to monitor trends that occur throughout the year. These trends can be viewed using the online *Traffic System Monitoring Dashboard*—created in 2021.

According to the dashboard, the pandemic had a major impact on travel, with traffic volumes decreasing by approximately 17% across the State from 2019 to 2020. In 2021, traffic volumes increased as more people began returning to pre-COVID travel patterns. Although traffic volumes are still lower in 2021 than they were in 2019, changes are occurring on the roadway network.

With more people telecommuting in 2021, significant transitions occurred in the time of day when people made trips. Urban interstates in 2021 experienced a reduction in traffic volumes due to lingering effects of the pandemic. The data shows AM peak period volumes were down 10.7% compared to 2019. However, the PM peak period volumes were only down by 1.2%. For rural interstates, the ADTs were down 6.5% and 1.3% in the AM and PM peak periods, respectively. The overall trend shows the PM peak period is returning to 2019 levels sooner than the AM peak period **(Figure 3)**. This could be attributed to a more flexible work schedule and peak period spreading. It should be noted that the midday volumes along rural interstates have surpassed 2019 levels.

Figure 3

2019 VS. 2021 URBAN AND RURAL WEEKDAY INTERSTATE AVERAGE HOURLY VOLUMES AT ATR STATIONS (vehicles per hour)



ANNUAL AVERAGE DAILY TRAFFIC (AADT)

MDOT SHA administers a traffic data collection program along roadways throughout the state. MDOT SHA uses equipment and personnel to collect the data on numerous sections of roadway. Annual average daily traffic (AADT) measures the volume of traffic for the year, divided by the number of days in a year. Traffic volumes across the state rebounded significantly in 2021. Several sections exceeded 200,000 vehicles per day **(Table 6)**. The highest volume locations saw a significant increase between 2020 and 2021.

Table 4

HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) VOLUMES (VEHICLES PER DAY)	
FREEWAY SECTION	2021 AADT
I-495 E of MD 190	232,000
I-495 W of MD 212	232,000
I-95 N of Virginia Line	225,000
I-95/I-495 E of Virginia Line	221,000
I-695 S of US 40	218,000
ARTERIAL SECTION	2021 AADT
US 301 N of Charles County Line	103,000
MD 5 S of MD 223	81,000
MD 3 N of Prince George's County Line	79,000
MD 3 N of MD 450 (South)	75,000
MD 185 S of I-495	74,000
MDTA TOLL FACILITY CROSSINGS	2021 AADT
I-95 Ft. McHenry Tunnel	120,000
I-95 Tydings Bridge	83,000
US 50/US 301 Bay Bridge	73,000
I-895 Harbor Tunnel	69,000

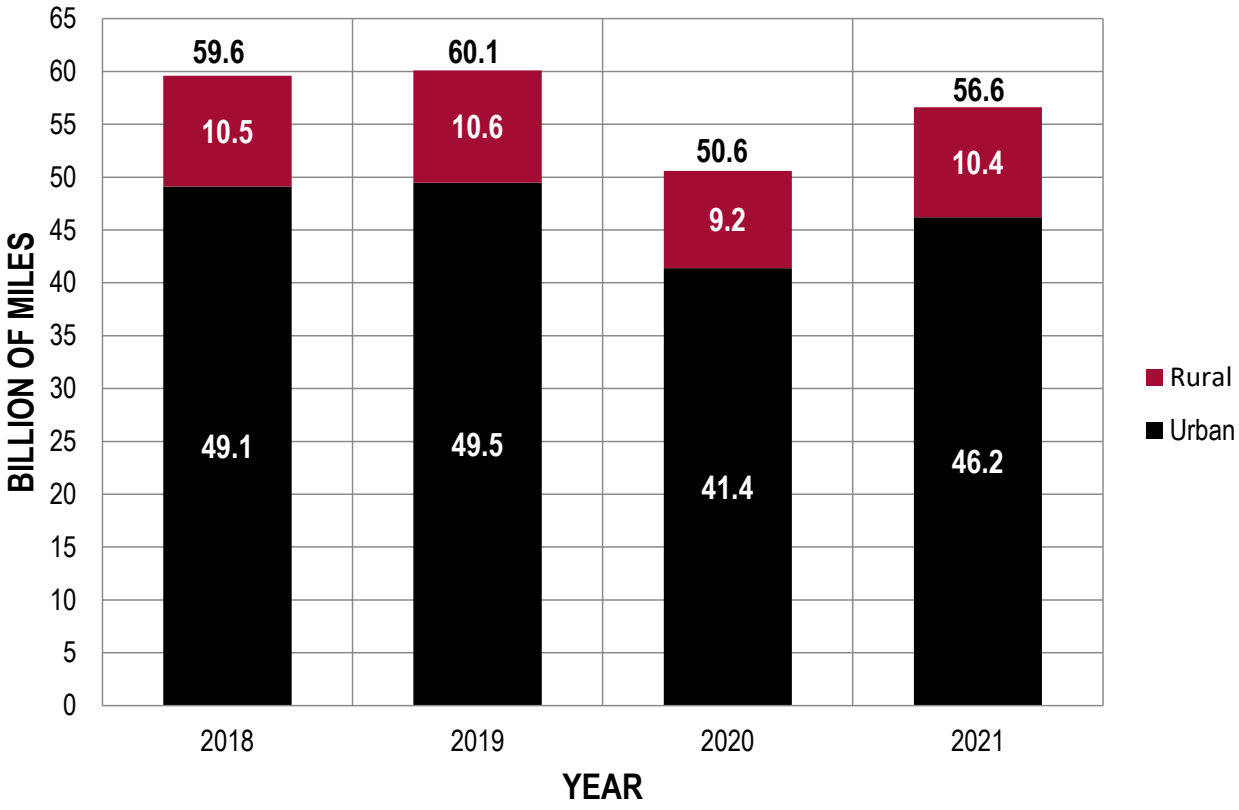
VEHICLE MILES TRAVELED – TOTAL/URBAN/RURAL

MDOT SHA measures traffic volume using counts and other sources to gauge annual variations in Maryland roadway travel. One such source is a standard performance measure known as Vehicle Miles Traveled (VMT), which indicates the overall use of roadways. VMT is determined by taking the number of vehicles and multiplying it by the distance traversed along the section of roadway. The state calculates VMT on local, state, US and interstate roadways. Comparing VMT is an effective method for tracking the growth and demands of the roadway network.

VMT rebounded in 2021, increasing by approximately six billion miles compared to 2020. This change occurred mostly on urban roadways, however, VMT in rural areas have nearly returned to pre-COVID levels **(Figure 4)**.

Figure 4

MARYLAND VEHICLE MILES TRAVELED (BILLIONS)



VEHICLE MILES TRAVELED - BY AGENCY AND FACILITY TYPE

Most travel in Maryland occurs along MDOT roads. In fact, a staggering 71% of VMT occurs on these roadways, despite MDOT SHA and MDTA only accounting for 17% of roadway miles **(Table 4 and Figure 5)**. Maryland-numbered routes account for the highest number of VMT, with more than 18 billion miles. Meanwhile, interstate highway travel is a close second **(Table 5 and Figure 6)**. Between 2020 and 2021, the percentage of VMT by agency and roadway classification remained the same, with no categorical change of more than 1%.

Table 5

VMT BY AGENCY	
AGENCY	VMT (BILLIONS)
MDOT SHA	37.11
County/Local/Others	16.15
MDOT MDTA	3.36

Figure 5
VMT BY AGENCY

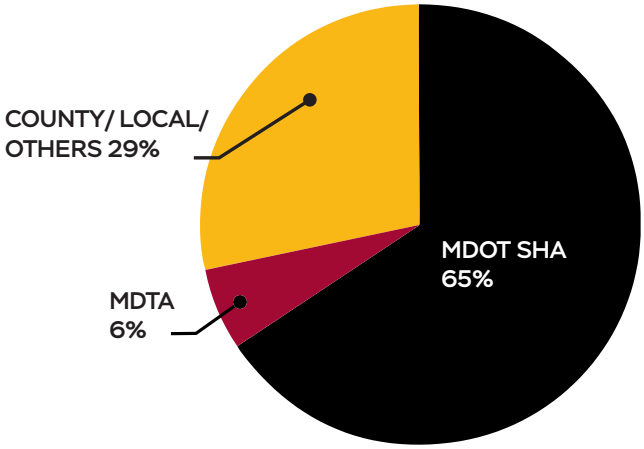
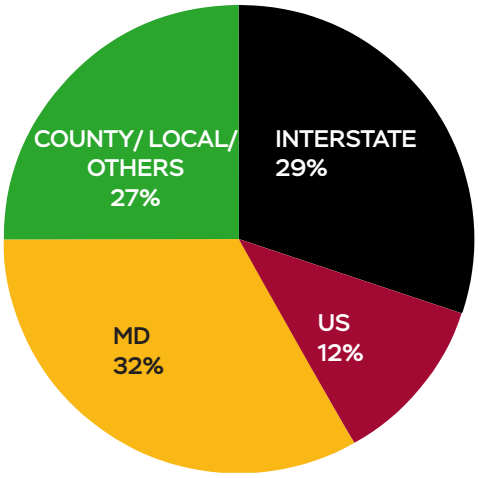


Table 6

VMT BY ROADWAY CLASSIFICATION	
ROADWAY DESIGNATION	VMT (BILLIONS)
Maryland Routes	18.07
Interstate Routes	16.59
County/Local/Others	15.16
US Routes	6.80

Figure 6
VMT BY ROADWAY CLASSIFICATION

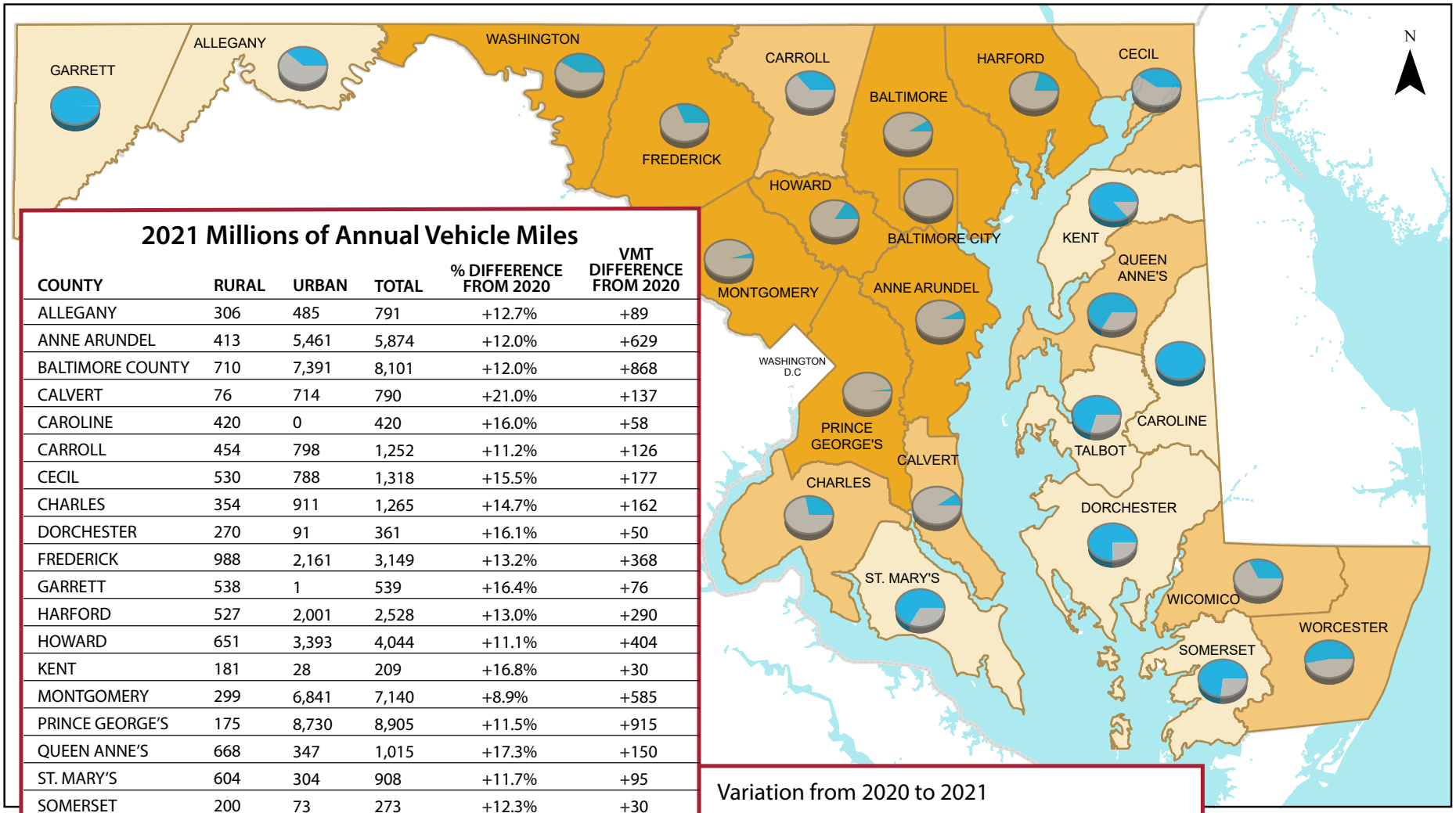


VEHICLE MILES TRAVELED – BY COUNTY

In 2021, every county experienced a VMT increase from 2020 by at least 7%. The largest increases in the amount of VMT occurred in Anne Arundel, Baltimore, Montgomery, and Prince George's Counties. These counties experienced an increase of 500 million miles **(Figure 7)**. Calvert County experienced the largest percentage increase at 21%.

2021 Vehicle Miles of Travel - By County

Figure 7



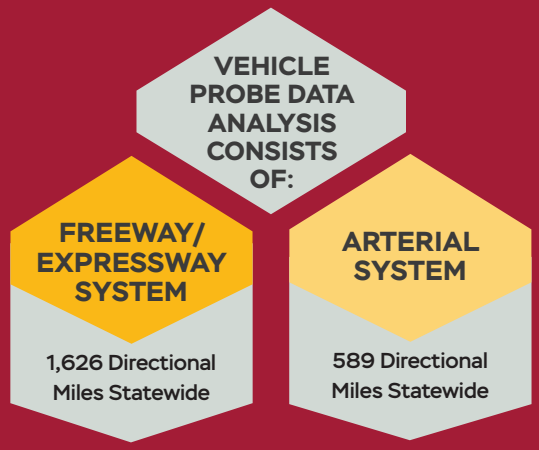
2021 Millions of Annual Vehicle Miles

COUNTY	RURAL	URBAN	TOTAL	% DIFFERENCE FROM 2020	VMT DIFFERENCE FROM 2020
ALLEGANY	306	485	791	+12.7%	+89
ANNE ARUNDEL	413	5,461	5,874	+12.0%	+629
BALTIMORE COUNTY	710	7,391	8,101	+12.0%	+868
CALVERT	76	714	790	+21.0%	+137
CAROLINE	420	0	420	+16.0%	+58
CARROLL	454	798	1,252	+11.2%	+126
CECIL	530	788	1,318	+15.5%	+177
CHARLES	354	911	1,265	+14.7%	+162
DORCHESTER	270	91	361	+16.1%	+50
FREDERICK	988	2,161	3,149	+13.2%	+368
GARRETT	538	1	539	+16.4%	+76
HARFORD	527	2,001	2,528	+13.0%	+290
HOWARD	651	3,393	4,044	+11.1%	+404
KENT	181	28	209	+16.8%	+30
MONTGOMERY	299	6,841	7,140	+8.9%	+585
PRINCE GEORGE'S	175	8,730	8,905	+11.5%	+915
QUEEN ANNE'S	668	347	1,015	+17.3%	+150
ST. MARY'S	604	304	908	+11.7%	+95
SOMERSET	200	73	273	+12.3%	+30
TALBOT	455	192	647	+12.9%	+74
WASHINGTON	843	1,190	2,033	+13.1%	+236
WICOMICO	320	660	980	+16.3%	+137
WORCHESTER	463	411	874	+14.2%	+109
BALTIMORE CITY	2	3,198	3,200	+7.7%	+229
TOTAL	10,447	46,169	56,616	+11.9%	+6,024

CONGESTION TRENDS

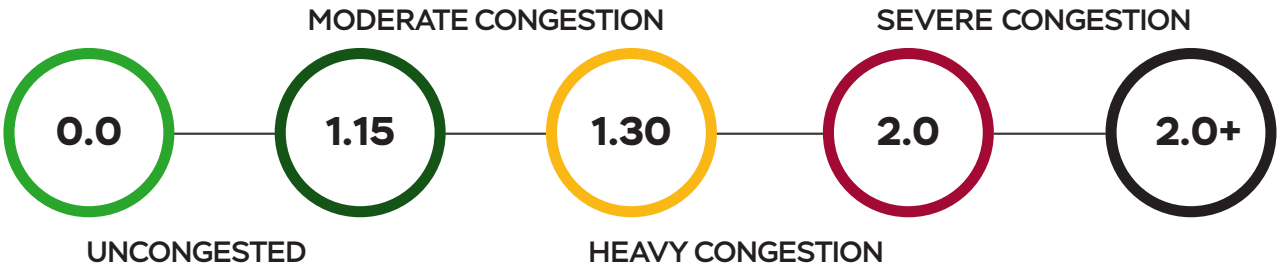
Higher traffic volumes result in a higher likelihood that more motorists will experience congestion along the roadway. However, this is not the only factor that can influence congestion. Crashes, vehicle breakdowns, work zones, special events, and inclement weather can cause motorists to experience slowing or stop-and-go traffic conditions. This is referred to as non-recurring congestion, versus the normal types of recurring congestion occurring in the morning (AM) and afternoon (PM) peak period hours. This type of congestion is influenced by high automobile- and truck-traffic volumes, narrow lane and shoulder widths, and roadway geometrics. Freeway/expressway operations are also influenced by areas where traffic enters and exits the roadway. Whereas motorists traveling on arterials confront delays at traffic signals, variations in speed and different geometrics such as shoulder widths and lane widths also impact congestion.

Congestion is measured by various time periods such as the traditional AM and PM peak periods, weekends, or based on an average day. This can range from theoretical analysis to field measurements. One such method is vehicle probe data. Probes are vehicles equipped with global positioning system (GPS) elements such as navigation devices that transmit real-time data. Analyzing this data helps evaluate mobility. Vehicle probe speed datasets are available from a variety of sources on a minute-by-minute basis. The data is provided to MDOT SHA by INRIX, a company which collects traffic speed data from an estimated 100 million probe vehicles nationwide, including commercial vehicle fleets. The University of Maryland Center for Advanced Transportation Technology (UMD CATT) uses the vehicle probe speed data and traffic volume data to develop metrics for measuring congestion **(Figure 8)**. Additionally, MDOT SHA collects traffic volume data on its roadways using automated traffic recorders (ATR).



Vehicle probe data uses the Travel Time Index (TTI) as its primary measure of congestion. 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.

Figure 8
METRIC: MEASUREMENT OF CONGESTION (TRAVEL TIME INDEX)



CONGESTION MEASURES

MDOT SHA evaluates statewide congestion from year to year. They do this using a set of metrics including the number and percent of roadway miles that operate with heavy to severe congestion. **(See Table 7 for freeways/expressways and Table 8 for arterials)**. For freeways, the percent of peak hour VMT impacted is calculated to measure the amount of VMT that occurs in heavy to severe congestion during the peak hour. This metric summarizes information about how many motorists experience these conditions, along with the distance they travel during the peak hour. As travel started to return to pre-COVID levels, all congestion measures increased over 2020.

Table 7

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

HEAVY TO SEVERE CONGESTION	2019		2020		2021		CHANGE FROM 2020 TO 2021	
	AM	PM	AM	PM	AM	PM	AM	PM
Roadway Miles	177	286	12	34	51	164	+39	+130
Percent of Roadway Miles	11	18	1	2	3	10	+2	+8
Percent of Peak Hour VMT Impacted	22	31	2	4	6	19	+4	+15

Table 8

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

HEAVY TO SEVERE CONGESTION	2019		2020		2021		CHANGE FROM 2020 TO 2021	
	AM	PM	AM	PM	AM	PM	AM	PM
Roadway Miles	80	201	8	89	57	203	+49	+114
Percent of Roadway Miles	15	34	1	15	10	34	+9	+19

Statewide congestion (TTI) maps were developed for the freeway/expressway and arterial system for five time periods, including the average weekday AM and PM peak hours. In addition to AM and PM peak hour analysis, it has been noted that certain areas experienced much greater congestion on summer weekends.

To further explain the congestion trend, maps were also developed for the 4–5 PM Friday, 1–2 PM Saturday, and 2–3 PM Sunday hours.

These are as follows:

- AM Peak Hour 8–9 AM - **Figure 9**
- PM Peak Hour 5–6 PM - **Figure 10**
- Friday Summer 4–5 PM - **Figure 11**
- Saturday Summer 1–2 PM - **Figure 12**
- Sunday Summer 2–3 PM - **Figure 13**

Figure 9

Maryland Congestion Map: 2021 AM Peak Hour (8-9) AM

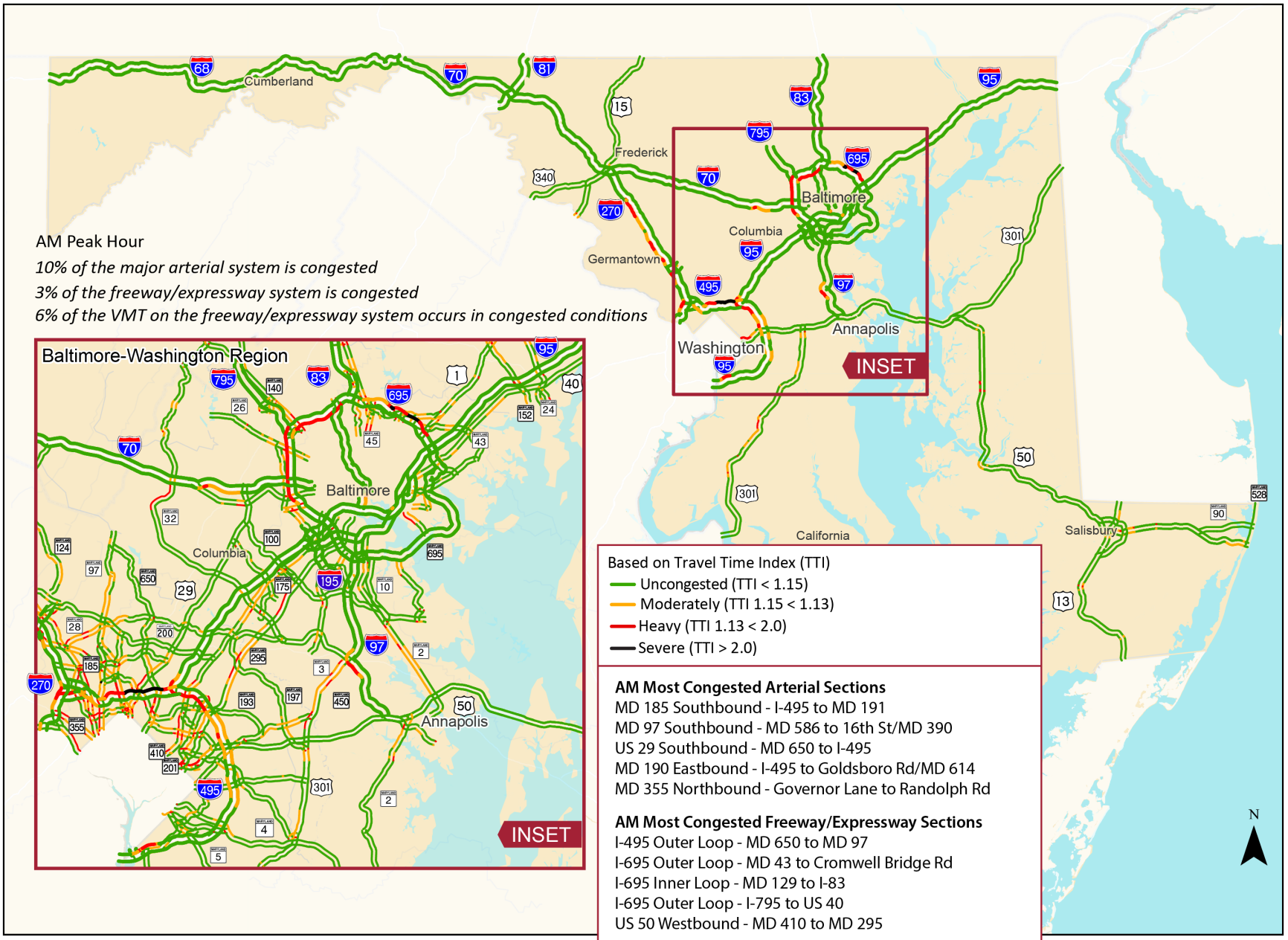
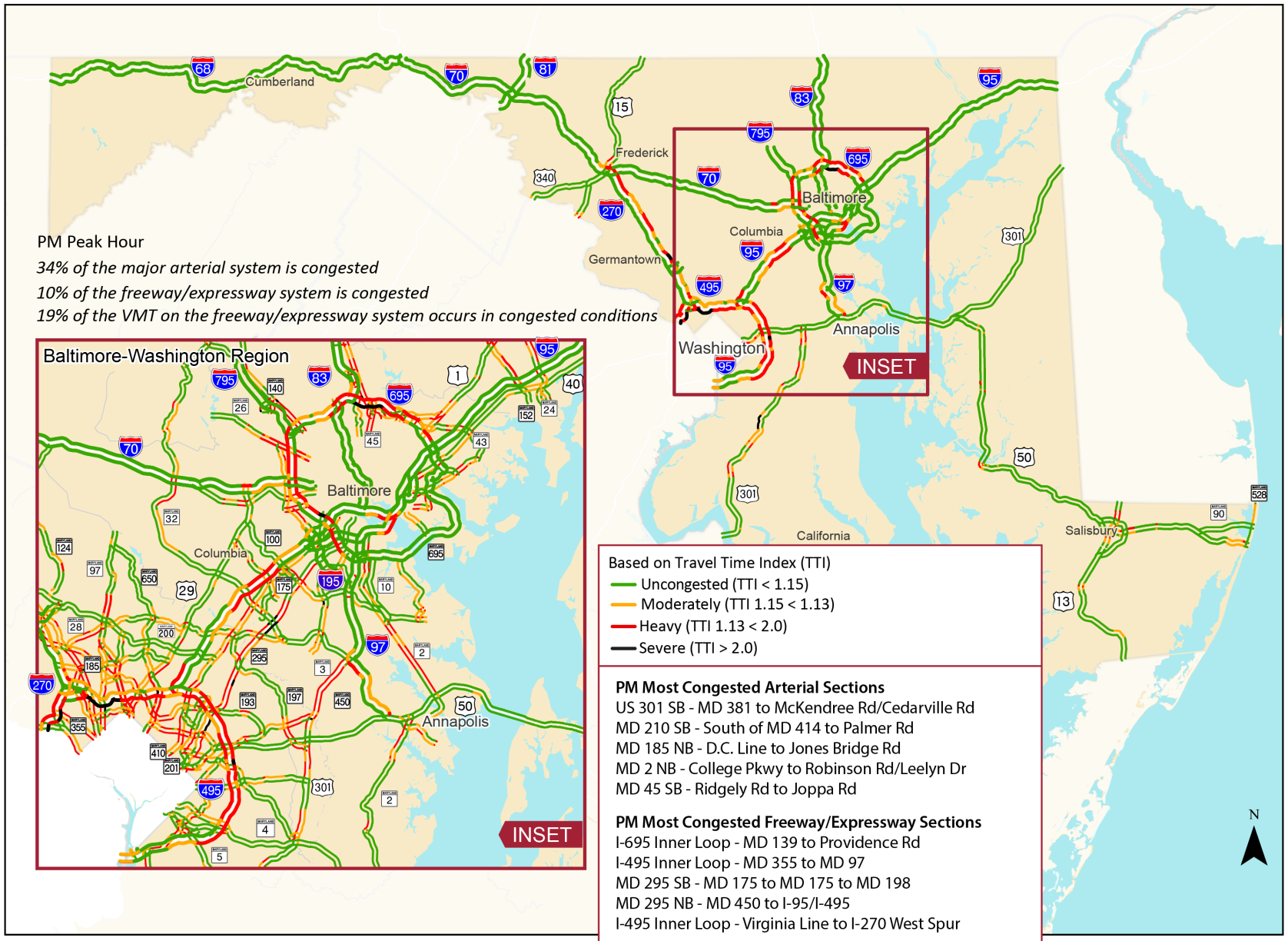
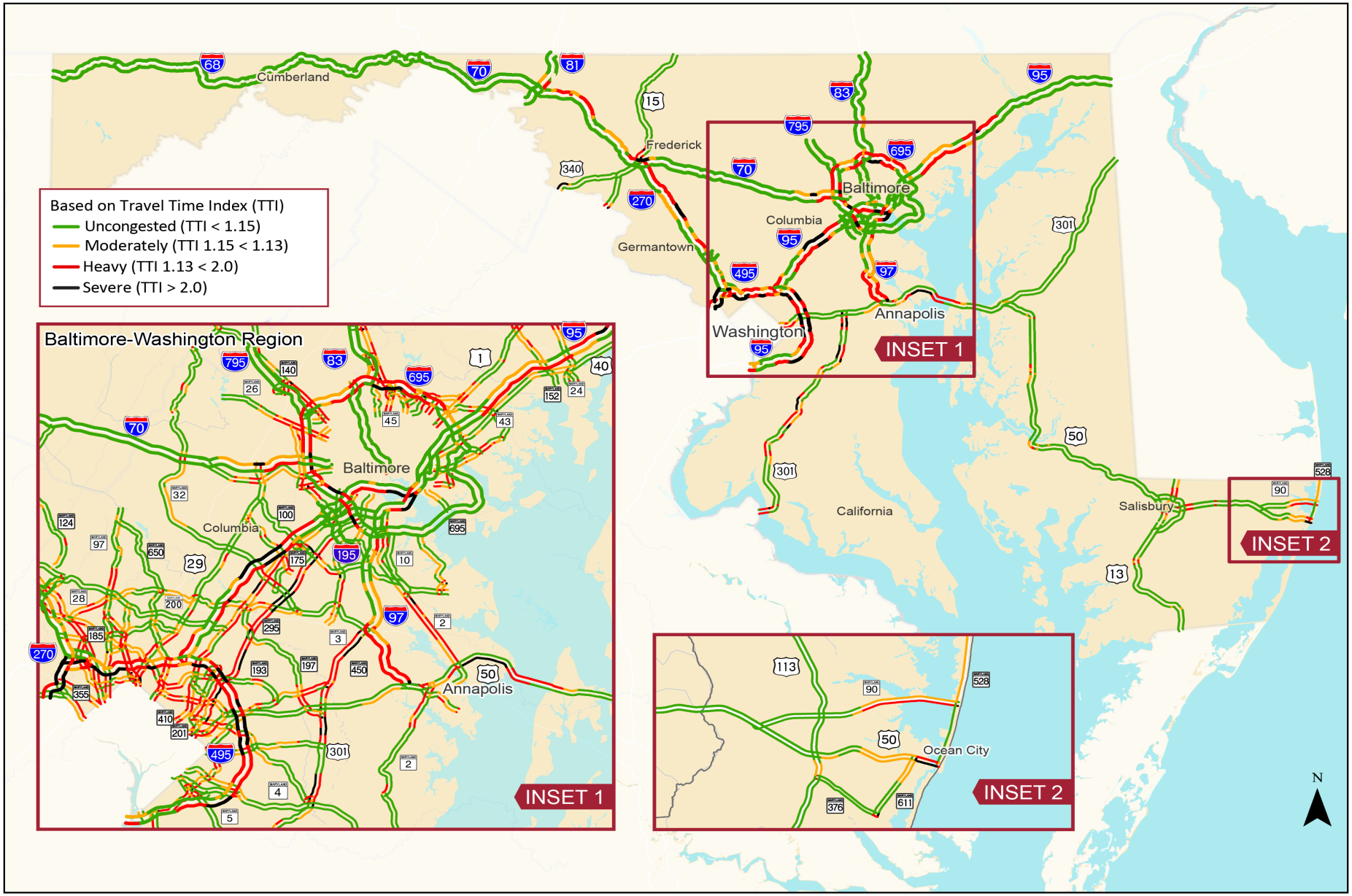


Figure 10

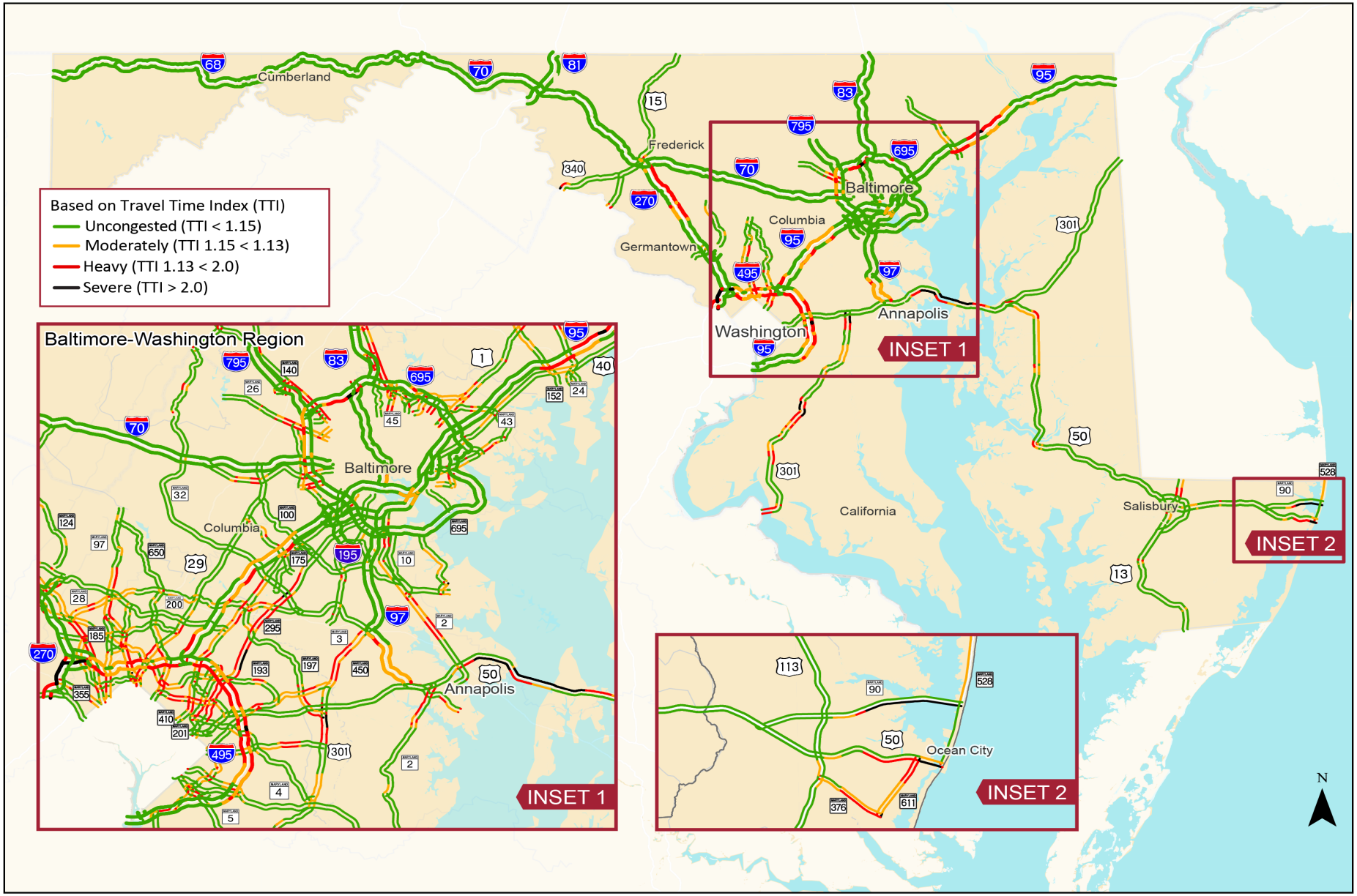
Maryland Congestion Map: 2021 PM Peak Hour (5-6) PM



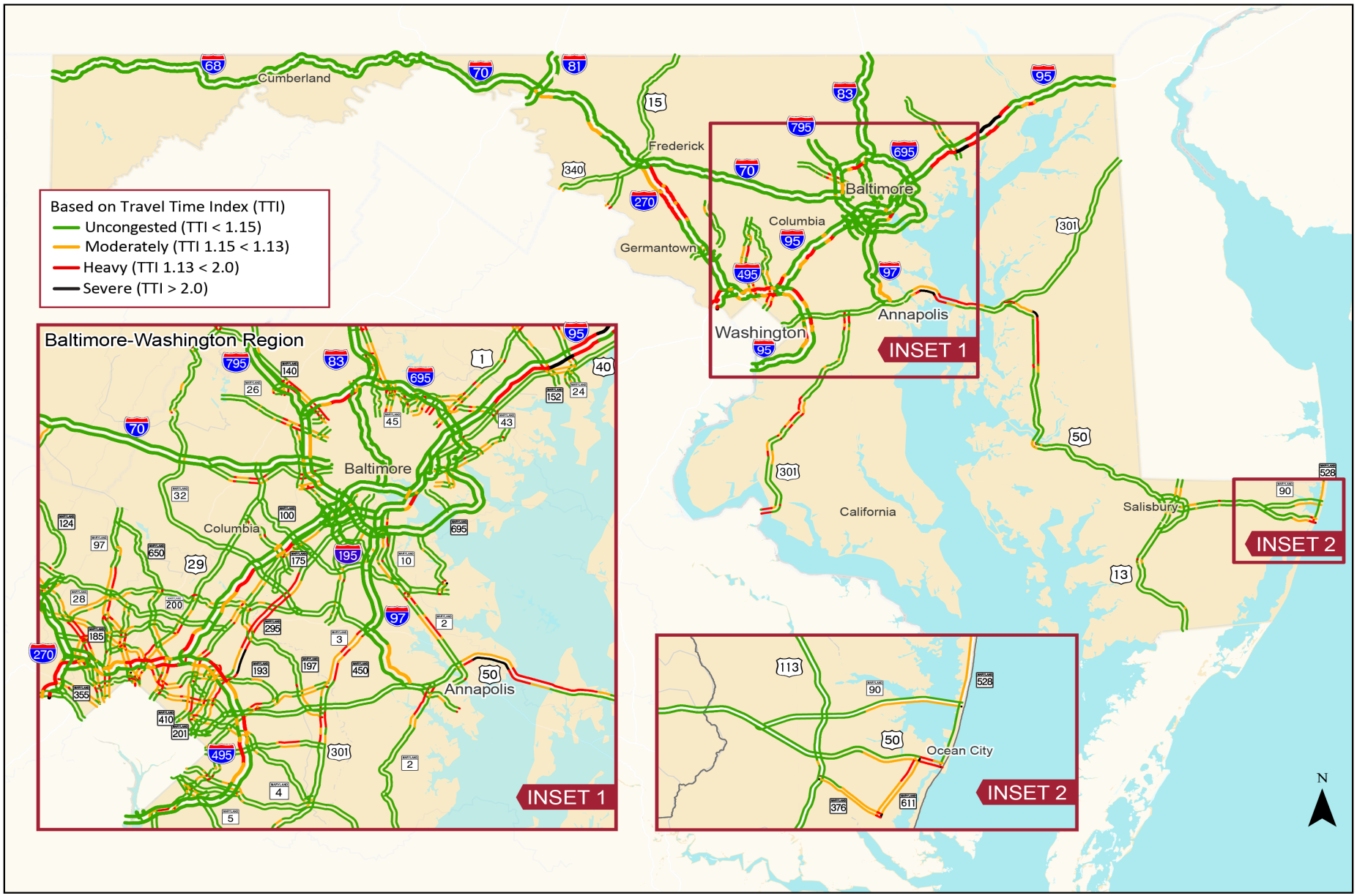
Maryland Congestion Map: 2021 Friday Summer Hour (4-5) PM



Maryland Congestion Map: 2021 Saturday Summer Hour (1-2) PM



Maryland Congestion Map: 2021 Sunday Summer Hour (2-3) PM



COST OF CONGESTION

A motorist or truck driver that is caught in stop and go traffic or progressing very slowly is experiencing decreased mobility. This decreased mobility can be costly. For instance, it may cause late deliveries, force companies to pay for extra delivery time, or result in a person failing to make an event. The MDOT SHA calculates the statewide cost based on auto delay, truck delay, wasted fuel and emissions. The statewide cost for congestion has increased between 2020 and 2021 **(Table 9)**. The change in congestion costs were driven by the higher volumes of traffic on the freeway/expressway system.

Table 9

TOTAL COST OF CONGESTION ON FREEWAYS/EXPRESSWAYS AND ARTERIALS ($ MILLIONS)[1]				
REGION	2019	2020	2021	CHANGE FROM 2020 TO 2021
Freeways/Expressways	$3,584	$744	$1,034	+290
Arterials	$1,576	$1,067	$987	-80
TOTAL	$5,160	$1,811	$2,021	+210

1 – Methodology will be updated in future reports to represent congestion costs for state and local roadways instead of only state roadways.

I-95 at MD 198

TOP 15 CONGESTED CORRIDOR SECTIONS

The TTI metric presented in Figure 8 was used to develop the most congested freeway/expressway and arterials corridors. The individual segments were combined to develop the AM and PM top 15 most congested freeways/expressway doarterial sections. Freeway/expressway corridor sections range from three to eight miles long or include the entire length of a freeway (I-370) or spur (I-270 East or West Spur), while arterial corridors range from two to five miles long. The top 15 sections for the worst congestion during the AM and PM peak hours are shown in **Tables 10 through 13**.

- Freeway/Expressway Sections AM Peak Hour - Table 10, **Figure 14**
- Freeway/Expressway Sections PM Peak Hour - Table 11, **Figure 15**
- Arterial Sections AM Peak Hour - Table 12, **Figure 16**
- Arterial Sections PM Peak Hour - Table 13, **Figure 17**
-

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

Table 10

2021 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS – AM PEAK HOUR

AM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	I-495 Outer Loop	MD 650 to MD 97	3.35	Montgomery	2.50
2	I-695 Outer Loop	MD 43 to Cromwell Bridge Road	3.07	Baltimore	2.17
3	I-695 Inner Loop	MD 129 to I-83	3.51	Baltimore	1.62
4	I-695 Outer Loop	I-795 to US 40	5.30	Baltimore	1.49
5	US 50 Westbound	MD 410 to MD 295	3.25	Prince George's	1.47
6	I-95/I-495 Inner Loop	I-95 to MD 201	3.23	Prince George's	1.46
7	MD 295 Southbound	Arundel Mills Boulevard to MD 32	3.25	Anne Arundel	1.41
8	I-270 West Spur Southbound	I-270 to I-495	3.25	Montgomery	1.41
9	I-270 Southbound	MD 27 to MD 124	4.03	Montgomery	1.36
10	MD 295 Southbound	MD 197 to Powder Mill Road	3.18	Anne Arundel/ Prince George's	1.35
11	I-270 Southbound	MD 80 to MD 109	3.78	Frederick/Montgomery	1.35
12	I-495 Outer Loop	MD 187 to MD 190	3.11	Montgomery	1.34
13	I-495 Local Inner Loop	MD 414 to I-295	3.38	Prince George's	1.28
14	I-70 Eastbound	Marriottsville Road to US 29	3.81	Howard	1.26
15	MD 295 Southbound	MD 410 to D.C. Line	3.76	Prince George's	1.25

Maryland's Most Congested Freeway Corridor Section: 2021 AM Peak Hour (8-9)

Figure 14

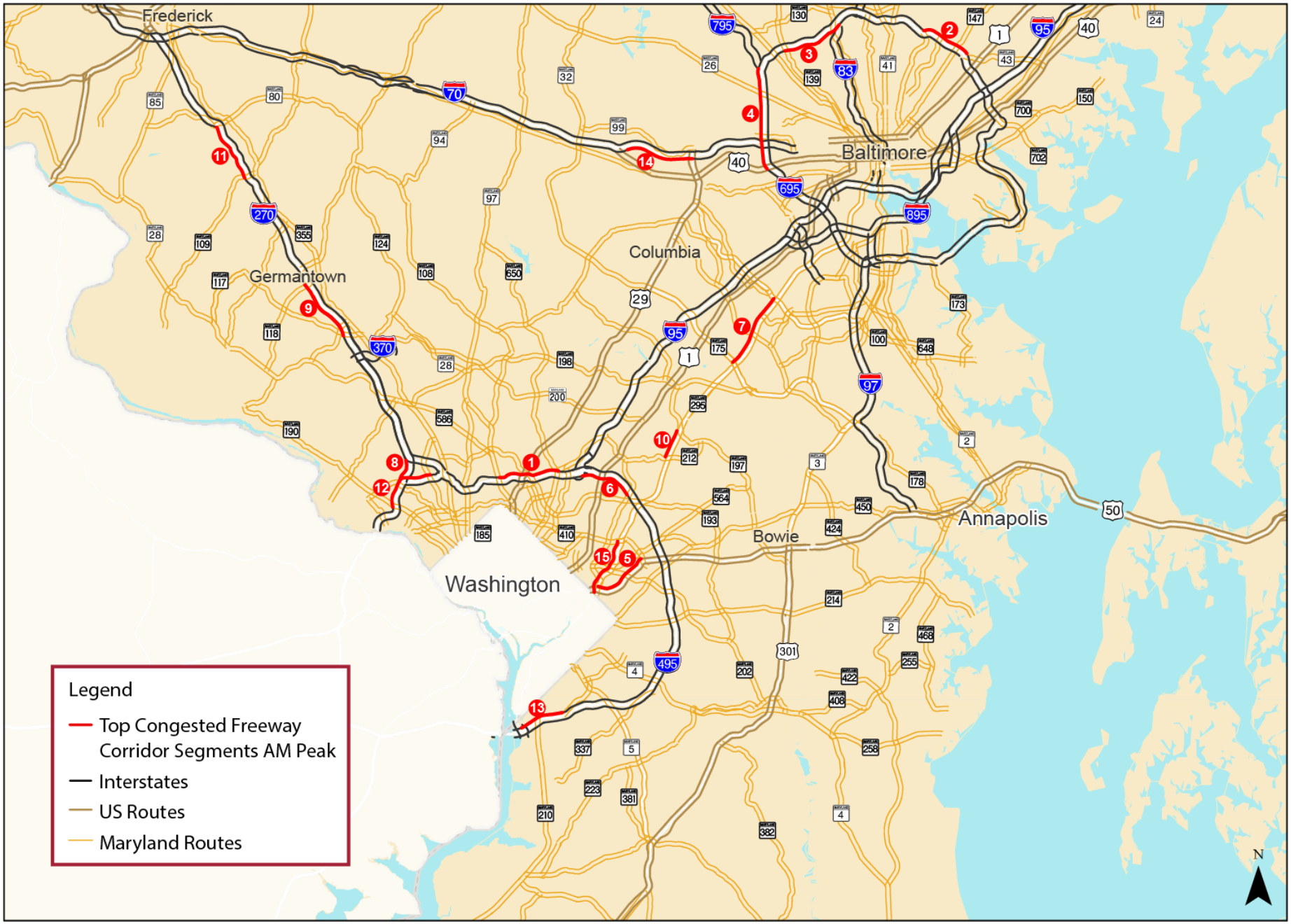


Table 11

2021 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS - PM PEAK HOUR					
PM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	I-695 Inner Loop	MD 139 to Providence Rd	3.02	Baltimore	2.77
2	I-495 Inner Loop	MD 355 to MD 97	3.44	Montgomery	2.45
3	MD 295 Southbound	MD 175 to MD 198	3.56	Anne Arundel	2.12
4	MD 295 Northbound	MD 450 to I-95/I-495	3.56	Prince George's	2.07
5	I-495 Inner Loop	Virginia Line to I-270 West Spur	3.74	Montgomery	1.98
6	MD 295 Northbound	MD 198 to MD 175	3.41	Anne Arundel	1.97
7	I-695 Inner Loop	US 1 to MD 144	3.22	Baltimore	1.92
8	I-270 Northbound	MD 117 to Middlebrook Road	3.27	Montgomery	1.82
9	I-95/I-495 Outer Loop	MD 450 to MD 201	3.45	Prince George's	1.77
10	I-95/I-495 Inner Loop	I-95 to MD 201	3.23	Prince George's	1.75
11	MD 295 Northbound	Explorer Road to MD 197	3.25	Prince George's	1.67
12	I-95/I-495 Inner Loop	MD 202 to Ritchie Marlboro Road	3.21	Prince George's	1.62
13	I-695 Outer Loop	MD 146 to I-83 South	3.18	Baltimore	1.62
14	I-95 Northbound	MD 32 to MD 100	3.48	Howard	1.59
15	I-270 Northbound	MD 121 to MD 109	3.91	Montgomery	1.56

Maryland's Most Congested Freeway Corridor Section: 2021 PM Peak Hour (5-6)

Figure 15

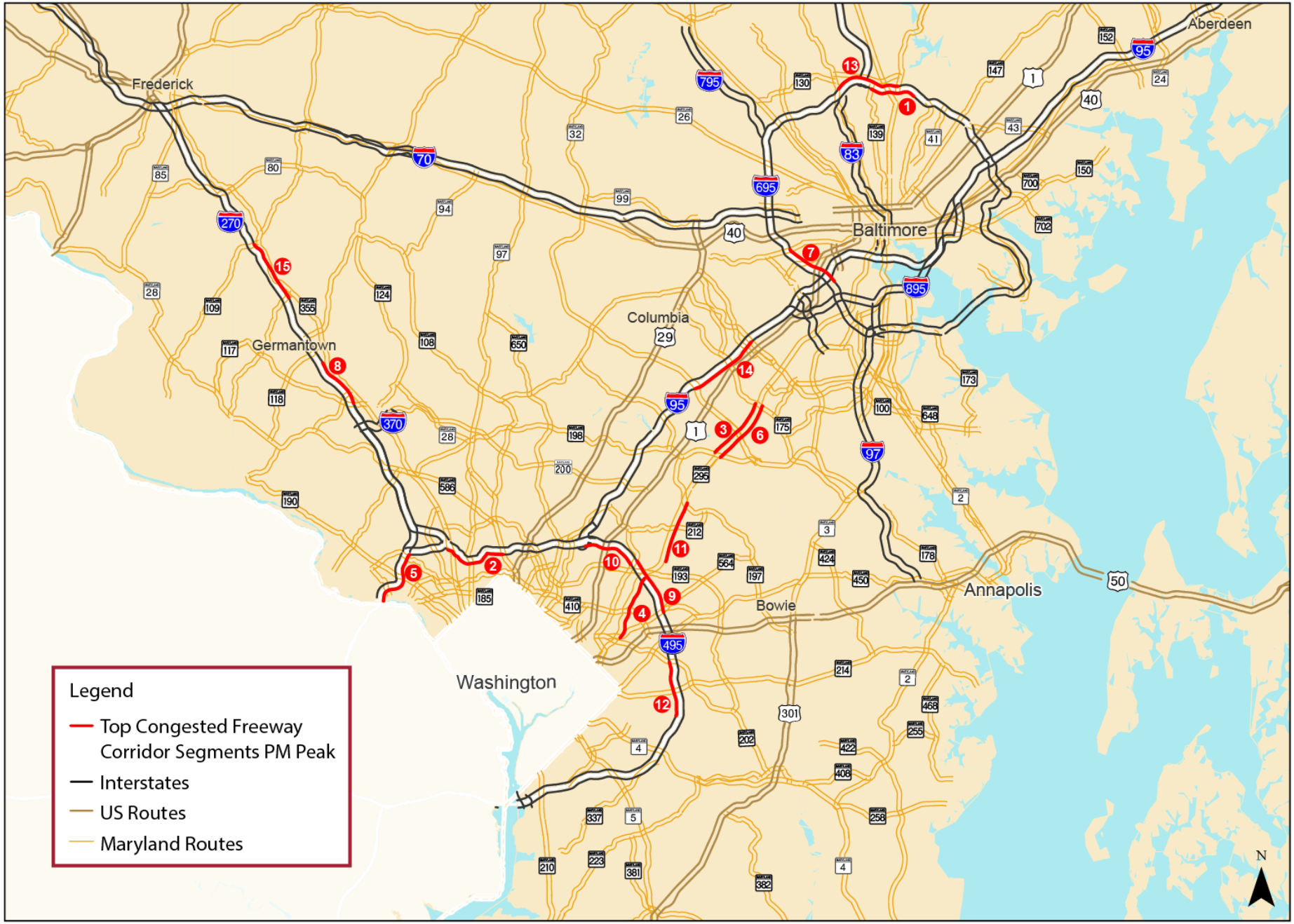


Table 12

2021 MOST CONGESTED ARTERIAL SECTIONS - AM PEAK HOUR					
AM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	MD 185 Southbound	I-495 to MD 191	2.08	Montgomery	1.64
2	MD 97 Southbound	MD 586 to 16th Street/MD 390	2.02	Montgomery	1.45
3	US 29 Southbound	MD 650 to I-495	2.10	Montgomery	1.42
4	MD 190 Eastbound	I-495 to Goldsboro Road/MD 614	2.42	Montgomery	1.40
5	MD 355 Northbound	Grosvenor Lane to Randolph Road	2.11	Montgomery	1.39
6	MD 189 Southbound	Wootton Parkway to Glen Road	2.08	Montgomery	1.38
7	US 301 Southbound	Short Cut Road to MD 5 (Mattawoman Beantown Road)	2.15	Prince George's	1.35
8	MD 28 Westbound	I-270 to MD 119	2.32	Montgomery	1.35
9	MD 32 Eastbound	I-70 to Triadelphia Road	3.63	Howard	1.35
10	MD 190 Westbound	MD 188 to MD 191	2.64	Montgomery	1.35
11	MD 355 Southbound	Cedar Lane to MD 191	2.07	Montgomery	1.35
12	US 1 Southbound	Campus Drive to Jefferson Street	2.28	Prince George's	1.34
13	MD 650 Southbound	I-495 to MD 193	2.08	Montgomery/ Prince George's	1.34
14	MD 187 Southbound	I-270 East Spur to Cedar Lane	2.10	Montgomery	1.34
15	MD 3 Southbound	I-97 to Waugh Chapel Road	2.04	Anne Arundel	1.33

Maryland's Most Congested Arterial Corridor Section: 2021 AM Peak Hour (8-9)

Figure 16

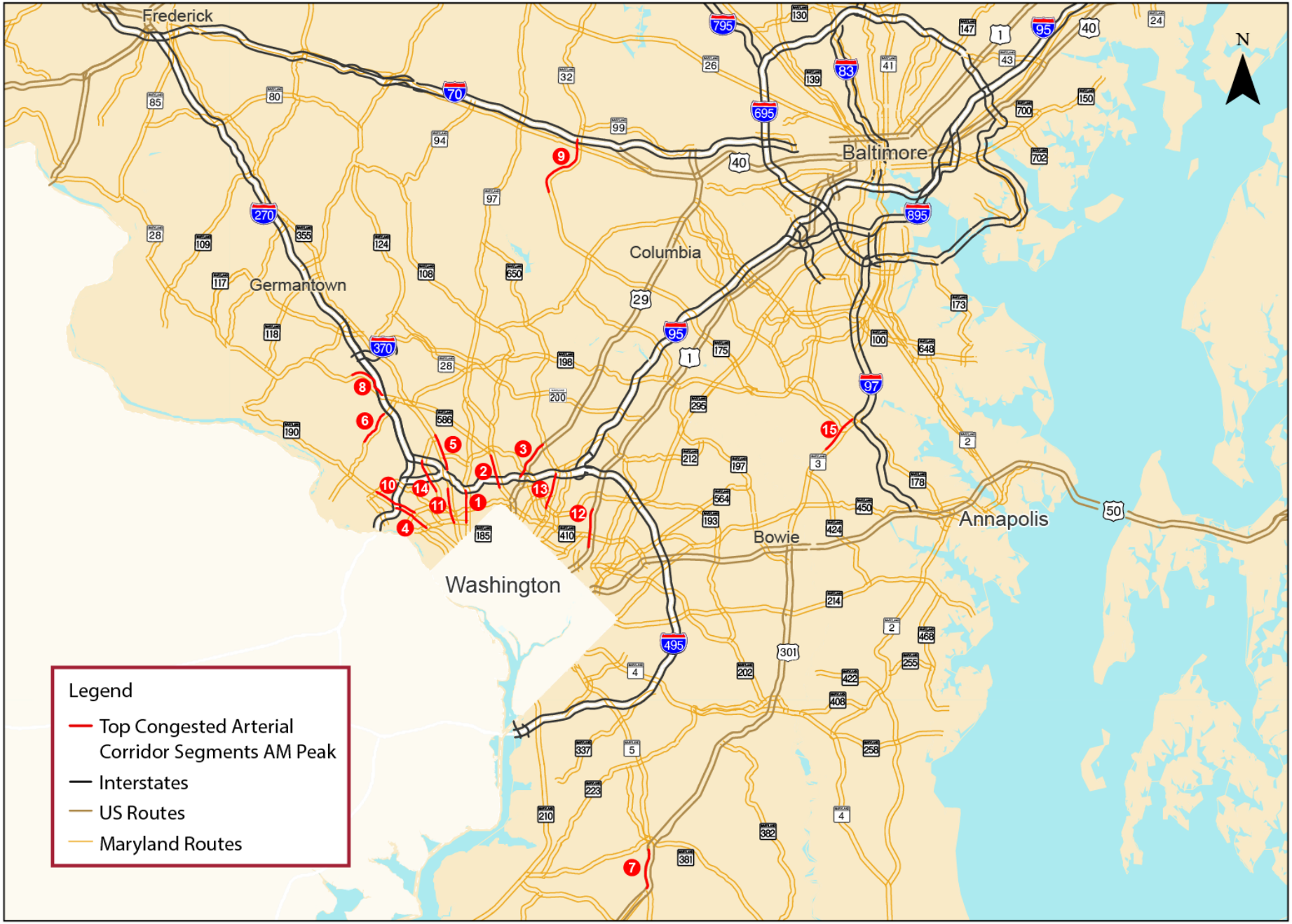
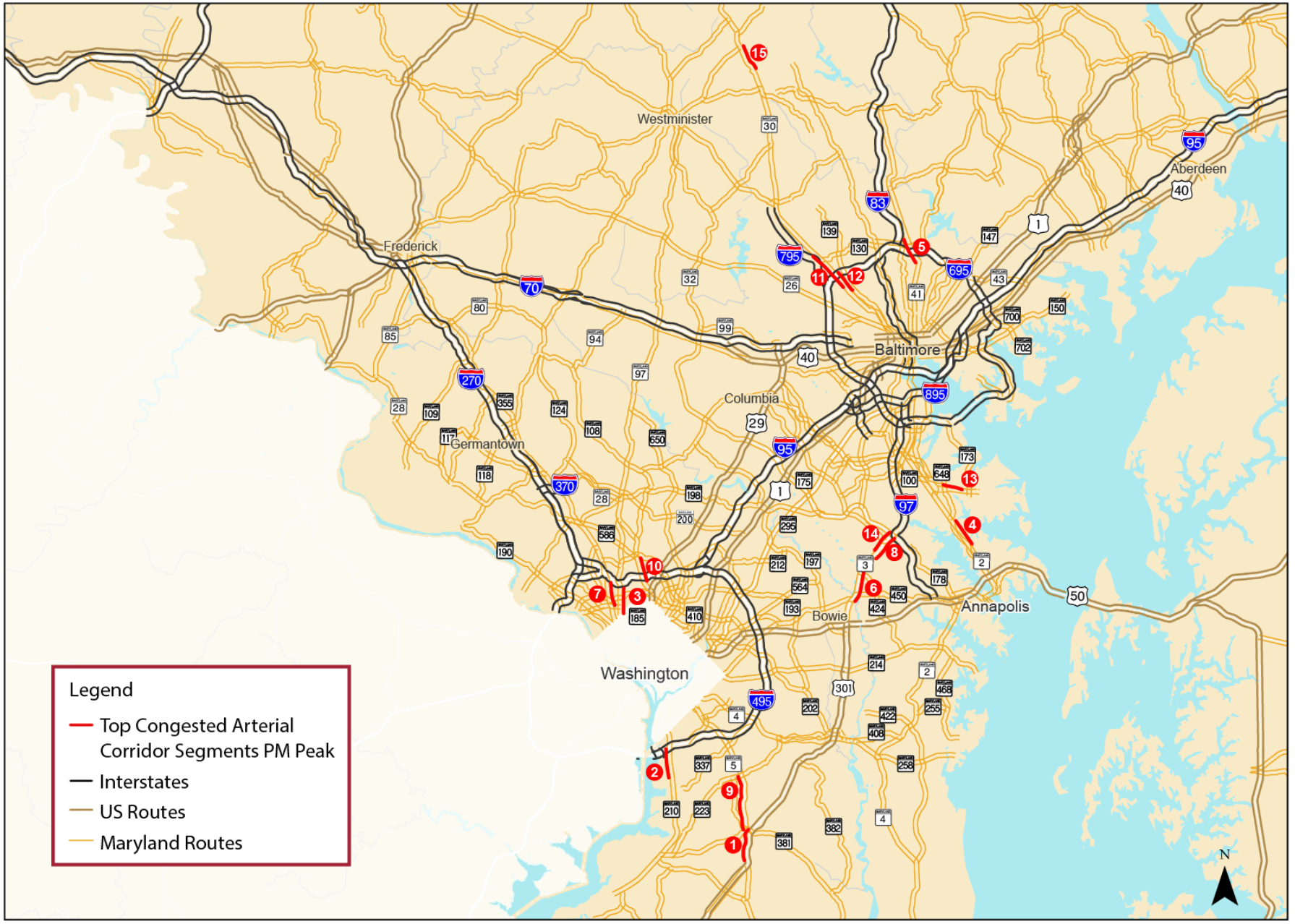


Table 13

2021 MOST CONGESTED ARTERIAL SECTIONS - PM PEAK HOUR					
PM RANK	ROUTE/ DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	US 301 Southbound	MD 381 to McKendree Road/Cedarville Road	2.58	Prince George's	2.15
2	MD 210 Southbound	South of MD 414 to Palmer Road	2.04	Prince George's	1.95
3	MD 185 Northbound	D.C. Line to Jones Bridge Road	2.20	Montgomery	1.88
4	MD 2 Northbound	College Parkway to Robinson Road/ Leelyn Drive	2.41	Anne Arundel	1.73
5	MD 45 Southbound	Ridgely Road to Joppa Road	2.21	Baltimore	1.70
6	MD 3 Northbound	MD 450 to MD 424	2.01	Anne Arundel	1.70
7	MD 355 Northbound	MD 191 to Cedar Lane	2.07	Montgomery	1.65
8	MD 3 Northbound	Waugh Chapel Road to I-97/MD 32	2.06	Anne Arundel	1.64
9	MD 5 Southbound	MD 223 to Brandywine Road	5.09	Prince George's	1.64
10	MD 97 Northbound	16th Street/MD 390 to MD 586	2.13	Montgomery	1.63
11	MD 140 Eastbound	St. Thomas Lane to Sudbrook Lane	3.80	Baltimore	1.63
12	MD 140 Westbound	Baltimore City Line to I-695	2.08	Baltimore	1.61
13	MD 177 Eastbound	MD 648 to Edwin Raynor Boulevard	2.20	Anne Arundel	1.61
14	MD 3 Southbound	I-97/MD 32 to St. Stephens Church Road	2.36	Anne Arundel	1.60
15	MD 30 Northbound	MD 30 Business to MD 27	2.37	Carroll	1.60

Maryland's Most Congested Arterial Corridor Section: 2021 PM Peak Hour (5-6)

Figure 17



SUMMER WEEKEND CONGESTION

Maryland travel varies during the summer. From the western mountains to the Atlantic beaches on the eastern shore, Maryland provides numerous summer destinations. As such, travelers take more long-distance trips along routes leading to these locations during summer months, especially on weekends. Longer trips lead to different congestion patterns during the summer as compared to the rest of the year. Summer weekend analysis was performed to identify those patterns.

After performing an analysis to determine the most congested areas, MDOT analyzed congestion data (TTI) to determine which locations experience the most congestion in the summer months during three different hours: 4–5 PM on Friday, 1–2 PM on Saturday, and 2–3 PM on Sunday. The highest locations for congestion were throughout the state during those time periods **(Table 14 and Figure 18)**. According to the analysis, the Eastern Shore experienced more congestion on the weekends than on the weekdays, particularly in areas that normally experience minimal weekday congestion **(Table 15 and Figure 19)**. The following rankings represent the most congested sections of roadway versus similar statewide roadway lengths for those time periods.

Table 14

2021 MOST CONGESTED SUMMER-WEEKEND FREEWAY AND ARTERIAL LOCATIONS

RANK/ FACILITY	DAY	ROUTE/ DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
Freeway	Friday	I-495 Outer Loop	MD 187 to MD 190	3.1	Montgomery	3.5
Arterial	Friday	US 340 Westbound	MD 180 to Virginia Line	2.2	Washington	3.4
Freeway	Saturday	US 50/US 301 EB	Buschs Frontage Rd to Chesapeake Bay Bridge	3.1	Anne Arundel	3.1
Arterial	Saturday	US 301 NB	Sub Station Rd to Short Cut Rd	3.0	Prince George's	2.3
Freeway	Sunday	US 50/US 301 EB	Buschs Frontage Rd to Chesapeake Bay Bridge	3.1	Anne Arundel	5.1
Arterial	Sunday	US 301 SB	MD 381 to Cedarville/ McKendree Rd	2.5	Prince George's	1.8

2021 Most Congested Summer Weekend Freeway and Arterial Locations

Figure 18

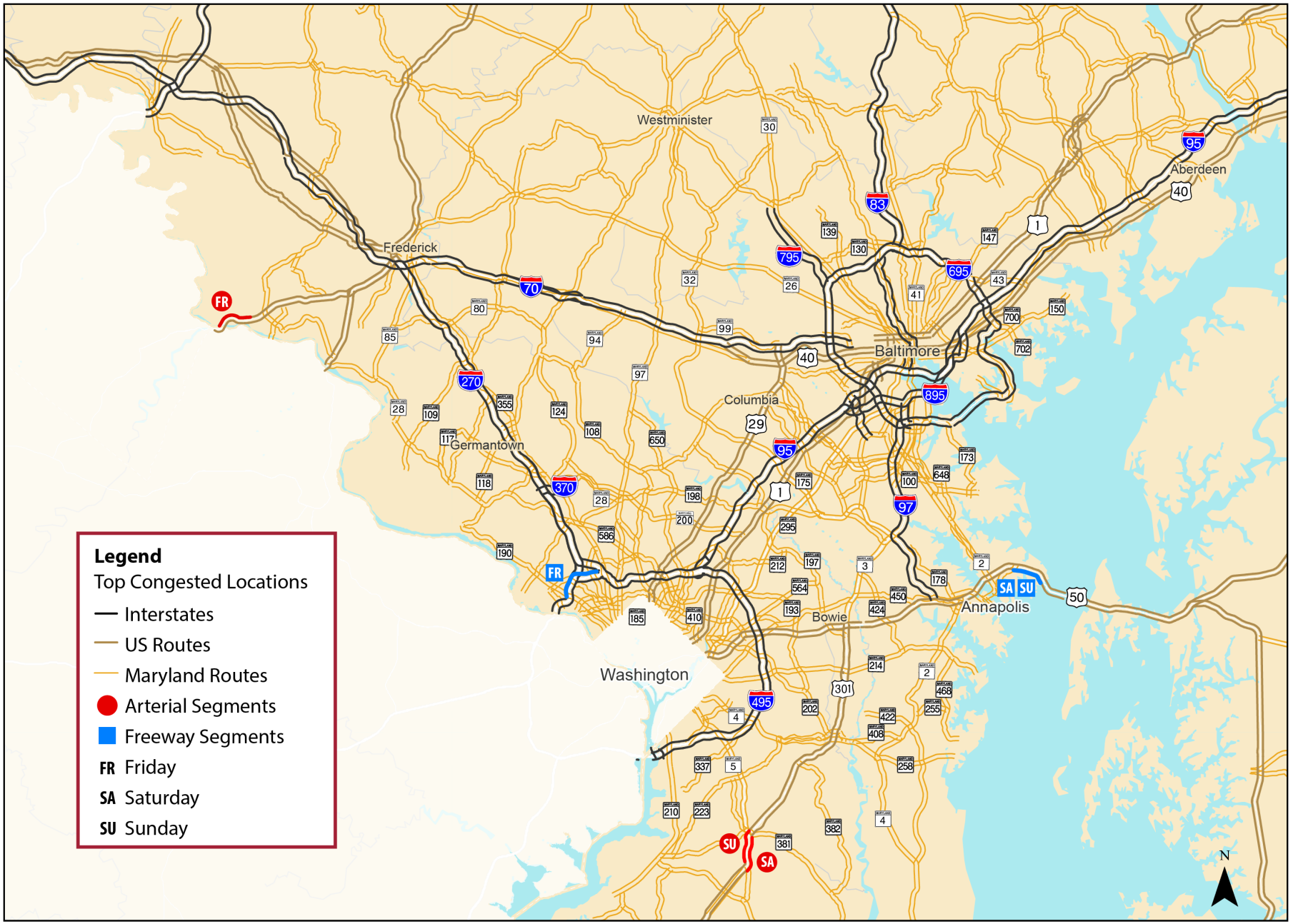
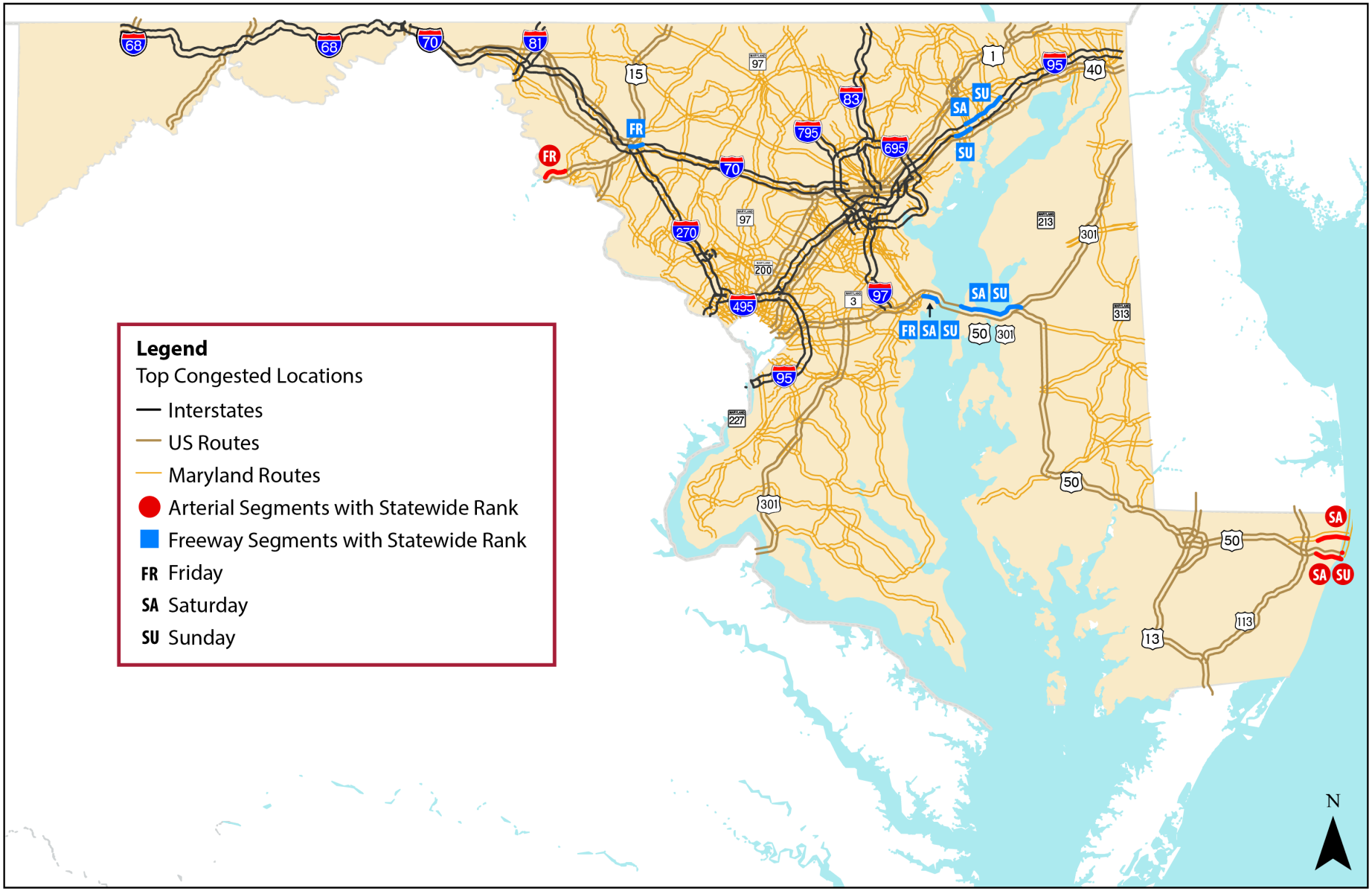


Table 15

2021 MOST CONGESTED SUMMER-WEEKEND ARTERIAL LOCATIONS THAT NORMALLY EXPERIENCE MINIMAL CONGESTION ON WEEKDAYS						
STATEWIDE RANK/ FACILITY	DAY	ROUTE/ DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
2/Freeway	Friday	US 50/US 301 EB	Buschs Frontage Rd to Chesapeake Bay Bridge	3.1	Anne Arundel	3.2
3/ Freeway	Friday	I-70 WB	South St to US 15	3.1	Frederick	2.9
1/ Arterial	Friday	US 340 WB	MD 180 to Virginia State Line	2.2	Washington	3.4
1/ Freeway	Saturday	US 50/US 301 EB	Buschs Frontage Rd to Chesapeake Bay Bridge	3.1	Anne Arundel	3.1
3/ Freeway	Saturday	US 50/US 031 WB	Chester Station Lane to Chesapeake Bay Bridge	3.2	Queen Anne's	2.8
5/ Freeway	Saturday	I-95 SB	MD 543 to MD 24	3.6	Harford	2.0
2/ Arterial	Saturday	MD 90 EB	MD 589 to MD 528	5.5	Worcester	2.2
4/ Arterial	Saturday	US 50 EB	MD 589 to MD 528	4.6	Worcester	2.0
1/ Freeway	Sunday	US 50/US 301 EB	Buschs Frontage Rd to Chesapeake Bay Bridge	3.1	Anne Arundel	5.1
2/ Freeway	Sunday	I-95 SB	MD 22 to MD 543	4.1	Harford	2.5
4/ Freeway	Sunday	I-95 NB	MD 152 to MD 24	3.1	Harford	2.1
5/ Freeway	Sunday	US 50/US 301 WB	MD 18 to Chesapeake Bay Bridge (west shore)	4.6	Queen Anne's	1.4
4/Arterial	Sunday	US 50 EB	MD 589 to MD 528	4.6	Worcester	1.4

2021 Congested Summer Weekend Freeway and Arterial Locations that Normally Experience Minimal Weekday Congestion



FREEWAY/EXPRESSWAY AND ARTERIAL CORRIDOR SUMMARY

In addition to statewide measures, traffic analysis was performed on individual roadways. Roadways where access is limited to interchanges are termed controlled access facilities. Controlled access facilities include freeways and expressways that are the highest classification of roadways in the state and indicate the greatest capacity to convey vehicles. Arterials are the next highest classification of roadways after freeways/expressways. These roadways have multiple lanes with traffic signals and carry a large volume of traffic.

The freeway/expressway and major arterial system were analyzed to determine the various levels of congestion experienced by motorists along these roadways statewide.

The number and percentage of miles for each level of congestion were determined for the AM peak hour (8-9 AM) and the PM peak hour (5-6 PM) **(Figure 20 and 21)**. The analysis highlights include:

- All roadways saw a significant increase in the number of congested miles.
- In 2020, there were no sections of roadways that experienced severe congestion (TTI >2.0), but these levels returned in 2021. In the AM peak hour, this amounted to approximately 6 miles of severe congestion reduced from 50 miles in 2019.
- The severe congestion on Maryland roadways in the PM peak hour increased by over 25 miles from 2020 but that was still 80 miles lower than 2019 levels.

Figure 20
NUMBER OF CONGESTED MILES

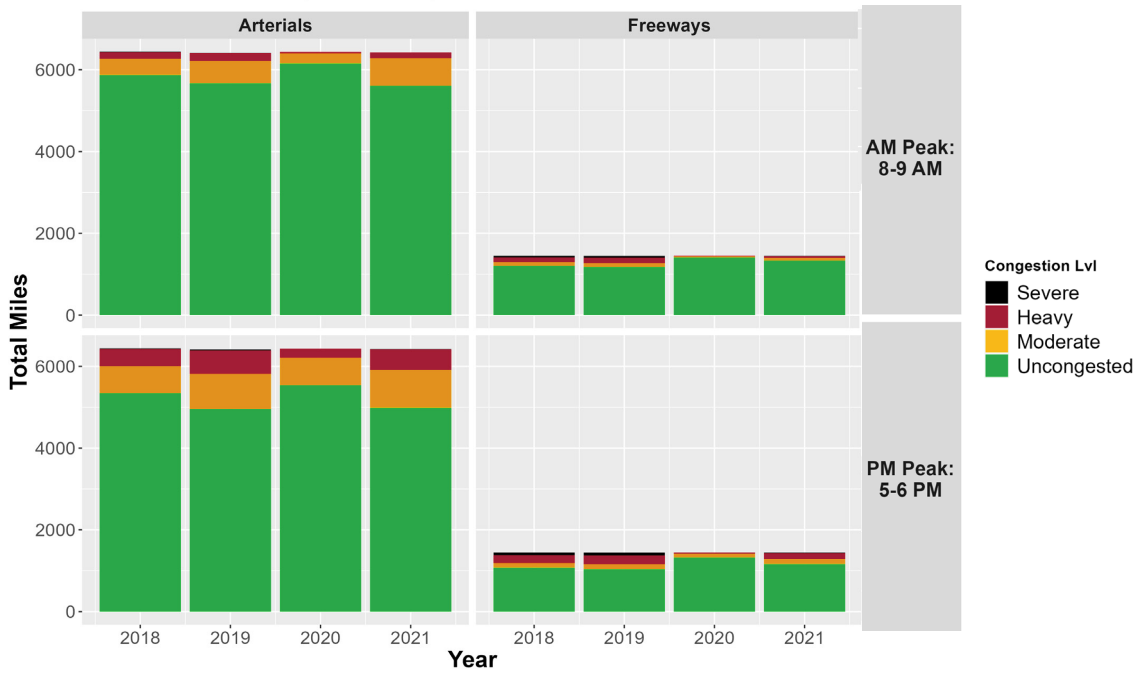
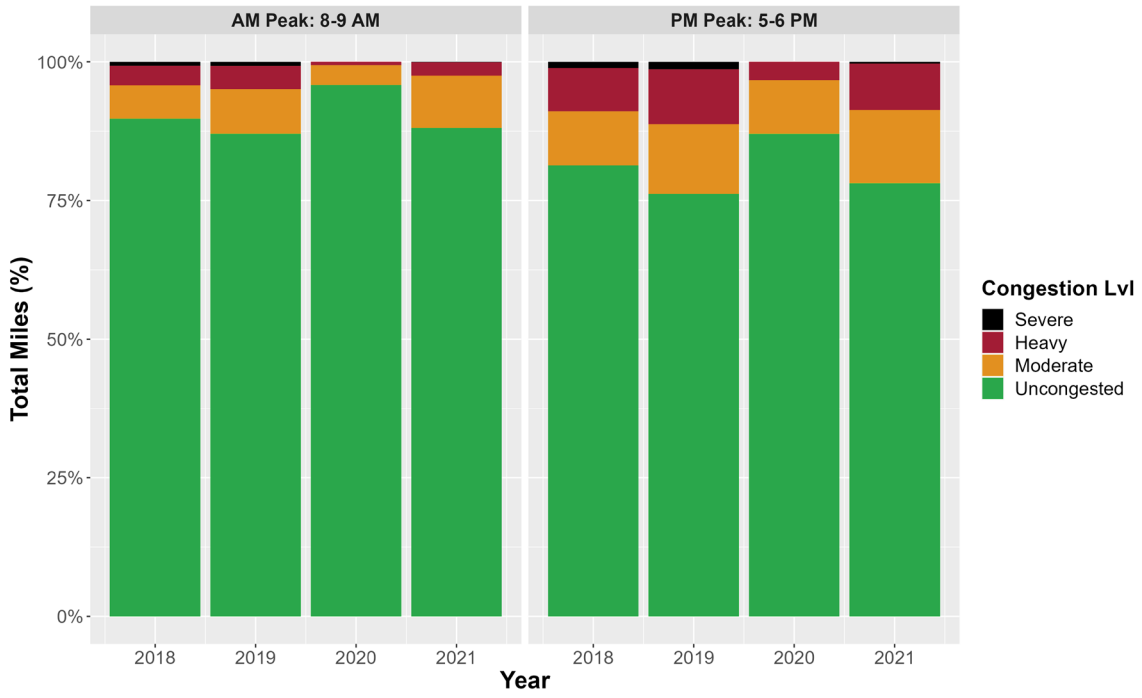


Figure 21
PERCENT OF CONGESTED MILEAGE FREEWAYS AND ARTERIALS



Each freeway/expressway section was analyzed to determine the number of miles that were recorded in the four levels of congestion **(Figure 22)**.

Figure 22
FREEWAY CONGESTION SUMMARY

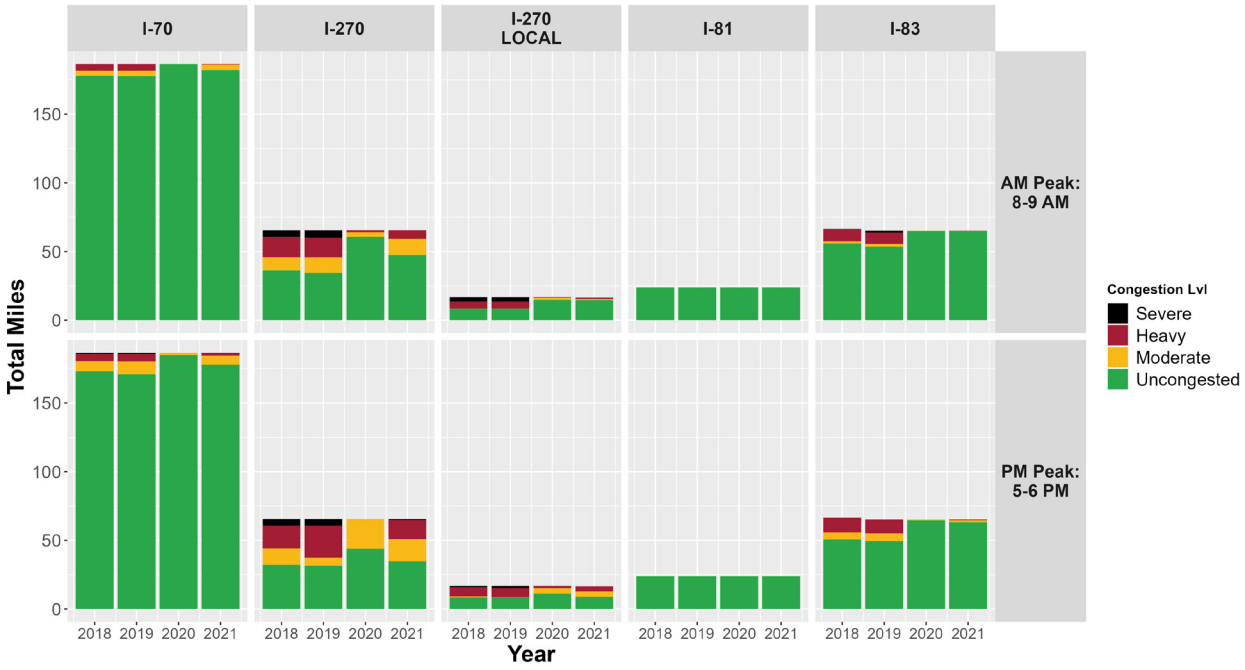
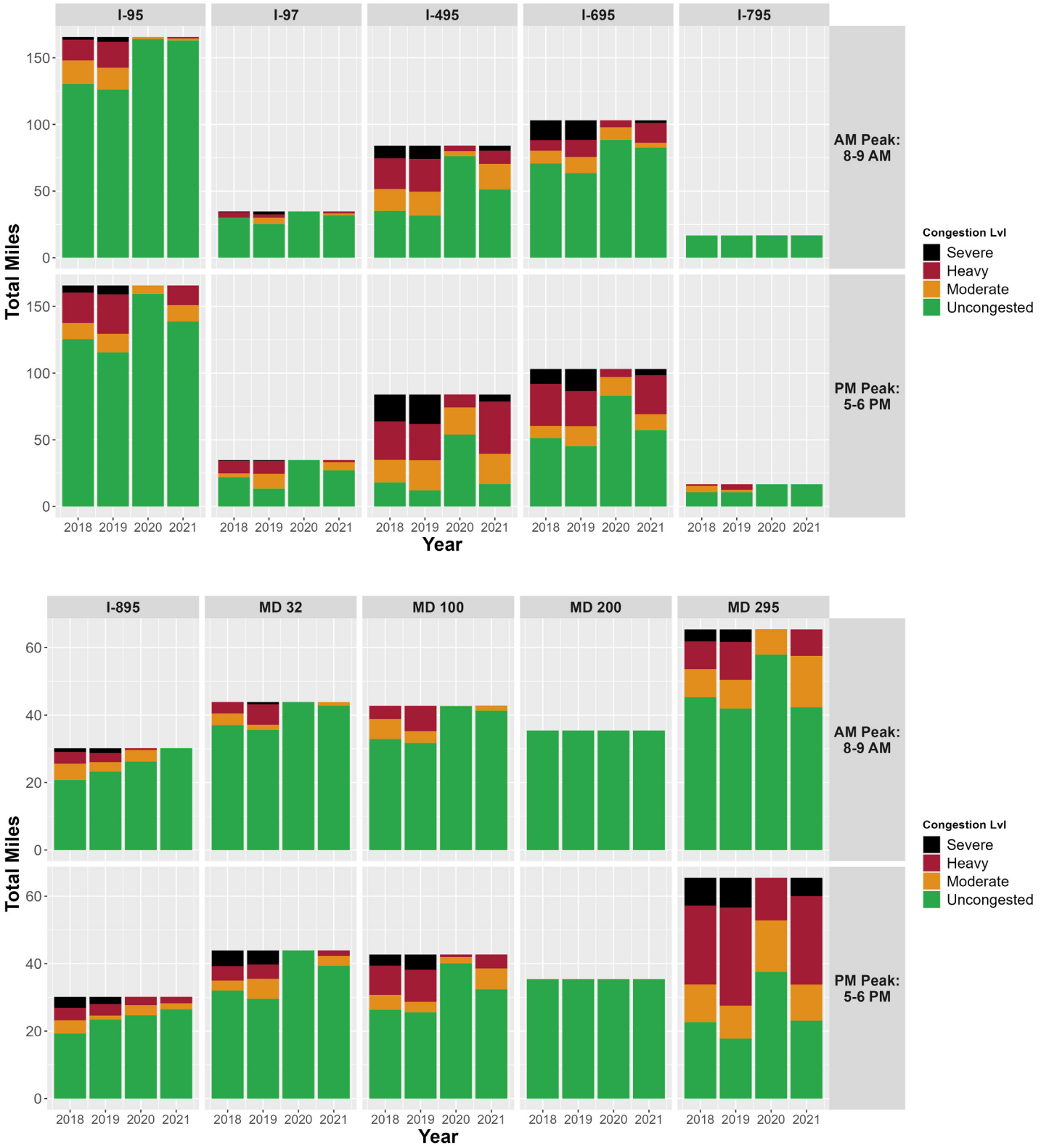


Figure 22 *(Continued)*
FREEWAY CONGESTION SUMMARY



Thirty-five major arterial corridors were selected based on observed traffic operations, traffic volumes, regional significance, and data availability to analyze in further detail. Traffic analysis was performed to evaluate the changes that took place in these corridors between 2019, 2020, and 2021—based on TTI values. Each corridor showed a significant increase in the most severe 2021 congestion levels **(Figure 23)**.

The overall operation of all freeways/expressways and arterials are depicted in the Peak Hour Statewide Congestion Maps **(Figures 9-10)**. The Maryland Mobility Report Supplement Chapter A provides additional in-depth information about the mobility performance of these corridors including the greatest improvement/reduction in operational measures over the past year, a detailed analysis of the number of miles operating at each level of congestion and the mapping of the corridor.

Figure 23
ARTERIAL CONGESTION SUMMARY

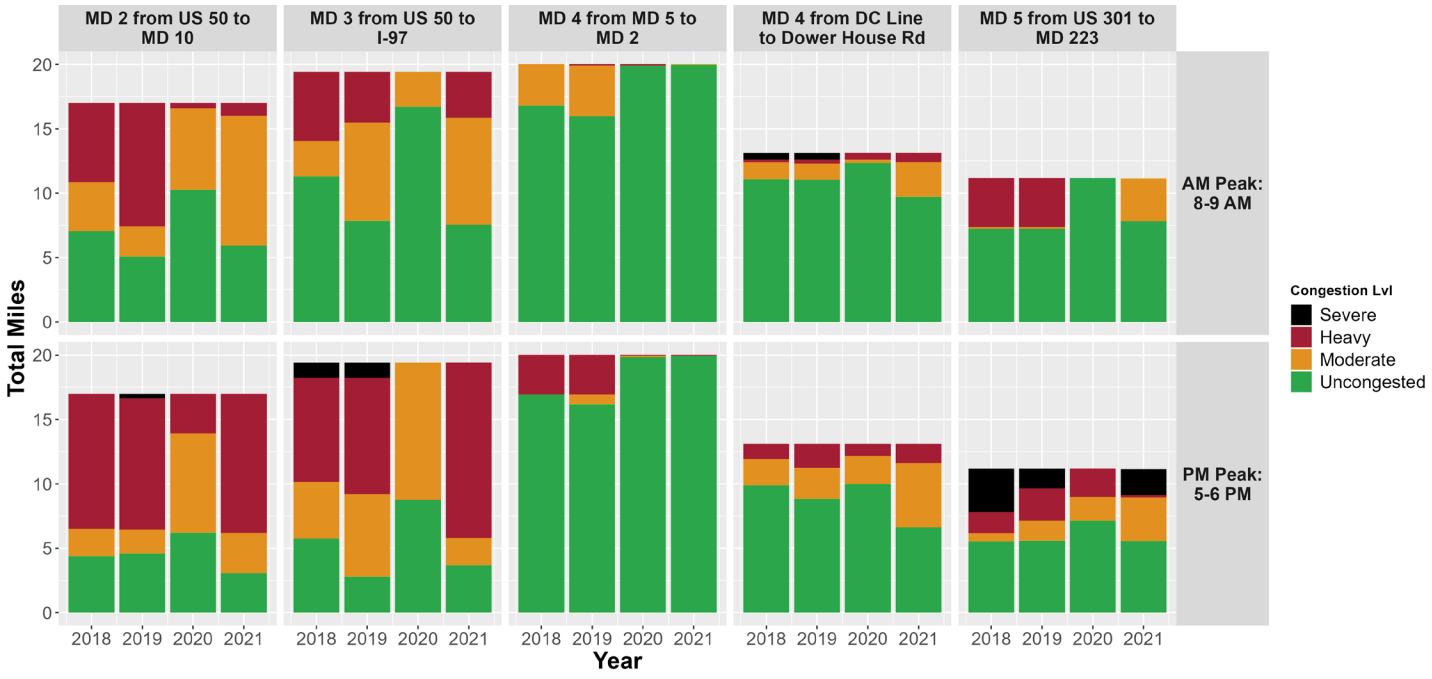


Figure 23 *(Continued)*
ARTERIAL CONGESTION SUMMARY

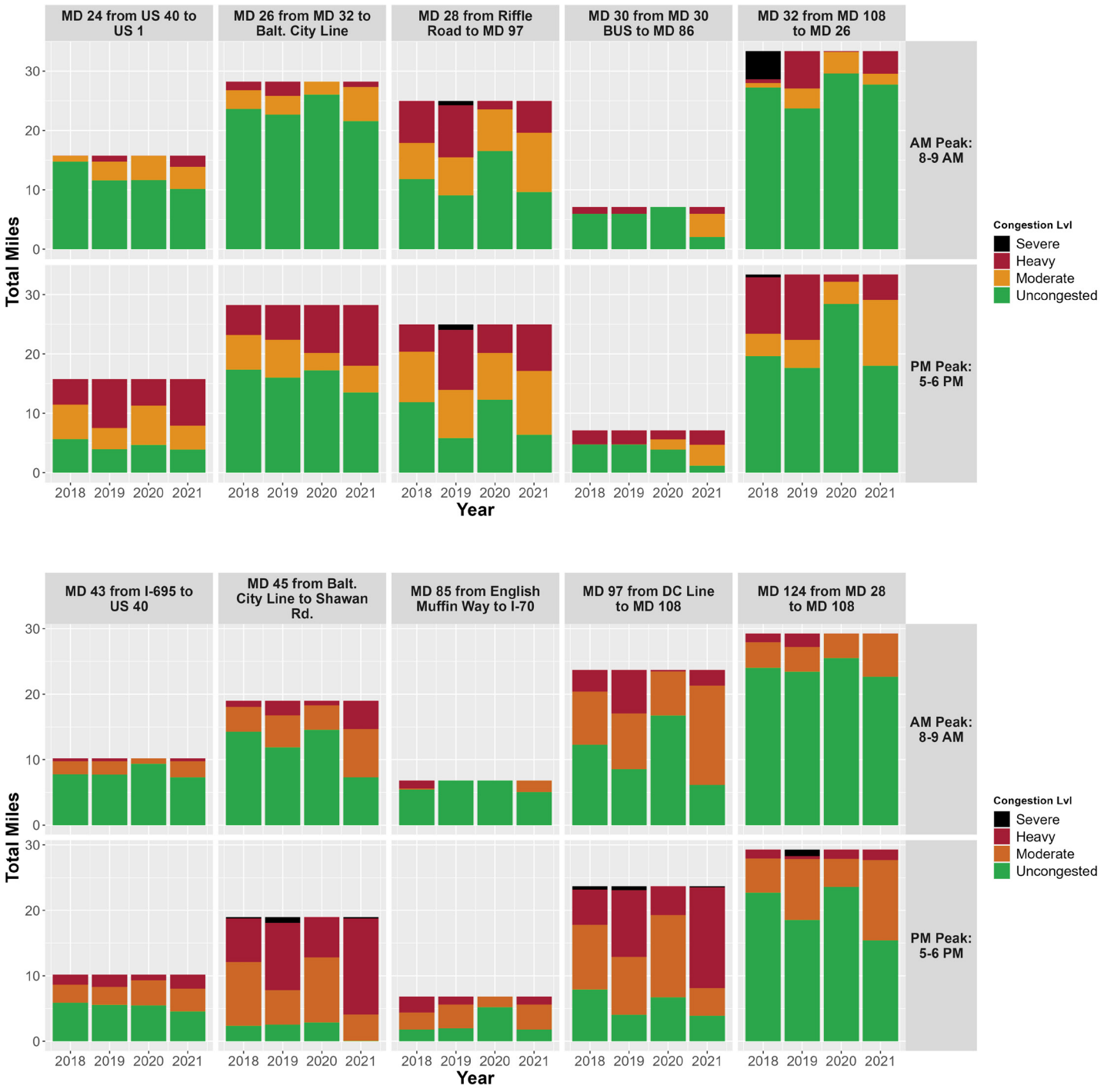


Figure 23 *(Continued)*
ARTERIAL CONGESTION SUMMARY

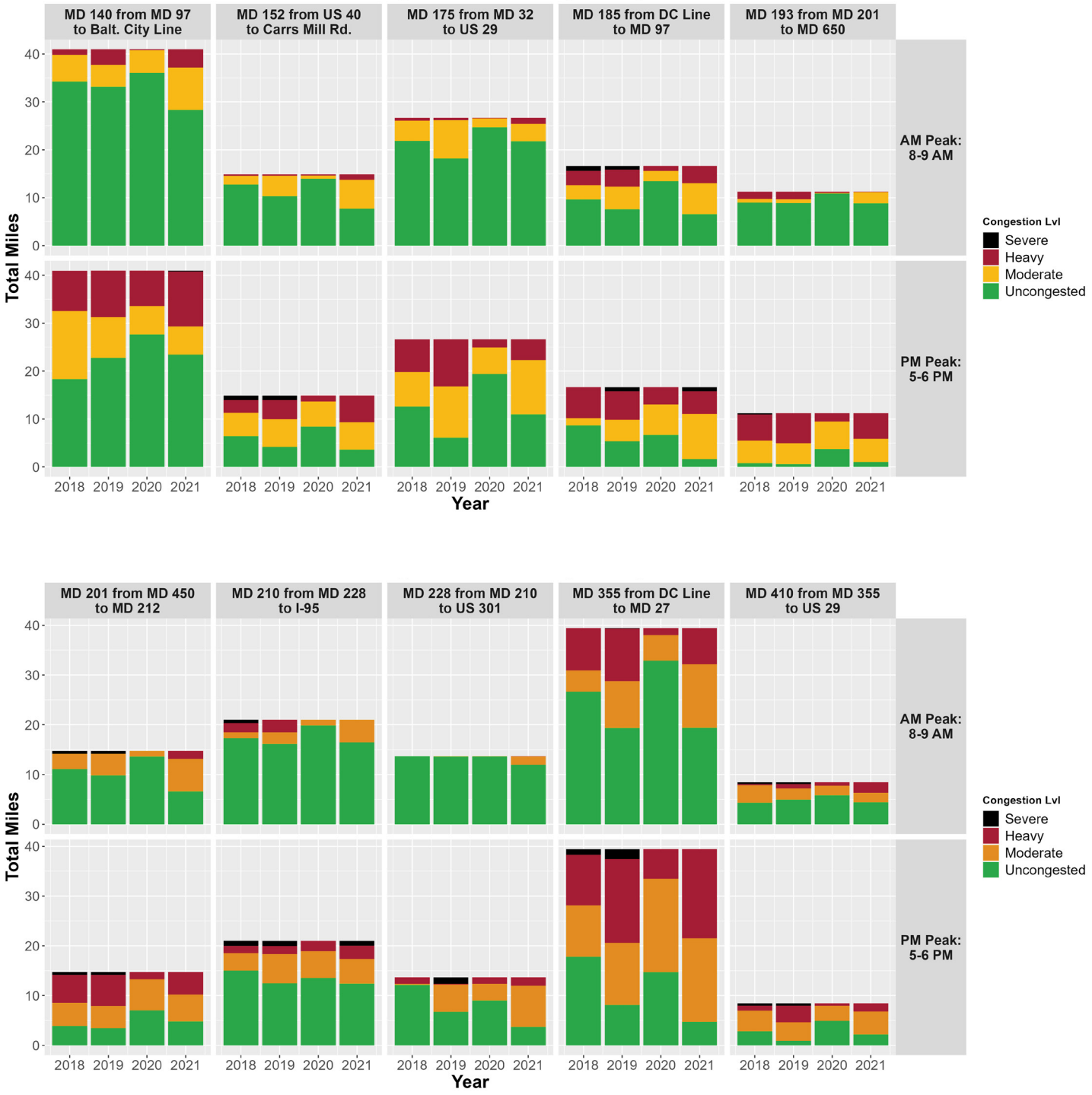
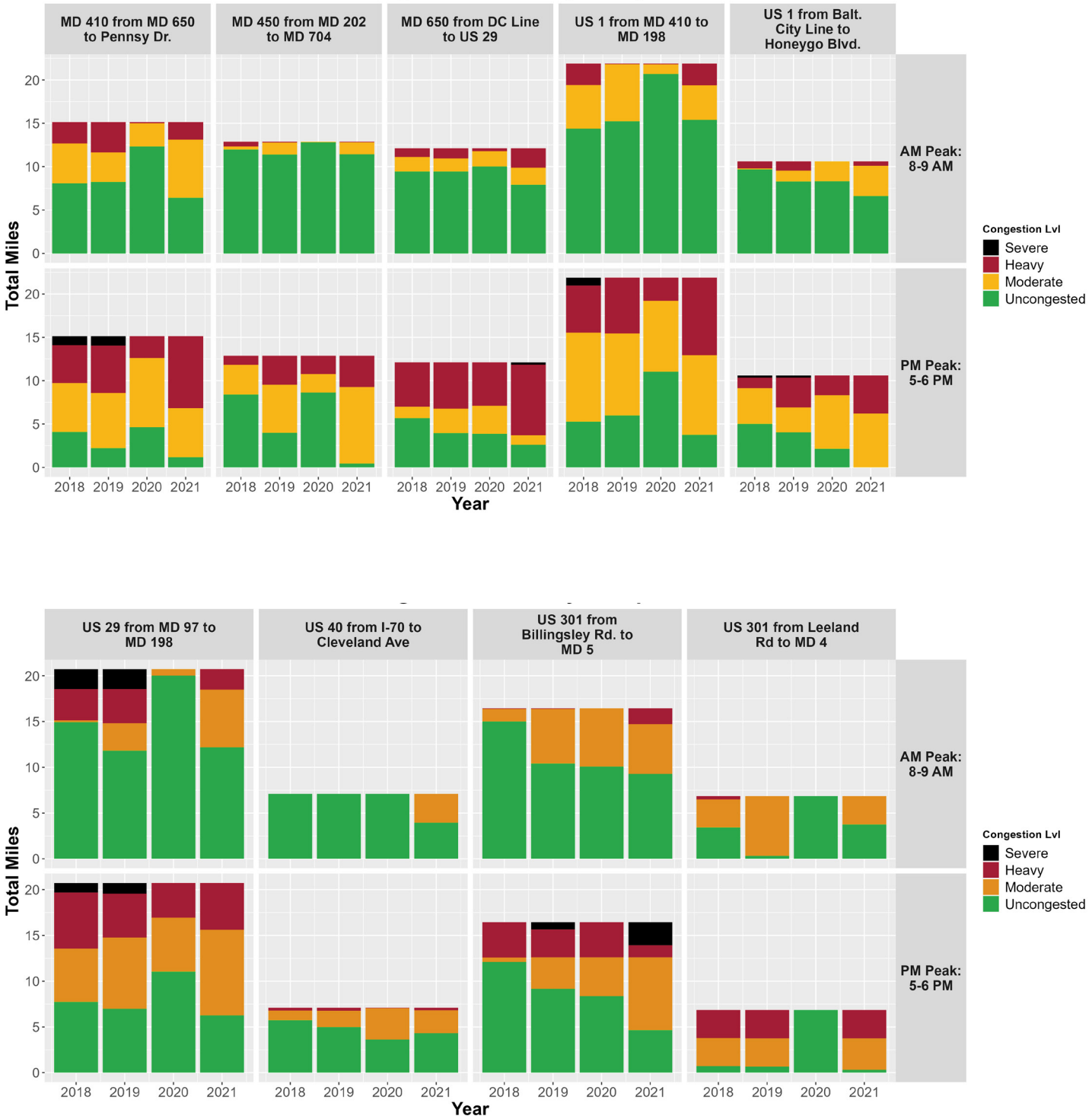


Figure 23 *(Continued)*
ARTERIAL CONGESTION SUMMARY



MD 26 at Lord Baltimore Dr

INTERSECTIONS

Along non-freeways/expressways, most congestion occurs at intersections. The worst performing intersection locations force motorists to wait multiple cycles before passing through. Intersection operations are graded from level of service (LOS) 'A' to 'F,' with 'A' being the best and 'F' being the worst **(Table 16)**. For purposes of this report, intersection analysis was performed using the critical lane analysis technique. The critical lane analysis technique evaluates the volumes of the highest conflicting movements and number of lanes.

Table 16

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

At the worst performing intersections—where LOS 'F' conditions exist—a further measure is developed to determine a more in-depth operations appraisal. This is the volume/capacity ratio which represents the critical lane volume, divided by the theoretical capacity of the intersection, which is 1,600.

Of the intersections counted in the past four years, 35 operated in the AM peak hour or PM peak hour at LOS F **(Tables 17 and 18)**. Five of these locations failed in both the AM and PM peak hours (yellow highlighted locations). Furthermore, US 50 at MD 404 and US 50 at MD 213 failed during the summer weekend. The location of these failing intersections is included in the Maryland Mobility Report Supplement.

Table 17

LOS "F" INTERSECTIONS AM PEAK HOUR COUNTED IN LAST 4 YEARS		
INTERSECTION	COUNTY	VOLUME/CAPACITY (SORTED HIGHEST TO LOWEST)
MD 4 at MD 337/Presidential Parkway	Prince George's	1.37
MD 26 at Lord Baltimore Dr/ I-695 Outer Loop Off Ramp	Baltimore	1.31
US 29 at Rivers Edge Rd	Howard	1.20
MD 5 @ Surratts Rd	Prince George's	1.18
MD 4 at Dower House Rd	Prince George's	1.15
MD 210 at Livingston Rd/Kerby Hill Rd[1]	Prince George's	1.13
MD 2 at Tarragon Ln	Anne Arundel	1.11
MD 4 at Chaneyville Rd	Calvert	1.05
MD 108 at Old Baltimore Rd	Montgomery	1.04
MD 410 at MD 212	Prince George's	1.04
MD 210 at Wilson Bridge Dr	Prince George's	1.03
MD 124 at Warfield Rd	Montgomery	1.02
MD 450 at 48th Street	Prince George's	1.02
MD 355 at MD 911/Wootten Pkwy	Montgomery	1.01
MD 193 at E. Franklin Ave/Franklin Ave	Montgomery	1.00

[1] – Intersection has been upgraded to an interchange in 2022.

Table 18

LOS "F" INTERSECTIONS PM PEAK HOUR COUNTED IN LAST 4 YEARS		
INTERSECTION	COUNTY	VOLUME/CAPACITY (SORTED HIGHEST TO LOWEST)
MD 500 at MD 410/Adelphi Rd	Prince George's	1.27
US 301 at Cedarville Rd/McKendree Rd	Prince George's	1.19
MD 4 at FDR Blvd	St Mary's	1.17
MD 500 at Eastern Ave	Prince George's	1.14
MD 410 at MD 212	Prince George's	1.14
MD 41 at Putty Hill Ave	Baltimore	1.11
MD 5 at MD 637 (Naylor Rd)	Prince George's	1.10
MD 119 at I-370/Sam Eig Hwy	Montgomery	1.09
US 1 at US 1AL/Hamilton St	Prince George's	1.08
MD 4 at MD 337/Presidential Pkwy	Prince George's	1.08
US 15 SB Ramps at Rosemont Ave/Schley Ave	Frederick	1.07
MD 210 at Livingston Rd/Kerby Hill Rd[1]	Prince George's	1.07
MD 414 at Ramp from I-95 WB	Prince George's	1.07
MD 355 at Jones Bridge Rd/Center Dr	Montgomery	1.06
MD 2 at MD 4 (Sunderland)	Calvert	1.04
MD 637 at Suitland Pkwy	Prince George's	1.04
MD 4 at Patuxent Blvd	St. Mary's	1.04
MD 3 at Crawford Blvd/Cronson Blvd	Anne Arundel	1.03
MD 26 at Lord Baltimore Dr/I-695 Outer Loop Off Ramp	Baltimore	1.02
MD 2 at Tarragon Ln	Anne Arundel	1.02
MD 214 at Ritchie Rd/Garrett A. Morgan Blvd	Prince George's	1.02
MD 5 at MD 458/Iverson St	Prince George's	1.02
US 301 at Chadds Ford Dr/Timothy Branch Dr	Prince George's	1.01
MD 5 at MD 471/Flat Iron Rd	St. Mary's	1.01
MD 26 at Croyden Rd	Baltimore	1.00

[1] – Intersection has been upgraded to an interchange in 2022.

RELIABILITY TRENDS

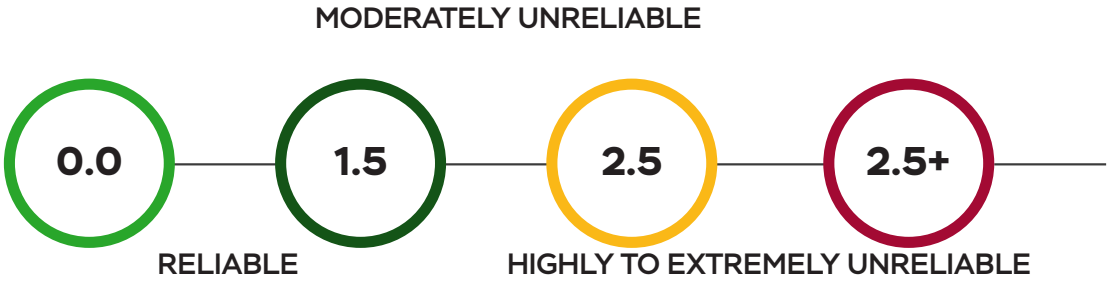
Another important means of measuring of mobility is through travel time reliability. Travel times vary for the same trip on the same day of the week. This variability in travel times demonstrates a level of unreliability of the roadway. When travel times vary greatly, this often frustrates motorists, truck drivers and transit riders. The unreliability is often caused by special events such as incidents, vehicular breakdowns, crashes, weather, or lane reductions through work zones. Furthermore, it impacts automobiles, trucks, and on-street transit services. The additional travel time due to network unreliability results in added costs for all travelers. These motorists must add a buffer to reach their destination on time, which takes away time for other tasks.

MDOT SHA understands the significance of providing a reliable transportation system by delivering programs and projects to improve system reliability. By improving reliability, travelers can 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. Each motorist has different needs, and each individual has differing life experiences. Network reliability improves the lives of all Marylanders and visitors.

The Planning Time Index (PTI) is used to measure travel time reliability. This measurement varies between states. This ranges in value from the 80th to the 95th percentile travel time. MDOT SHA uses the 95th percentile travel time for PTI values along a section of roadway and is generalized as the travel time it would take if a major incident or event occurs. For example, a PTI of 2.0 means that if it takes 10 minutes to traverse a roadway segment in free flow conditions, a motorist should allow 20 minutes for travel to ensure a 95% chance of on time arrival. The lower the value the more reliable the trip, while conversely, the higher the value, the longer a trip could take. There are three levels of reliability and their range of values are from a reliable system to highly to extremely unreliable **(Figure 24)**.

Figure 24
METRIC: MEASUREMENT OF RELIABILITY (PLANNING TIME INDEX)



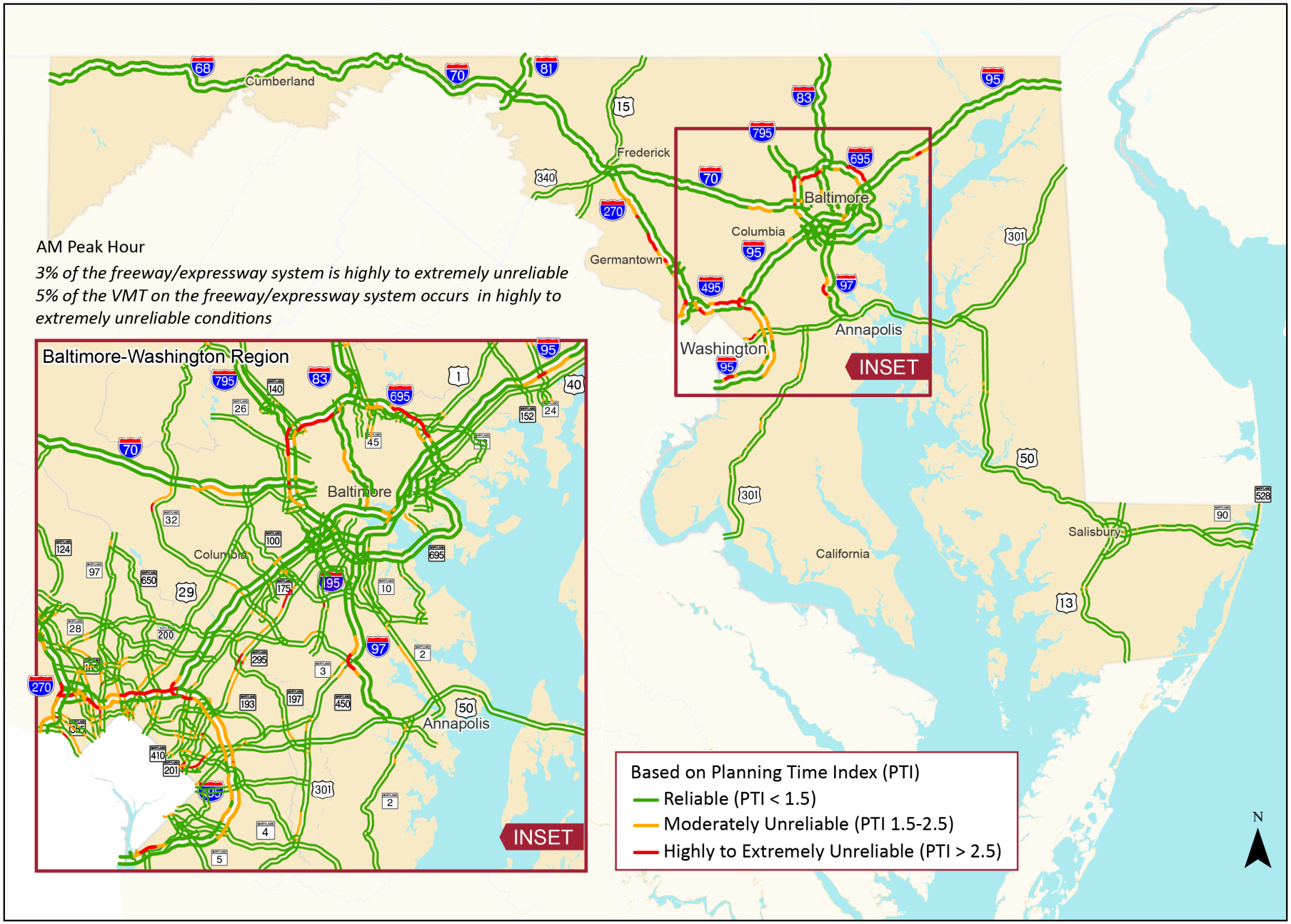
RELIABILITY MEASURES ON THE MARYLAND FREEWAY/ EXPRESSWAY SYSTEM

As with congestion metrics, a yearly comparison is performed on Maryland's freeway/expressway system for three measures associated with reliability. These three measures are (1) the number of freeway/expressway miles that are highly to extremely unreliable, (2) the percent of the total freeway/expressway system that is highly to extremely unreliable, and (3) the percent of the peak hour VMT that is impacted which compares the traffic volumes to the portion of the system that is operating at highly to extremely unreliable conditions. The AM and PM peak hours were evaluated on a statewide basis for reliability as follows:

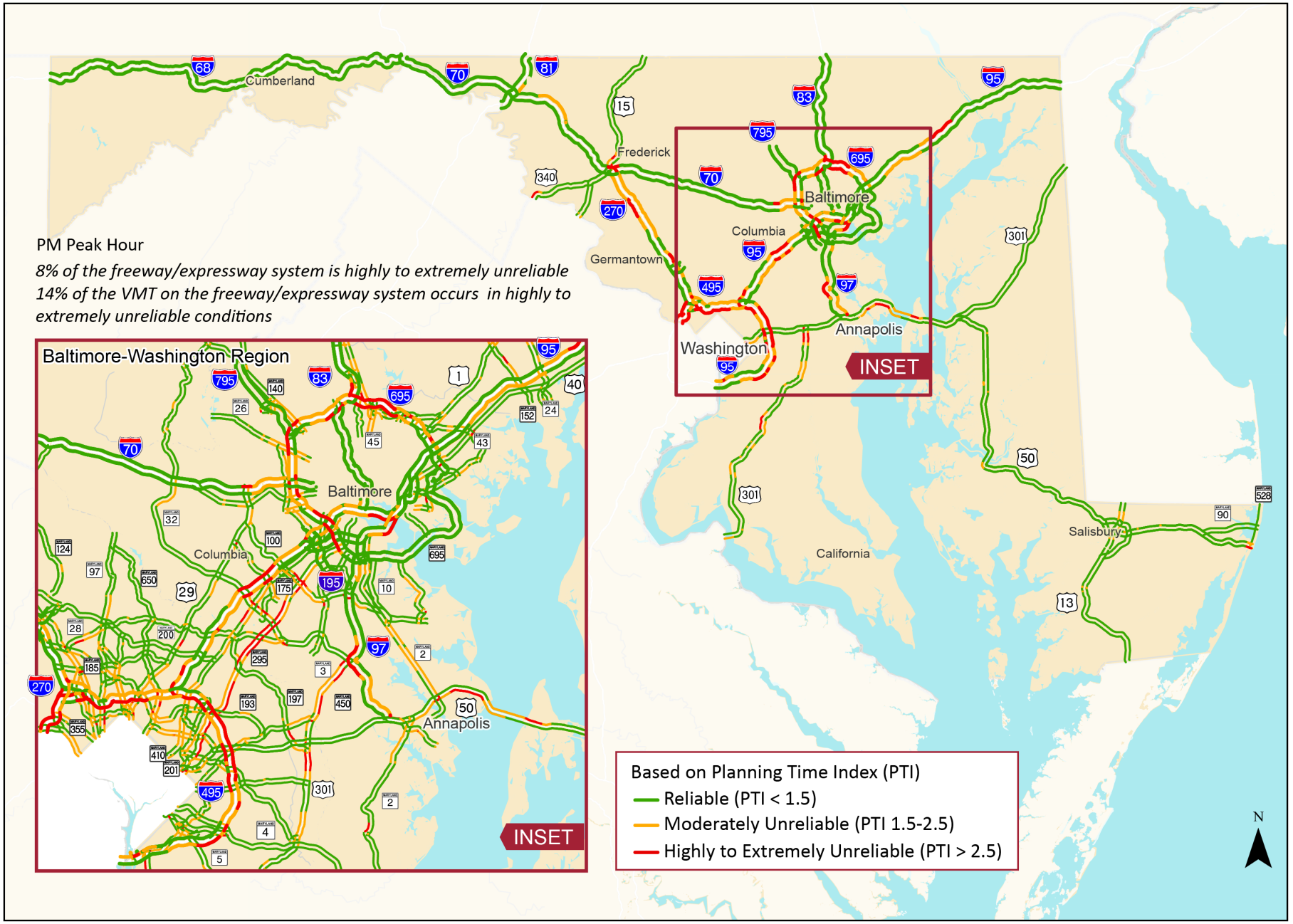
- AM peak hour - **Figure 25**
- PM peak hour - **Figure 26**

Figure 25

Maryland Reliability Map: 2021 AM Peak Hour (8-9) AM



Maryland Reliability Map: 2021 PM Peak Hour (5-6) PM



The lowest level of reliability is termed highly to extremely unreliable conditions. These conditions for motorists on Maryland's freeway/expressway system showed a substantial increase in the number of roadway miles and percent of peak hour VMT that impacted the worst conditions in the PM peak hours from 2020 to 2021 **(Table 19)**.

Table 19

STATEWIDE FREEWAY/ EXPRESSWAY SYSTEM AVERAGE WEEKDAY AM & PM PEAK HOUR RELIABILITY SUMMARY								
HIGHLY TO EXTREMELY UNRELIABLE CONDITIONS	2019		2020		2021		CHANGE FROM 2020 TO 2021	
	AM	PM	AM	PM	AM	PM	AM	PM
Number of Roadway Miles	109	213	46	77	40	133	-6	+56
Percent of Roadway Miles	7	13	3	5	3	8	0	+3
Percent of Peak Hour VMT Impacted	14	24	6	9	5	14	-1	+5

Normally, there is a strong correlation between sections of roadway that experience severe congestion and that are highly unreliable. Conversely, some sections of roadway experience much higher levels of congestion on certain days. These locations are often influenced by the congestion that is occurring downstream of these sections or experience issues due to strong peaking characteristics such as summer traffic.

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

- I-495 Outer Loop from I-95 to MD 193
- I-695 Outer Loop from US 1 to MD 147
- I-695 Outer Loop from MD 140 to MD 26
- I-95/ I-495 Inner Loop from MD 414 to I-295
- MD 295 Southbound from MD 202 to the DC Line

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

- US 50 Eastbound from MD 179 to Oceanic Dr
- I-495 Outer Loop from MD 187 to I-270 West Spur
- MD 295 Southbound from MD 175 to MD 32
- I-695 Inner loop from MD 139 to MD 146
- I-495 Inner Loop from MD 187 to MD 185

TRUCK DATA AND TRENDS

One of the most important aspects of a transportation network is the safe and logical movement of freight throughout an area. Freight movement is vital to support the economy. To accomplish this, MDOT SHA created a well-connected and maintained network of highways, inter-modal connections to ports, user-friendly airports and rail terminals, and first/last mile routes accessible to industries.

Maryland's freight infrastructure is nationally significant in that I-95, I-81, I-70, and I-68 are critical freight corridors supporting national freight flows. Trucks are critical, as they carry the bulk of freight and are necessary for the first and last mile connections. In terms of tonnage, trucks haul more than 70% of freight, mostly across MDOT SHA roads.

In Maryland, the total freight value moved by trucks is estimated at $304 billion. To evaluate truck freight movement, MDOT performs traffic data collection on a three-year cycle to identify the number of trucks that use a particular roadway. Among all the major interstate routes in Maryland, I-95 contains the highest volume of trucks in a particular section **(Table 20 and Figure 27)**. Trucks made up one-third of the traffic on roadways with the highest percentage of trucks with more than 1,000 ADT **(Table 21 and Figure 27)**.

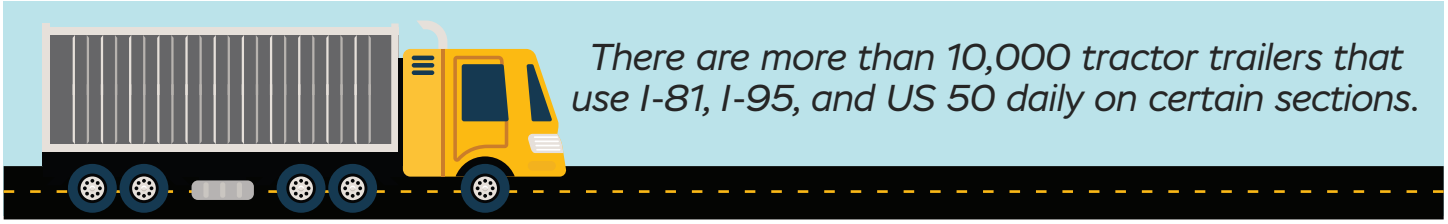
Table 20

HIGHEST TRUCK VOLUME		
	LOCATION	AVERAGE DAILY TRUCK VOLUME[1]
1	I-95 North of I-695	28,900
2	I-95 North of MD 24	24,300
3	I-95 South of MD 24	23,200
4	I-81 North of I-70	21,000
5	I-95 North of I-195	20,200

Table 21

HIGHEST TRUCK PERCENTAGE LOCATIONS		
	LOCATION	TRUCK %[1]
1	MD 159 S of US 40	35%
2	I-81 S of Pennsylvania Line	33%
3	I-81 S of Showalter Rd	32%
4	MD 313 S of Caroline County Line	30%
5	I-70 W of MD 56	29%

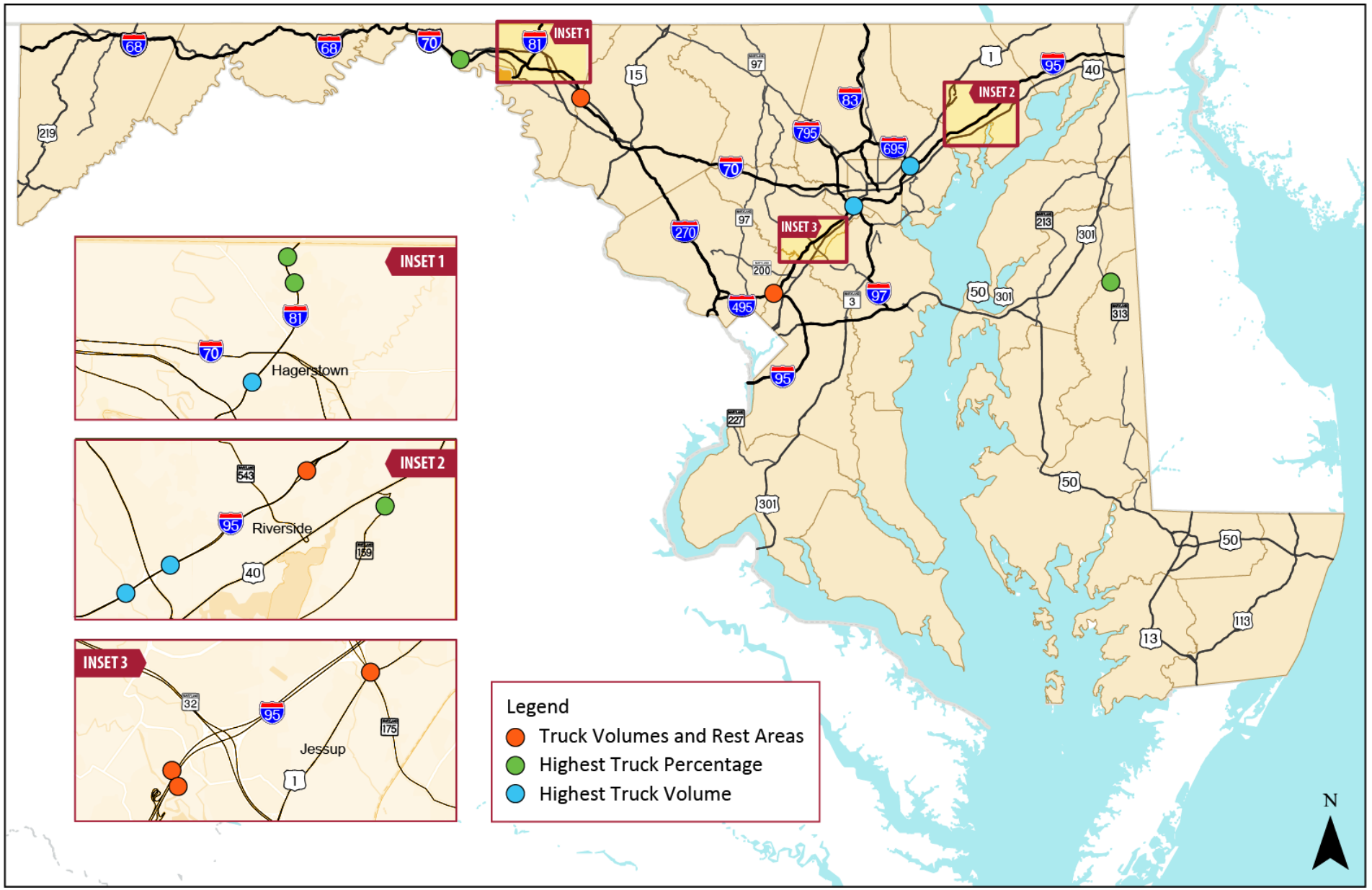
1 - Includes all types of trucks



There are more than 10,000 tractor trailers that use I-81, I-95, and US 50 daily on certain sections.

Truck Volumes and Rest Areas

Figure 27



OVERNIGHT TRUCK PARKING

The demand for goods throughout the United States requires interstate truck travel to meet the needs of citizens and businesses. This means, truck drivers must travel long hours, but they need truck parking places to stop for rest in compliance with safety regulations. The I-95 corridor has a major truck parking shortage, especially in metropolitan areas such as the Baltimore-Washington region. Currently, Maryland has a total of approximately 600 publicly supplied spaces and more than 2,300 private parking spaces. These 2,900 spaces cannot support the demand. The lack of truck parking is a significant challenge and solutions need to be multi-faceted.

In 2012, Moving Ahead for Progress in the 21st Century Act (MAP-21) required the U.S. Department of Transportation to study truck parking (Jason's Law) by:

- Surveying states' capabilities to provide adequate truck parking
- Assessing commercial vehicle traffic volumes in each state
- Developing a system of metrics to assess truck parking (MAP-21, 2012)

The inaugural report found that truck parking is a problem every day; in every state; and at all times of the day, month, and year. This work helped establish the National Coalition for Truck Parking—a group of public and private stakeholders formed to generate truck parking ideas and solutions. It also helped pave the way for the Fixing America's Surface Transportation (FAST) Act in 2015, which included a freight formula fund and made truck parking an eligible use of those funds by state departments of transportation. An update to Jason's Law in 2019 found that these problems still exist, and that Maryland still has truck parking shortages.

MDOT released a statewide truck parking study using a combination of INRIX and trucker path data. The study found clusters of need throughout the state and low parking availability. It also identified top locations where clusters of truck parking exceeded capacity. The top five spots were located in areas where truck parking existed, but not enough spaces were available **(Table 22 and Figure 26)**.

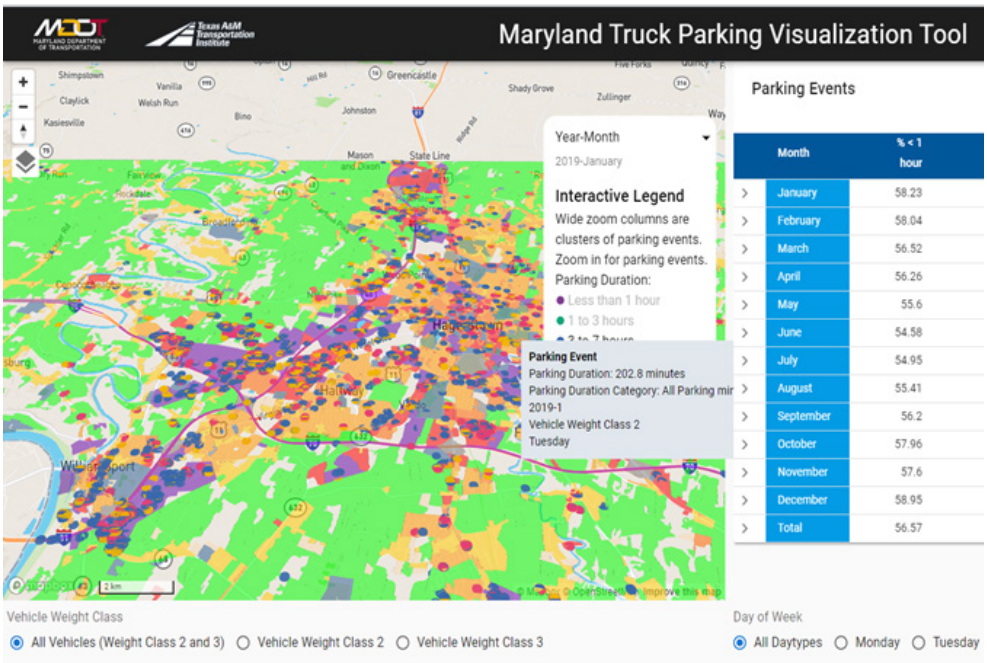
Table 22

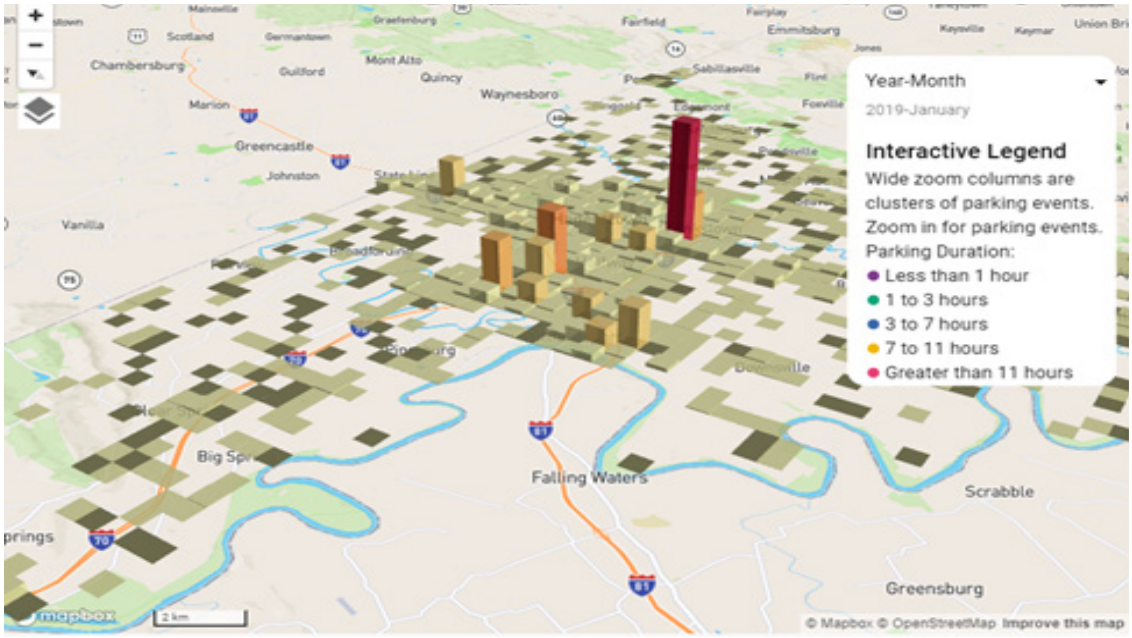
HIGH DEMAND TRUCK PARKING LOCATIONS		
RANK	LOCATION	COUNTY
1	I-95 Welcome Center	Howard
2	I-70 South Mountain Welcome Center	Frederick
3	I-95/I-495 Weigh Station	Prince George's
4	US 1/MD 175	Howard
5	I-95 Maryland House Travel Plaza	Harford

MDOT SHA is advancing several efforts to solve the truck parking shortage. First, MDOT SHA is using data in smarter ways to develop performance visualization information. This illustrates the problem and helps engage stakeholders. Secondly, this information is used to monitor parking needs. Thereby, identifying capacity and operational strategies. MDOT SHA was already advancing capacity at select locations throughout the state, but data shows there is great need to coordinate with local governments and the private sector on parking opportunities. MDOT SHA is also considering its own property that can be used to support truck parking opportunities. Another initiative includes investing in a shared freight data platform and truck information systems that can help with truck parking availability information. Finally, MDOT SHA is teaming with the other transportation business units (TBUs) and The Secretary's Office (TSO) to work with local governments, communities, and freight stakeholders to support solutions.

At the root of all truck parking efforts is having the data and intel in a format that helps engage stakeholders. MDOT SHA's Truck Parking Tool is a platform that anyone can use to view Maryland parking demand and supply. It provides a view of parking demand statewide by showing parking based on INRIX Trips data by duration throughout the state, as well as the capacity (supply) at state-owned lots. On state-owned lots, the tool also shows a capacity ratio and a ratio of trucks having to park on ramps and shoulders, which usually means the lot is full. This information helps to understand when there are capacity constraints and provides context for identifying solutions. An example of the number of events and duration for Washington County is demonstrated, below **(Figure 28)**.

Figure 28
TRUCK PARKING VISUALIZATION TOOL - WASHINGTON COUNTY





WORST CONGESTION BOTTLENECKS

One of MDOT SHA's most essential objectives is to determine where freight operators experience the highest congestion levels. MDOT SHA is accomplishing this through a new tool, which the state is currently testing. The Maryland Roadway Performance Tool (MRPT) will identify top bottlenecks based on delay per mile, which is weighted by traffic volume and normalized by roadway length (in miles). The MRPT tool uses INRIX data conflated to the Maryland's Highway Performance Monitoring System (HPMS) GIS, so performance analytics can be conducted in house.

In the short-term, the University of Maryland CATT Lab developed an alternative method as part of their Vehicle Probe Project (VPP) that identifies bottlenecks using speed-based methodology to pinpoint Maryland freight bottlenecks. Bottlenecks are identified by analyzing each roadway segment to determine when and where the speed drops below 60% of the free flow speed for more than five minutes. From that, an algorithm is used to determine and rank the bottleneck locations weighted by number and length of occurrences. The top five locations in Maryland used by trucks include:

1. I-495 Inner Loop @ I-270 Spur
2. I-95 SB @ MD 24
3. I-270 SB @ MD 109
4. I-270 NB @ MD 109
5. US 50 EB @ Bay Bridge

MARYLAND FREIGHT CONGESTION COSTS

Motorists do not like to be caught in traffic—and that is especially true for truck and bus drivers. Congestion and traffic wait times can have a great economic impact on motorists in these scenarios. This is especially important for freight operators since they experience congestion costs due to truck driver delay, truck cargo delay, additional fuel cost, and emissions cost along the freeway/expressway system. These costs are calculated at the roadway segment level and account for the price of diesel fuel, value of commercial vehicle time, and delay experienced between congested and uncongested conditions for all Maryland freeways/expressways **(Table 23 and Figure 29)**.

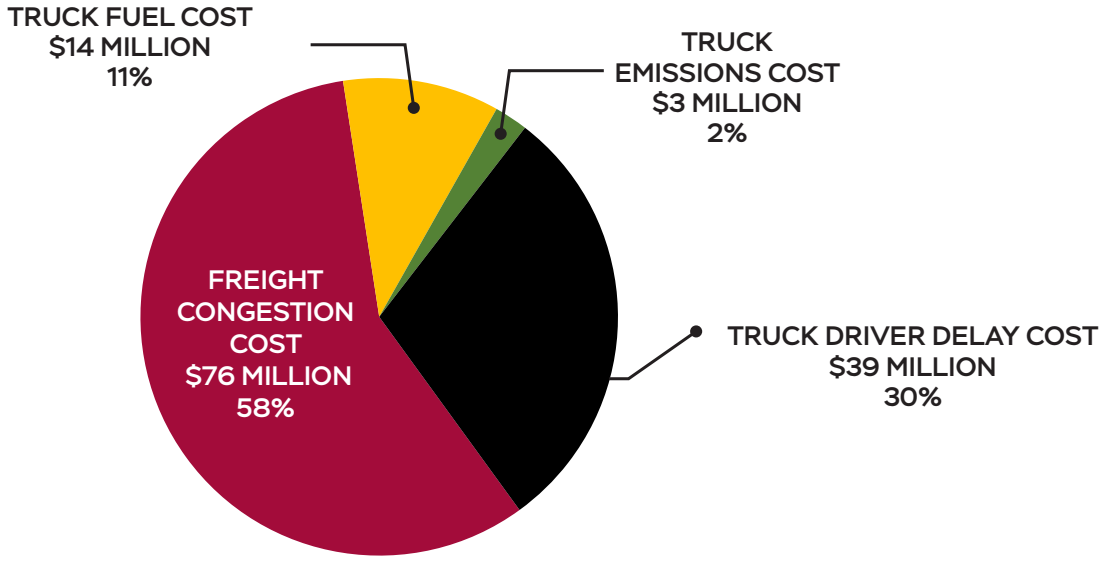
Table 23

2021 FREIGHT CONGESTION COSTS ON MARYLAND'S FREEWAY/EXPRESSWAY SYSTEM

CONGESTION ELEMENT	COST IN MILLIONS
Truck Cargo Delay	$76
Truck Driver Delay	$39
Truck Fuel	$14
Truck Emissions	$3
TOTAL	$132

Figure 29

2021 FREIGHT CONGESTION COSTS ON MARYLAND'S FREEWAY/EXPRESSWAY SYSTEM
$132 million



Congestion costs for trucks increased by almost 200% to $132 million in 2021.

TRUCK TRAVEL TIME RELIABILITY INDEX

Though reliability is a key consideration for all motorists, it is most important for freight deliveries. Late freight deliveries can cause goods to spoil or miss deadlines thereby, increasing cost to the consumer. The Federal Highway Administration (FHWA) has requested each state report a standard level of freight performance. The Truck Travel Time Reliability (TTTR) Index represents the 95th percentile travel time divided by the 50th percentile travel time for each segment. The TTTR is calculated for five time periods—the maximum value determines final system performance. The five time periods are AM peak period, midday peak period, PM peak period, overnight and weekends. The time periods are AM peak period, mid-day peak period, PM peak period, overnight and weekend.Each individual TTTR value is combined in three-to-eight-mile segments or complete sections of freeways to develop the limits of the most unreliable corridors for trucks on freeways/expressways **(Table 24 and Figure 30)**. The higher the TTTR value, the worse the operations are in that segment.

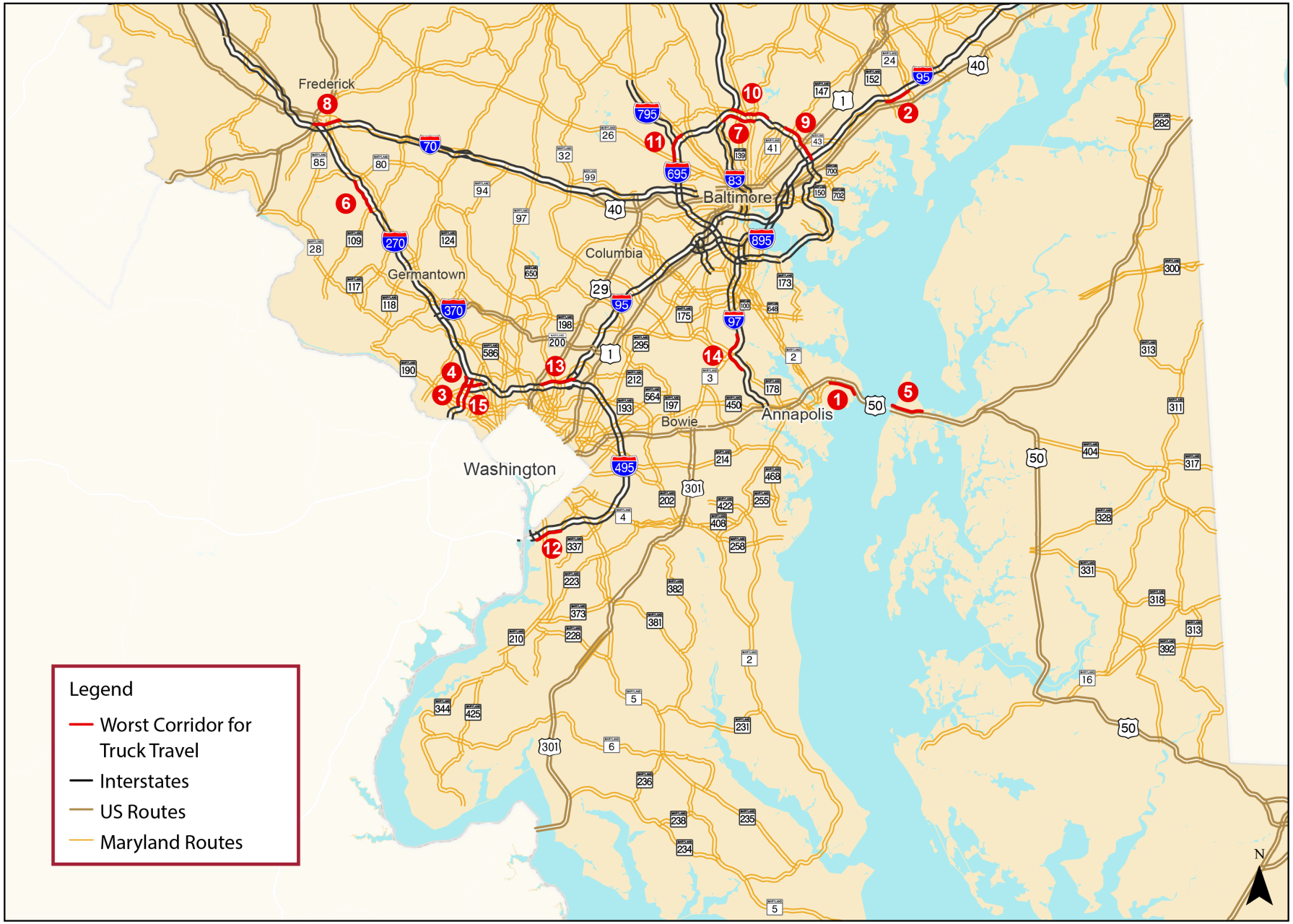
Table 24

2021 TOP 15 WORST CORRIDORS FOR FREEWAY/EXPRESSWAY TRUCK TRAVEL

RANK	ROUTE/DIRECTION	LIMITS	COUNTY	MILEAGE	TTTR MAX VALUE
1	US 50/US 301 Eastbound	Buschs Frontage Road to Chesapeake Bay Bridge	Anne Arundel	3.1	8.9
2	I-95 Northbound	MD 152 to MD 24	Harford	3.1	4.9
3	I-495 Outer Loop	MD 187 to MD 190	Montgomery	3.2	4.4
4	I-270 West Spur Southbound	I-270 Split to I-495	Montgomery	1.7	4.3
5	US 50/US 301 Westbound	Chester Station Lane to Chesapeake Bay Bridge	Queen Anne's	3.2	3.9
6	I-270 Southbound	MD 80 to MD 109	Frederick/ Montgomery	3.7	3.8
7	I-695 Inner Loop	I-83 (South) to MD 146	Baltimore	3.3	3.7
8	I-70 Westbound	MD 144 to US 15/US 340	Frederick	3.0	3.7
9	I-695 Outer Loop	I-95 to MD 41	Baltimore	3.5	3.6
10	I-695 Outer Loop	Providence Road to I-83	Baltimore	3.1	3.5
11	I-695 Outer Loop	MD 140 To MD 26	Baltimore	3.2	3.4
12	I-495 Local Inner Loop	MD 414 to I-295	Prince George's	3.1	3.4
13	I-495 Outer Loop	I-95 to MD 193	Prince George's	3.3	3.3
14	I-97 Southbound	Benfield Boulevard to MD 178	Anne Arundel	3.6	2.9
15	I-495 Inner Loop	MD 190 to MD 355	Montgomery	4.0	2.9

Figure 30

Maryland's Worst Corridors for Truck Travel: 2021



MDOT SHA

MOBILITY PROJECTS

MD 5 at MD 373

CAPITAL PROJECTS

Congestion, reliability, and safety issues exist throughout the state of Maryland. Capital projects are developed to address these issues. This is accomplished through a performance-based approach to identify, plan, design, and implement congestion mitigation and safety solutions. The capital projects program is one of the most recognizable and effective ways MDOT SHA addresses congestion and reliability issues. Project types range from capacity improvements such as constructing interchanges, providing turn lanes at intersections, and implementing roundabouts to improve safety. They also include enhancing pedestrian and bicycle networks. The improvement projects completed in the 2021 calendar year provide congestion relief, improve safety, and enhance multi-modal traffic operations.

These completed capital projects deliver essential benefits to the traveling public. They decrease congestion, reduce fuel usage, and increase safety benefits. Furthermore, we can use these benefits as data to estimate and summarize an overall benefit for each capital project **(Table 25)**.

Table 25

CAPITAL IMPROVEMENT PROJECTS OPENING YEAR BENEFITS

COUNTY	ROUTE	LIMITS	CONGESTION & FUEL SAVINGS	SAFETY SAVINGS	ANNUAL COST SAVINGS
			$ (Thousands)		
Anne Arundel	MD 175	Reece Rd to Disney Rd	$8,139	$499	$8,638
Baltimore	I-695	US 40 to MD 144	$17,075	$4,938	$22,013
Baltimore	MD 140	Garrison View Rd to North of Painters Mill Rd	$4,051	$74	$4,125
Carroll	MD 27	Gillis Falls Rd/ Harrisville Rd	$148	$398	$546
Carroll	MD 32	Bennett Rd/Jonesville Rd	$435	$75	$510
Cecil	MD 272	South of US 40 to Rogers Rd	$433	$180	$613
Frederick	MD 26	Old Annapolis Rd/Water Street Rd	-$80	$615	$535
Garrett	US 219	I-68 to Old Salisbury Rd	$79	$178	$257
Howard	US 1	Kit Kat Rd	$202	$59	$261
Montgomery	MD 355	Brink Rd to South of Greenridge Dr	$1,032	$209	$1,241
Prince George's	MD 5	MD 373	$56,806	$3,760	$60,566
Prince George's	I-95/I-495	MD 214	$17	$851	$868
	TOTAL		**$88,337**	**$11,836**	**$101,173**

1 - For more details see Mobility Report Supplement.

The improvement projects completed in 2021 provide over $100 million in user cost savings in the opening year or more than $8 million per project on average.

PEDESTRIAN PROJECTS

MDOT SHA has prioritized improving pedestrian facilities as a major safety concern. These vulnerable users accounted for approximately 130 fatalities in 2021. Various sources focused on improving safety for pedestrians have funded many projects. These improvements are often part of a dedicated pedestrian project or a comprehensive roadway improvement project. These improvements include upgrading sidewalks in poor condition, filling in sidewalk gaps, adding off-road trails, implementing signals (countdown, pedestrian hybrid beacon), enhancing crosswalks, and upgrading ADA-compliant facilities such as ramps and audible pedestrian signals. In 2021, Maryland constructed new sidewalks in 14 counties **(Table 26)**. The location of new sidewalks is shown in the Maryland Mobility Report Supplement.

Table 26

2021 NEW SIDEWALK LOCATIONS		
COUNTY	ROUTE	LIMITS
Anne Arundel	MD 2	at MD 10
Anne Arundel	MD 175	MD 295 to Odenton Rd
Anne Arundel	MD 176	Candlewood Rd to Ashton Rd
Anne Arundel	MD 177	at Long Hill Rd/Mountain Rd
Anne Arundel	MD 424	Duke of Kent Dr to MD 450
Anne Arundel	Jennifer Rd	at Annapolis Plaza
Baltimore	MD 45	at Broadmead Dr
Baltimore	MD 147	at Cub Hill Rd
Baltimore	MD 588	Overlea High School to Nicken Ct
Baltimore	US 1	Schroeder Ave to Honeygo Blvd
Baltimore	Edmondson Ave	at I-695 Northbound on/off ramps
Calvert	MD 2/4	at Stoakley Rd
Carroll	MD 140	MD 27 to N. Center St
Cecil	MD 272	over Amtrak Railroad Bridge
Charles	MD 228	Magdalene Acres Pl to Sun Valley Dr
Charles	US 301	at Willetts Crossing Rd/Marshall Corner Rd
Charles	US 301	at KFC Entrance
Dorchester	MD 16	East of MD 335
Dorchester	MD 335	South of MD 16

COUNTY	ROUTE	LIMITS
Frederick	MD 80	at Campus Dr
Frederick	MD 85	Pegasus Ct to Westview Promenade
Frederick	MD 180	at Lander Rd/Holter Rd
Frederick	US 15	Monocacy Park and Ride
Frederick	US 40 Alt	Creamery Row to Lombardy Dr/Cone Branch Dr
Harford	MD 755	at US 40
Harford	MD 924	MD 24/MD 924 Park & Ride
Harford	MD 924	MD 24/MD 924 Park & Ride to Woodsdale Rd
Howard	MD 99	at Old Mill Rd/Bethany Ln
Howard	US 1 NB	Patuxent River Bridge to Laurel Racetrack Entrance
Howard	US 1	at Montgomery Rd
Howard	Tridelphia Rd	at MD 32 Bridge
Montgomery	MD 27	at Snowden Farm Pkwy
Montgomery	MD 190	at Braeburn Pkwy
Montgomery	MD 355	at W. Old Baltimore Rd
Montgomery	MD 355	at Brink Rd
Prince George's	MD 5	Curtis Dr to Suitland Pkwy
Prince George's	MD 193	at Aerospace Rd
Prince George's	MD 212	Edwards Way to Adelphi Rd
Prince George's	MD 214	at I-95/I-495
Prince George's	MD 216	at Main St (Laurel)
Prince George's	MD 223	Sherwood Dr to Dower House Rd
Prince George's	MD 228	at Manning Rd
Prince George's	US 1	Hollywood Rd to Edgewood Rd
Prince George's	US 1	at MVA Beltsville Entrance
Prince George's	Manning Rd	at Caribbean Way Roundabout
Prince George's	Powder Mill Rd	Pine St to Chilcoate Ln
Prince George's	Southway	at Baltimore-Washington Pkwy On & Off Ramps
Saint Mary's	MD 5	at Clarks Rest Rd
Wicomico	US 13 Bus	at Cedar Ln

MDOT SHA constructed 7.8 miles of new sidewalks and reconstructed 9.7 miles of sidewalks. To date, 71% of sidewalks are ADA compliant along Maryland Routes.

BICYCLE PROJECTS

During COVID-19, more people began to realize the health advantages of bicycling. As such, a demand for bicycle facilities increased. Fortunately, MDOT SHA had already developed a Complete Streets policy to help address these deficiencies.

The MDOT SHA strives to improve bicycle safety and accessibility while providing transportation equality on roadway projects. These upgrades include bicycle facilities such as shared bike lanes, on-street bike lanes, signing, pavement markings, and accommodation improvements at intersections. Standalone bicycle facilities (such as separated bike paths) are also part of bicycle upgrade projects.

Capital for these projects is received through a wide variety of sources ranging from money set aside for bicycle facilities to funding dedicated to resurfacing, maintenance, safety, and capacity improvement projects. In 2021, MDOT SHA improved six directional miles for bicycle access. Selected bicycle facility upgrades in 2021, below, depict several different improvements **(Table 27)**.

Table 27

2021 SELECTED BIKE FACILITY UPGRADE LOCATIONS			
COUNTY	ROUTE	LIMITS	IMPROVEMENT
Allegany	US 220	MD 135 to Dawson Cemetery Rd	3.3 miles of increased bike compatibility
Allegany	MD 36	Jennings Run to North Branch	1.3 miles of increased bike compatibility
Frederick	MD 26	near Water St	< 1 mile of new bike lane
Washington	MD 63	US 11 to Conococheague Creek	1.6 miles of increased bike compatibility
Prince George's	MD 218	DC Line to MD 458	1.6 miles buffered bike lane
Prince George's	MD 564	11th St to MD 197	Upgraded signage
Garrett	US 40	Pennsylvania Line to I-68	3.7 miles of increased bike compatibility

There are more than 6 directional miles of new marked bike facilities added in 2021.

FREIGHT PROJECTS

During COVID-19, we also realized the importance of moving freight efficiently to serve residents and businesses. The MDOT SHA has implemented various freight projects and operational/TSMO solutions to keep up with the increasing demand from users.

Freight projects are divided into two categories. The first category (logistics) addresses roadway projects that enhance overall mobility and provide improvements for freight operators. The second category (systematic efficiency) encompasses projects that are directly associated with improving trucking operations. These projects aim to enhance the mobility of trucks while keeping other network users such as motorists, bicyclists, pedestrians, and transit safe.

The MDOT SHA Motor Carrier Division is responsible for several ongoing freight projects to keep trucks moving. The "Maryland One Permit System" allows the state to process applications more effectively for overweight/over-dimensional cargo. Previously, permit approval could take days depending on the request.

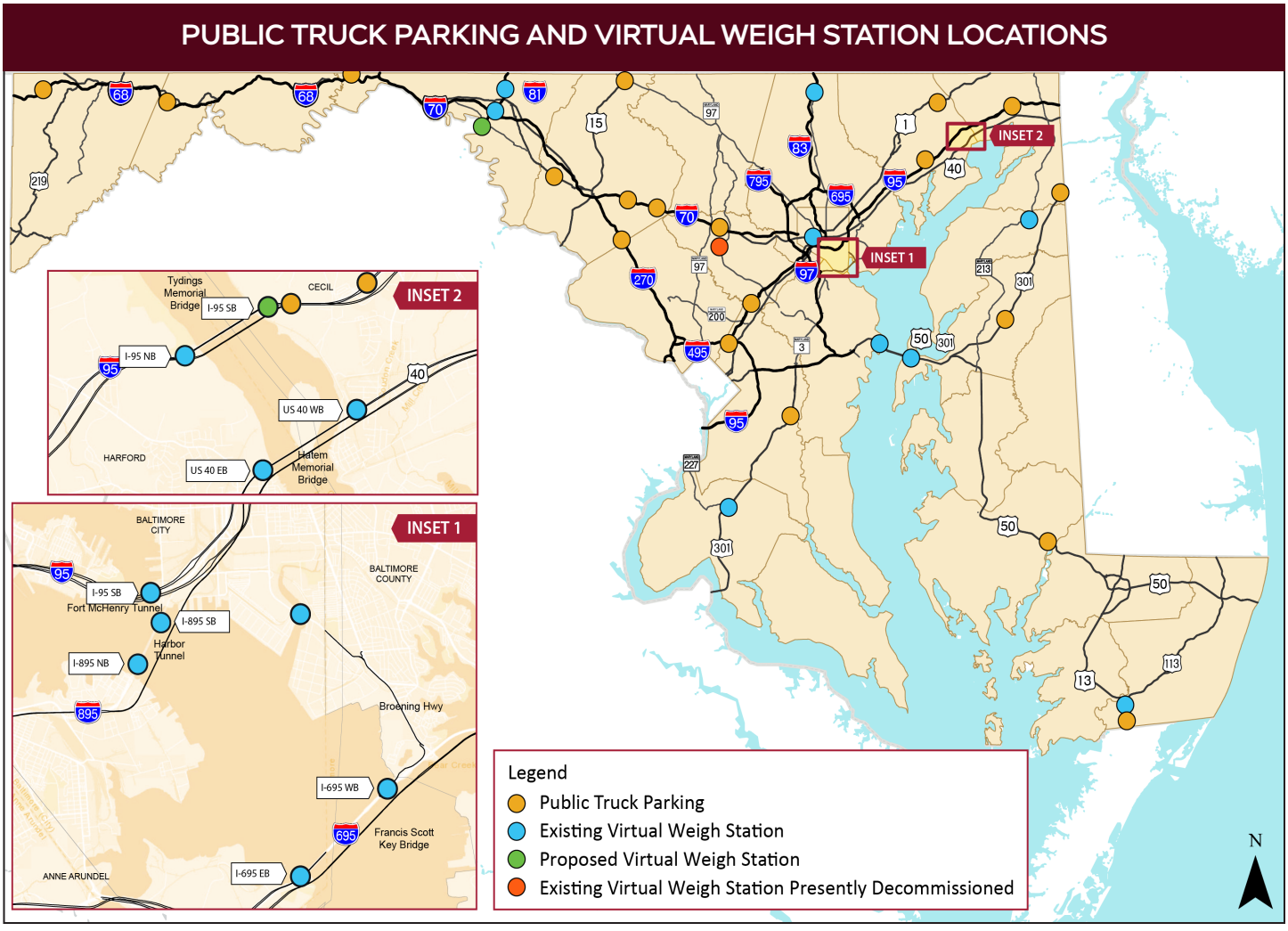
The improved automated hauling permit system now auto-issues approximately 82% of all permits for loads up to 200,000 pounds, 13-feet wide, 14.6 feet high, and 100-feet long, if the route analysis is approved. Of these types of requests, 95% of all permits are issued within two hours or less and 100% are issued within two days or less.

Megaload permits (up to one million pounds) require coordination between multiple agencies and take a longer to process. Additionally, system improvements allow users to automatically revise, extend, reprint, and process bill payments to expedite service. Testing is ongoing for turn-by-turn directions and driver detail sheets in an effect to increase safety.

I-95 Welcome Center

In 2022, Maryland will be the first state to become OIML F5 certified to perform high speed enforcement. This will be accomplished through KI digital traffic weigh-in motion and tire anomaly sensors. The Motor Carrier Division is also responsible for constructing and maintaining Virtual Weigh Stations (VWS). VWS use 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 helps limit damage to roads and bridges by eliminating overweight trucks on the road. There are currently 18 active VWS sites. The US 301 northbound site in Charles County has been decommissioned and will be replaced by a northbound and southbound site at the Nice Bridge. The MD 32 site in Howard County is currently decommissioned at this time due to construction **(Figure 31)**.

Figure 31



Finding a location to park trucks for rest breaks is a safety issue for both motorists and truck drivers. Truck parking at rest areas and welcome centers provides safe, off-road locations **(Figure 31)** to reduce potential crashes between moving vehicles and parked trucks. Trucks parked along shoulders or entrance/exit ramps create a safety hazard for other drivers. Unfortunately, identifying locations for new or expanded truck parking can be challenging.

Truck drivers prefer to stop close to their destination, which are often near populated urban centers with limited right-of-way or in areas where nearby residents are unhappy with expansions and new lots. MDOT SHA's Freight Planning Program is working on solutions to expand parking capacity at existing locations, while using Transportation Systems Management and Operations (TSMO) solutions and partnering with the private sector to provide awareness about truck parking and potentially temporary solutions.

MDOT SHA's Office of Transportation Mobility and Operations (OTMO) is also working on solutions to help assist in providing driver awareness of parking availability. This includes working to establish freight traveler and truck parking information systems that can alert drivers to available parking and to determine how to push existing data available from MDOT SHA OTMO to the freight community. MDOT SHA OTMO also works with emerging technology such as truck platooning and automated trucking advancements to determine how to implement these in Maryland.

OVERNIGHT TRUCK PARKING EXPANSION

I-70 Welcome Center Frederick County – Up to 25 added spaces under design

I-70 Welcome Center

RAILROAD GRADE CROSSING PROJECTS

At-grade railroad crossings can present a safety issue for interacting trains and motorists. Each year, MDOT SHA improves location safety of at-grade railroad crossings to either eliminate hazards or improve traffic control devices. These improvements include installing new flashing light signals (with or without gates), updating the components at existing active warning devices, and improving crossing surfaces. In 2021, MDOT SHA completed two projects to improve at-grade crossings.

- Mt Wilson Lane – Baltimore County
- Passive Signing Upgrades at Norfolk Southern Crossings – Statewide

In addition to these improvements in 2021, MDOT SHA developed the federally mandated Highway – Rail Grade Crossing State Action Plan in Maryland for the Federal Railroad Administration.

Mount Wilson Lane

DEVELOPER PROJECTS

Maryland businesses are developing new residential units, commercial centers, office buildings, and warehouses and redeveloping existing sites across the state. Consequently, roadways around these sites will experience the additional traffic they generate. Therefore, developers are often required to mitigate additional volume. In 2021, these wide-ranging improvements included intersection modifications, enhancements for pedestrian, bicycle, and transit, and interchange improvements and access improvements such as acceleration and deceleration lanes **(Table 28)**. Through a joint permitting process, MDOT SHA works to offset traffic impacts caused by developments using improvements that are beneficial throughout the corridor. These improvements can reduce or eliminate potential operational and safety issues such as traffic from turn lanes extending into through lanes.

Table 28

2021 SELECTED DEVELOPER IMPROVEMENT PROJECTS			
COUNTY	ROUTE	LIMITS	IMPROVEMENT
Allegany	US 220	East of Crestwood Dr	Left turn lane addition
Calvert	MD 2	Wilson Rd	Left turn lane addition
Calvert	MD 506	Grist Mill Ln	Right turn lane addition
St. Mary's	MD 235	Oak Crest Dr	Right turn lane addition
Somerset	MD 413	MD 667	Right turn lane addition
Washington	MD 63	McGregor Dr	Left turn lane addition

MD 506 at Grist Mill Lane

MDOT PROGRAMS TO IMPROVE
MOBILITY 2021 RESULTS

I-270 HOV Lane at Shady Grove Rd

COORDINATED HIGHWAYS ACTION RESPONSE TEAM (CHART)

Transportation agencies such as MDOT SHA aim to improve safety and mitigate congestion by addressing the needs of the system. Much of this is accomplished through projects, which are vital to improving mobility. However, MDOT SHA has also established programs to help improve traffic flow and reduce congestion. These programs incorporate methods such as reducing demand on the roadway and making better use of existing pavement to deal with mobility issues.

One such program uses TSMO through the Coordinated Highways Action Response Team (CHART). CHART is a multi-agency effort to improve mobility for the Maryland highway system through its advanced traffic management system (ATMS), service patrols, communications, systems integration, and incident response and management.

The CHART program focuses on non-recurring congestion caused by crashes, vehicle breakdowns, work zones, special events, and weather events. These non-recurring congestion events impact the mobility, safety, and reliability of the roadway system. Waiting for an incident to clear directly influences motorist mobility and reliability.

Secondary incidents can affect safety, for instance, when an accident causes drivers to slow or stop suddenly, resulting in another crash. The CHART program finds primary incidents quickly, allowing emergency personnel to be alerted and minimizing time spent in congestion. This saves motorists time and money. The improved response time reduces the potential for secondary collisions and decreases the amount of time motorists spend in traffic, thereby lowering the cost of these incidents. The typical approach of CHART incident management is showed, below.

CHART INCIDENT MANAGEMENT PROCESS

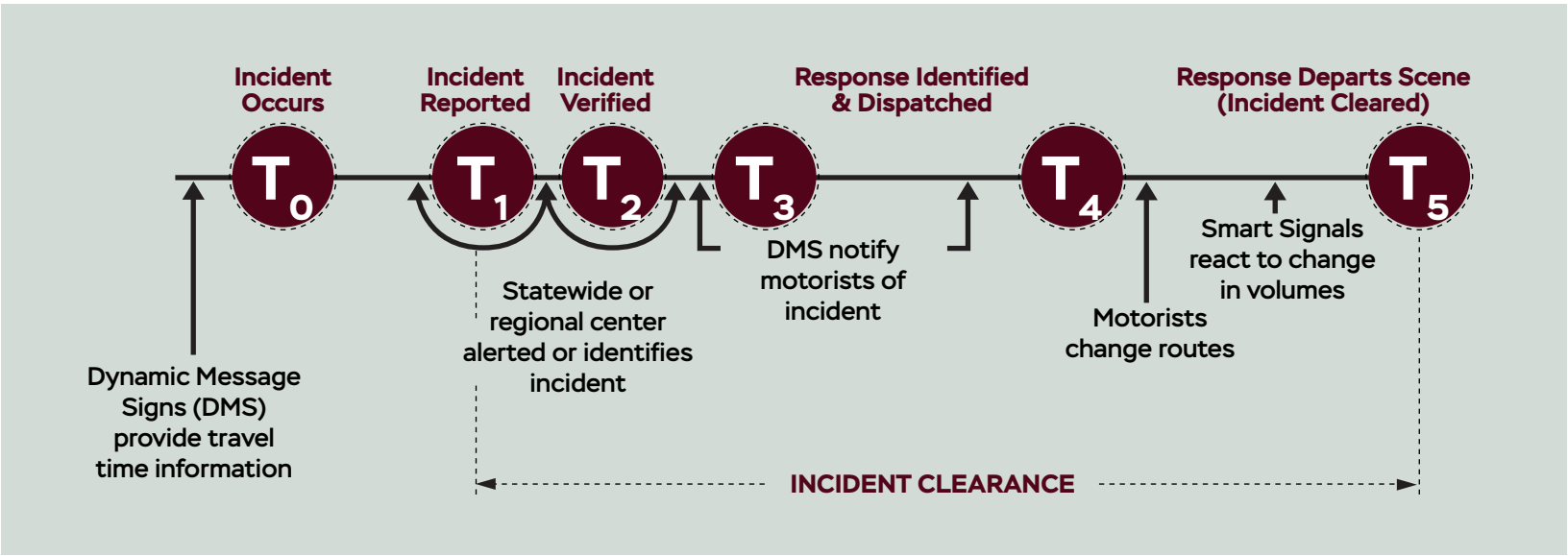


CHART is involved in the following core functions to address non-recurring congestion:

- Communications
- Emergency and weather operations
- Incident management
- Traffic management
- Traffic and roadway monitoring
- Traveler information

CHART has many different resources dedicated to traffic management including:

- Emergency response units
- Freeway incident traffic management plans and response trailers
- Intelligent transportation systems (ITS) equipment
- Clear the Road Policy and Move It Law
- Information exchange network clearinghouse
- Traffic incident management training for first responders and partner agencies

CHART incorporates diverse types of data to evaluate how the roadway system is operating. This data is collected from a variety of ITS equipment, strategically found throughout the state. Travel time information is available based on the analysis of INRIX probe speed data. It is displayed on more than 200 Dynamic Message Signs (DMS). The Maryland 511 Travel Information Service continues to supply useful, quality, and prompt travel information.

Presently, CHART has access to:

- 1000+ Closed circuit television (CCTV) cameras statewide (200+ MDOT SHA controlled)
- 300+ Speed detectors
- 200+ DMS
- 40+ Roadway weather information systems (RWIS)
- 10+ Traveler advisory radios
- 15+ Variable toll rate signs

The information from these devices is coordinated through the Statewide Operations Center in Hanover, along with three strategic traffic operations centers in Frederick, College Park, and Essex, Maryland.

Emergency response technicians (ERTs) aid drivers when their vehicles become disabled or after a crash. These ERTs are assigned to high volume and high incident routes to boost the efficiency of the emergency response program. Areas served by ERTs include:

- Baltimore and National Capital Region (Full-time 24/7 Patrols)
- Annapolis and Frederick
- Eastern Shore (Seasonal)

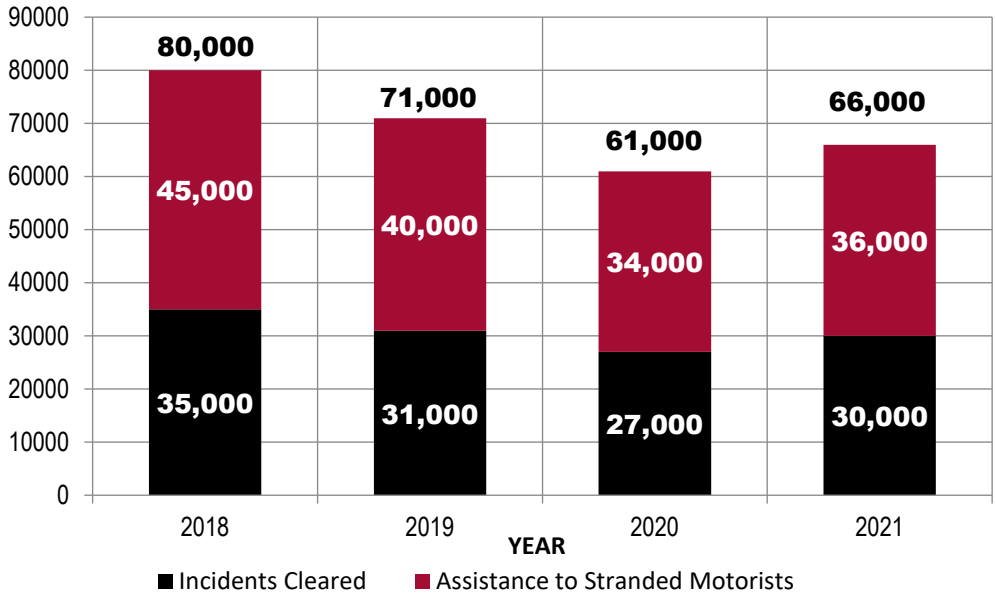
There are 32 full-time emergency traffic patrols that run 24 hours a day, seven days a week.

US 50 Eastbound west of Bay Bridge

ERTs responded to approximately 66,000 service calls to address motorist and emergency response agency needs along Maryland's highways. This included responding to approximately 30,000 incidents along Maryland roadways and more than 36,000 service calls for aid to motorists **(Figure 32)**. This aid included changing flat tires, supplying hotshots and delivering fuel. ERTs have provided over 34,000 responses to assist stranded motorists per year over the last four years.

Figure 32

EMERGENCY RESPONSE TECHNICIAN RESPONSES



The number of incident responses directly correlates to the time it takes to be on site and clear the occurrence. A decrease in response and incident clearance time translates into a reduction in delay. CHART services reduce the amount of delay and provide annual user cost savings. The identified annual vehicle hours of delay savings and the average incident duration for the last four years is shown in **Figures 33 and 34**. Less congestion on the roadway results in less waiting time for motorists, thereby decreasing the annual vehicle hours of delay.

Figure 33

CHART REDUCTION IN DELAY

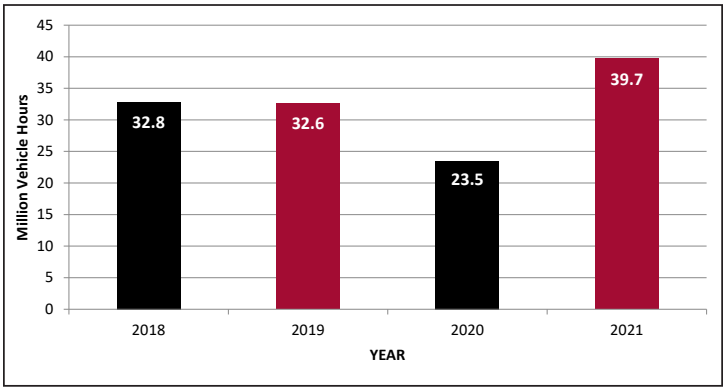
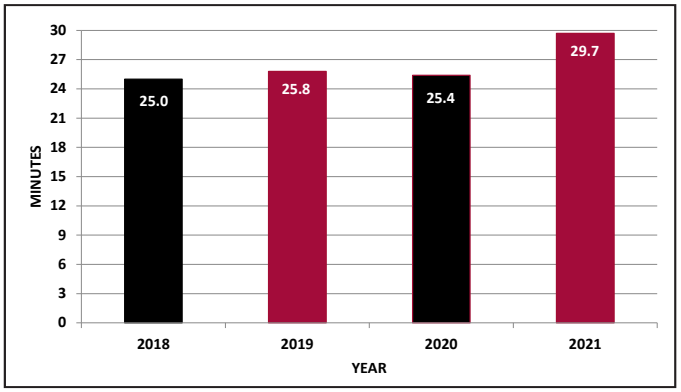


Figure 34

AVERAGE INCIDENT DURATION



Every minute saved through reductions in delay translates into savings in annual user costs. The annual user cost savings to Maryland travelers amounted to $1.88 billion dollars in 2021 **(Figure 35)**. Annual user cost savings includes reduction in delay, and savings in fuel and emissions.

Figure 35

CHART ANNUAL USER COST SAVINGS

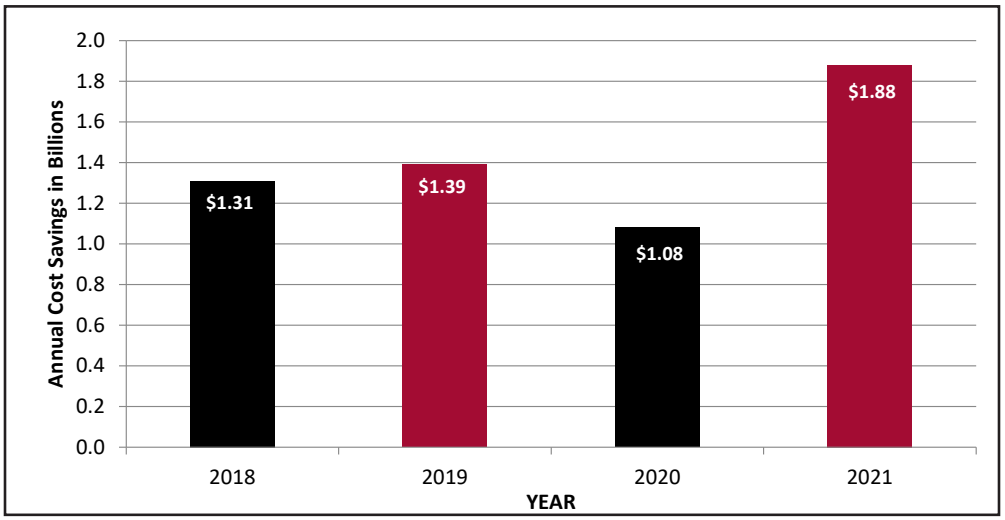


CHART services supplied a record annual benefit of $1.88 billion and reduced delay by 39.7 million hours.

SIGNAL OPERATIONS

Along many arterial, collector, and local roadways the major constraint to mobility is at the junction of two roadways that are signalized. Motorists have to wait until they receive the green indication. If the signals are poorly timed, motorists often feel they have to wait too long to receive the green sign or get stopped at every signal. In order to reduce delay and improve mobility, perfecting traffic signal timing is one of the most cost-effective methods to address recurring and non-recurring congestion. Signal timing improvements can reduce the potential for red light running, decrease delay and emissions and support a more walkable environment. Individual signals that are next to each other are often grouped together into a signal system that allows motorists to progress along an entire corridor more efficiently. Overall, MDOT SHA is responsible for:

- 1,588 Traffic signals
- 266 Signal systems

MDOT SHA reviews selective corridors each year to improve operations. In 2021, the signal timings for 47 signals in eight systems were reviewed to improve progression and operations. Other areas addressed as part of signal operation efforts are work zone signals, new signal testing and turn-ons, phase modifications, working with school systems to improve operations at arrivals and dismissals and supporting the implementation of mass vaccination sites. The overall improvements for the eight systems:

- Reduced almost 100,000 hours of delay
- Saved more than 81,000 gallons of fuel
- Reduced delay by 9%
- Saved users annually $4.4 million

In 2021, the highest annual delay savings occurred along MD 22 in the Bel Air area. **(Table 29)**.

Table 29

2021 NETWORK DELAY SAVINGS FOR MDOT SHA SIGNAL SYSTEMS UPGRADES

ROUTE	LIMITS	COUNTY	NO. OF SIGNALS	DELAY SAVINGS (VEH-HRS)
MD 22	John Carroll High School to MD 543	Harford	4	51,000
MD 175	Reece Rd to MD 170	Anne Arundel	7	44,000
MD 27	Penn Shop Rd to Twin Arch Rd	Frederick	7	7,000
MD 213	Howard St to MD 545	Cecil	5	2,000
MD 222	St. Marks Church Rd to MD 275	Cecil	3	< 1,000
MD 213	Water St to Broadway	Queen Anne's	3	0
US 50	MD 589 to Inlet Isle Ln	Worcester	10	-5,000
MD 2/4	Stoakley Rd to Old Field Ln	Calvert	7	N/A
TOTAL			**47**	**100,000**

N/A - Delay savings predicted for 2022

The highest overall largest delay reductions by percentage were:

- MD 22 – (22%)
- MD 175 – (19%)
- MD 27 – (6%)

TRANSIT SIGNAL PRIORITY

Transit signal priority (TSP) at signalized intersections allows for buses to gain a time advantage to encourage more riders and improve on-time performance and reliability. TSP extends the green time of the signal if a bus is approaching while it is ready to turn yellow or reduces the wait time if the bus arrives when the signal is red. The following systems are either planned or currently operating:

Ride On extRa service (Montgomery County):

- MD 355 – Lakeforest Mall to Medical Center METRO Station – 30 signals
- In 2021, buses operating on the corridor made over 335,000 TSP requests at signalized intersections.

Ride On FLASH service: (Montgomery County)

- US 29 – Burtonsville to Silver Spring METRO – 15 signals
- Service start date was delayed from mid-2020 due to COVID-19-service reductions.
- Data is unavailable for TSP requests in 2021 due to operational limitations related to the pandemic.

US 29 Ride On FLASH Bus

SMART/ADAPTIVE SIGNAL SYSTEMS

Modern technology plays a vital role in improving mobility by reducing delay. This relates to several methods such as the use of ITS technology which includes deploying innovative Smart/adaptive signal technology that supports real-time signal timing adjustments.

Smart signals use computer software that responds to real-time traffic conditions, effectively deploying artificial intelligence to keep traffic moving. These systems maximize the green time for the major roadway, while considering 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 signals differ from standard signal timing improvements by allowing for timing modifications to occur instantly as traffic flow changes throughout the network. MDOT SHA are using this technology on some of state's most congested corridors.

By the end of 2021, adaptive signal systems have been implemented in 21 congested corridors throughout the State. These included three new systems with 25 signals, which became operational in 2021 **(Table 30)**. A comparison was made of the delay savings these adaptive signal corridors provided by using PTI values **(Table 31)**. This was based on 2021 versus 2019 data since COVID-19 impacted data from 2020 and therefore a valid correlation could not be made.

US 40 at Ingleside Avenue Adaptive Signal System

Table 30

2021 ADAPTIVE SIGNAL IMPLEMENTATION CORRIDORS			
COUNTY	LIMITS	ROUTE	# OF SIGNALS
Anne Arundel	MD 2: MVA Entrance to MD 270; MD 710: MD 2 to Chesapeake Center Dr	MD 2/MD 270	10
Baltimore	Golden Ring Rd to Rossville Blvd	US 40	2
Carroll	MD 140: Market St to MD 31 and WMC Dr to MD 832; MD 31: Main St to Uniontown Rd	MD 140/MD 31	13

Table 31

2021 ADAPTIVE SIGNAL IMPLEMENTATION CORRIDORS BENEFITS			
COUNTY	LIMITS	ROUTE	% IMPROVEMENT FROM BEFORE SYSTEM IMPLEMENTATION TO 2021[1]
Anne Arundel	MD 10 Ramp to Arnold Rd	MD 2	Up to 33%
Anne Arundel	MD 2:Forest Dr to MD 450; MD 178/MD 450: MD 2 to Bestgate Rd	MD 2/MD 178/ MD 450	Up to 11%
Anne Arundel	MD 450 to St Stephens Church Rd	MD 3	Up to 24%
Anne Arundel	Hammond Lane to 11th St	MD 2	Up to 34%
Baltimore	Kelox Rd to Offut Rd	MD 26	Up to 8%
Baltimore	Nuwood Dr to Coleridge Rd	US 40	Up to 34%
Charles	US 301: Chadds Ford Rd to Smallwood Dr; MD 228/MD 5 Business: Western Pkwy to Post Office Rd	US 301/ MD 228/MD 5	Up to 3%
Harford	Technology Dr to US 40	MD 22	Up to 14%
Harford	Singer Rd to Boulton Rd	MD 24	Up to 28%
Howard	Montgomery Rd to MD 175	US 1	Up to 38%
Howard	Chatham Rd to Normandy Center	US 40	No Improvement
Prince George's	Sweitzer Rd to Old Gunpowder Rd	MD 198	Up to 28%
Prince George's	I-95/I-495 Ramps to Arena Dr	MD 202	Up to 7%
Prince George's	Governor Bridge Rd to Pointer Ridge Rd	US 301	Up to 36%
Wicomico	Winner Blvd to Centre Rd	US 13 Bus	Up to 17%

1 - Represents greatest improvement for AM or PM in-peak or off-peak direction

PARK AND RIDE LOTS

A method to connect motorists to multi-modal options is through a network of park and ride lots. This is done through state and county agencies. MDOT SHA and MDTA maintain the largest number of locations, with 112 park and ride lots in 21 counties including shared lots with MDOT MTA. Additional park and ride locations are operated by MDOT MTA and other transit and local agencies.

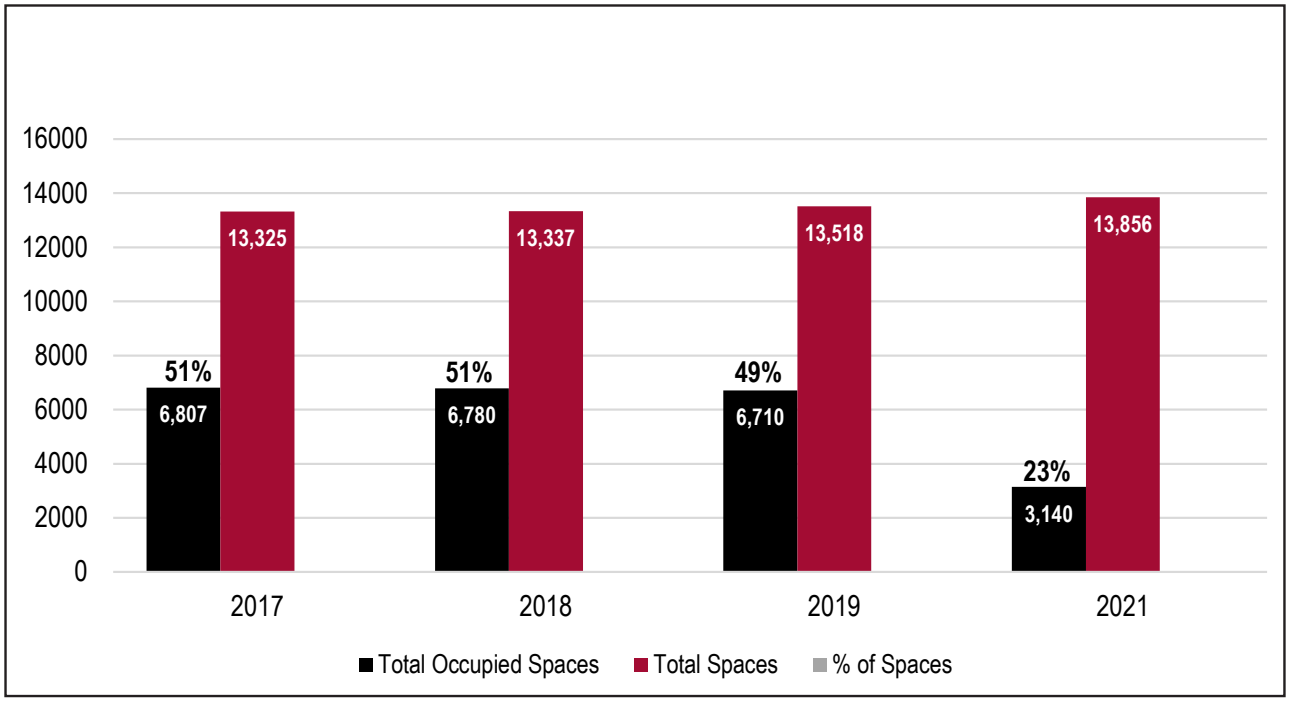
MDOT park and ride lots also provide safe emergency event parking locations for trucks. The lots provide more than 13,500 spaces and range from less than 10 spaces to more than 800. The largest lots are along MD 5 in the Waldorf area of Charles County and along MD 665 at Riva Road in Annapolis. Usage of park and ride lots in 2021 is still substantially lower than pre-COVID-19, with a decrease from over 6,500 vehicles in 2019 or earlier to approximately 3,100 vehicles parked at these lots.

MDOT SHA perform a survey of all facilities to assess use. Overall, 3,100 motorists on an average survey day used the park and ride lots **(Figure 36)**. The highest volume locations where motorists were parking at are:

- I-270 at MD 124 (248)
- I-95 at I-495 (181)
- I-270 at MD 117 (159)
- US 15 at Monocacy Blvd (123)
- I-70 at MD 66 (118)
- I-70 at MD 65 (107)

Figure 36

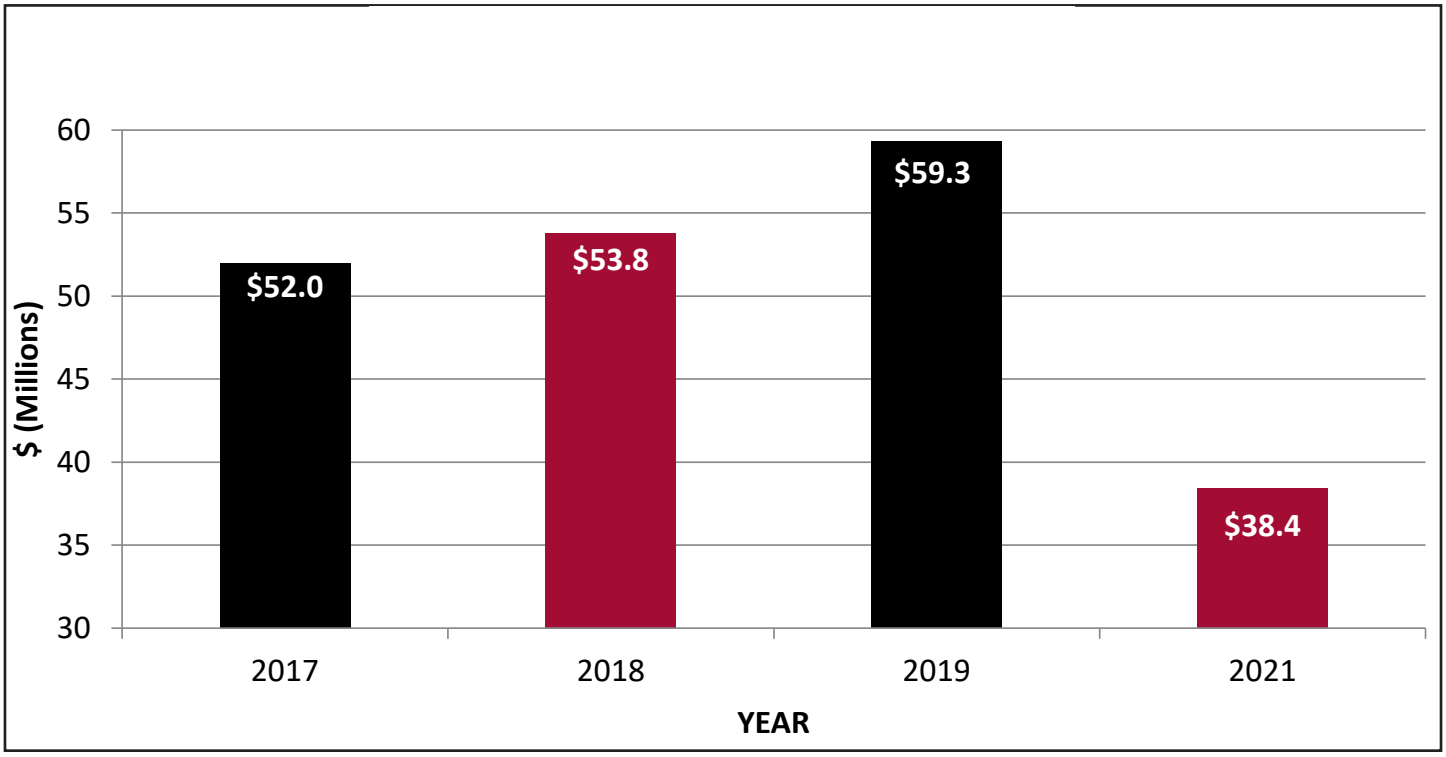
MDOT SHA/MDTA PARK AND RIDE LOT SPACES AND OCCUPANCY



Note: Data was not available for 2020

The availability of these park and ride lots reduced the amount of VMT driven on Maryland roadways and resulted in over $38 million in annual cost savings in 2021 **(Figure 37)**. This benefit decreased in 2021 due to a lower number of motorists parking at the lots partially related to COVID-19 concerns.

Figure 37
MDOT SHA/MDTA PARK AND RIDE LOT SAVINGS TO MOTORISTS (MILLIONS)



Note: Data was not available for 2020

A new lot has opened as part of the MD 5/MD 373/Spine Road interchange reconstruction. This lot has approximately 246 spaces. The existing eighty-nine space lot at US 15 and Mount Zion Road was replaced with a new commuter parking lot that has 154 spaces in 2021. Also, under design are 25 spaces at the I-70 South Mountain Welcome Center.Additionally, MDOT SHA has committed to installing EV charging stations at 16 park and ride lots to meet the growing demand.

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 the WMATA lots provide service to the Washington Metrobus and Metrorail systems.

MDOT SHA and MDTA Park and Ride lot usage was down over 50% from 2019. More than 300 additional parking spaces are available to motorists via Park and Ride lots constructed since January 2021.

HIGH OCCUPANCY VEHICLES (HOV) LANES

High occupancy vehicle (HOV) lanes are used 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 savings to multi-occupant vehicles since motorists in these lanes usually operate at free flow conditions while the general-purpose lanes (non-HOV lanes) usually experience congestion and lower travel speeds.

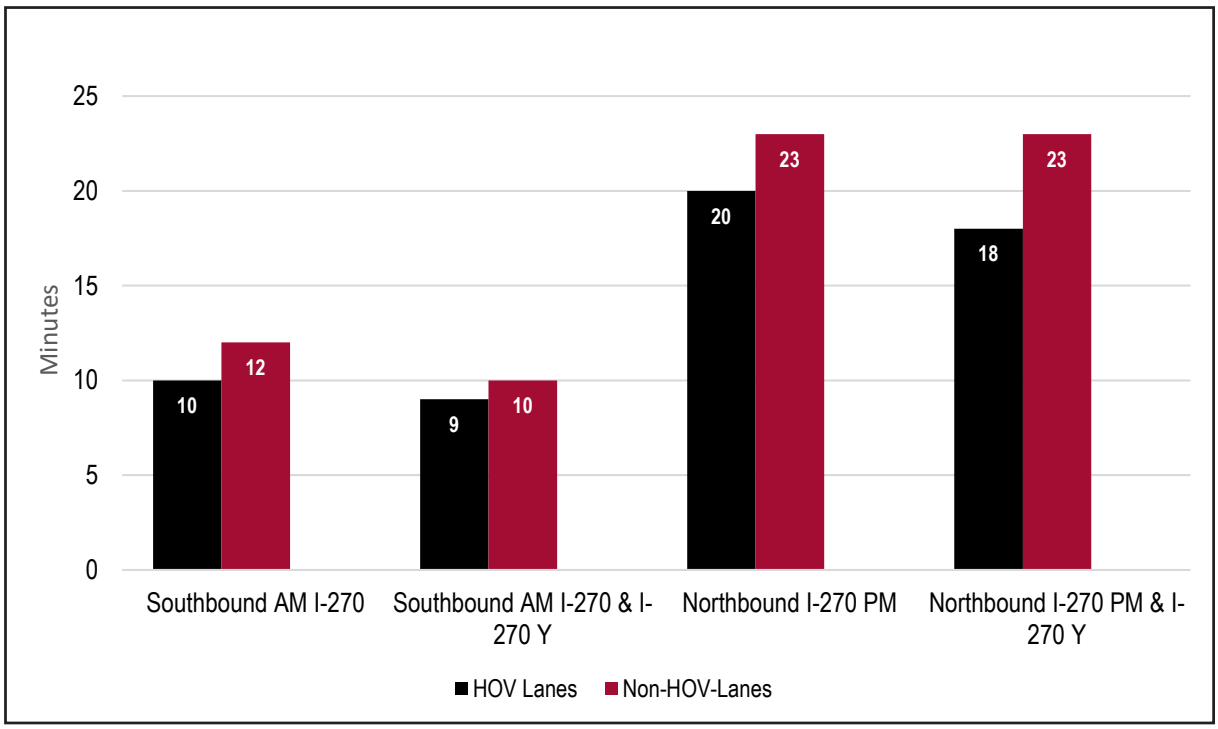
Maryland has two corridors served by HOV lanes. Only vehicles with two or more occupants, transit vehicles, motorcycles or plug-in electric vehicles may use these lanes during the directional operating hours listed below:

- 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]

A study was conducted to evaluate the operations associated with the HOV and general purpose or non-HOV lanes along I-270 and US 50. Travel time studies were performed along both the HOV lanes and the general-purpose lanes. The lower volumes on I-270 allowed for faster speeds in the non-HOV lanes, minimizing the travel time advantage of the HOV lanes, although the HOV lanes were operating at or above posted speeds. The savings in 2021 was limited to one to five minutes **(Figure 38)**. On US 50, travel time savings were less than one minute in both the AM and PM peak periods by motorists using the HOV lane.

Figure 38

I-270 HOV AND NON-HOV LANES TRAVEL TIME



The travel time savings for the HOV lane on I-270 was up to five minutes.

REVERSIBLE LANES

Active travel demand management (ATDM) is dynamically managing a roadway by technology to improve mobility. ATDM can include such strategies such as the I-270 ramp metering, dynamic pricing such as along I-95 or dynamic lane controls including reversible lanes. Reversible lanes are implemented normally when commuting patterns are very directional with motorists mostly traveling one way in the morning and the opposite direction in the afternoon. Reversible lanes allow for one or more lanes of a roadway to be converted from one direction to the opposite direction to accommodate the increase in peak hour volumes. The lane conversion occurs for defined hours. There are four reversible lane locations along MDOT roadways **(Table 32)**.

Table 32

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

The most familiar location to most Marylanders is the Chesapeake Bay Bridge. The lanes on this structure 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. Presently, the MDTA is further automating the implementation of the reversible lanes to minimize personnel needed and to improve safety. The remaining reversible lanes operated by MDOT SHA are along MD 177, US 29, and MD 97. These reversible lanes are used to improve the standard AM and PM peak period commuting traffic flows. Volumes on the reversible lanes range from less than 10 vehicles to over 1,400 **(Table 33)**.

Table 33

2021 REVERSIBLE LANE VOLUMES AND NUMBER OF LANES							
LOCATION	VOLUME OF PEAK DIRECTION FOR NON-REVERSIBLE LANES (VEHICLES PER HOUR)		NUMBER OF NON-REVERSIBLE LANES		VOLUME OF PEAK DIRECTION FOR REVERSIBLE LANE(S) (VEHICLES PER HOUR)		NUMBER OF REVERSIBLE LANES
	AM	PM	AM	PM	AM	PM	AM
US 50/301	N/A	2,840[1]	N/A	2	N/A	1,425[1]	N/A
MD 177	650	860	1	1	5	90	1
US 29	780	1,015	2	2	435	500	2
MD 97	2,175	2,310	3	3	290	290	1

1 - Volumes represent Saturday peak hour

MANAGED LANE FACILITIES AND EXPRESS TOLL LANES

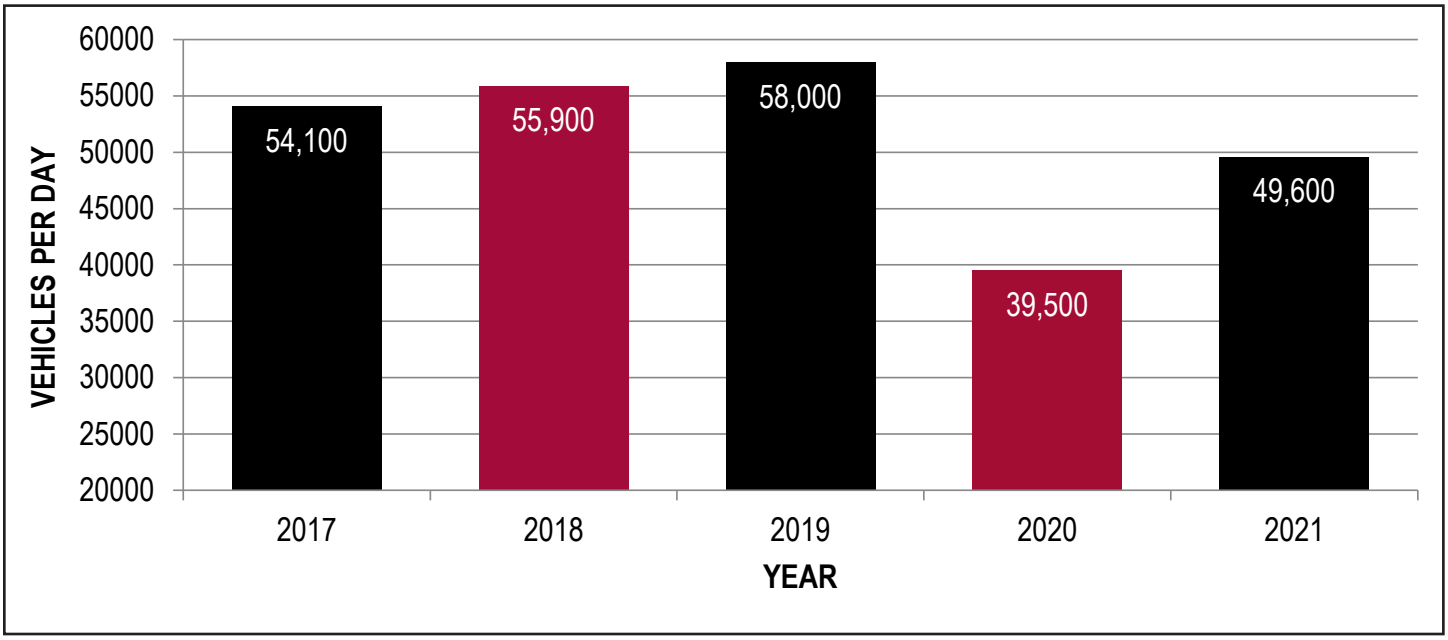
The Maryland Transportation Authority (MDTA) manages all toll facilities in Maryland including the Chesapeake Bay Bridge, Nice Bridge, Hatem Bridge, Key Bridge, I-895 Harbor Tunnel Thruway (Harbor Tunnel, MD 200, and I-95 from the Baltimore City Line on the south side to the Delaware Line including the Fort McHenry Tunnel and Tydings Bridge).

To address congestion issues on some of these roadways, MDOT evaluated several innovative strategies. For freeways/expressways, strategies could include separate lanes or a separate facility that would operate at acceptable speeds without experiencing delays. These separate or managed lanes could include high occupancy vehicle lanes, truck lanes, or various tolling strategies. In Maryland, two projects have been in operation since 2014, which were developed to improve traffic flow with tolls.

The first project, MD 200 (Intercounty Connector), 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 time of day. MD 200 extends from I-370 in Montgomery County to US 1 in Prince George's County for approximately 19 miles. Traffic volumes on MD 200 increased from 39,500 vehicles per day in 2020 to 49,600 vehicles per day in 2021 between I-370 and I-95 **(Figure 39)**.

Figure 39

MD 200 AVERAGE DAILY TRAFFIC VOLUMES BETWEEN I-370 AND I-95 FOR FIVE SEGMENTS

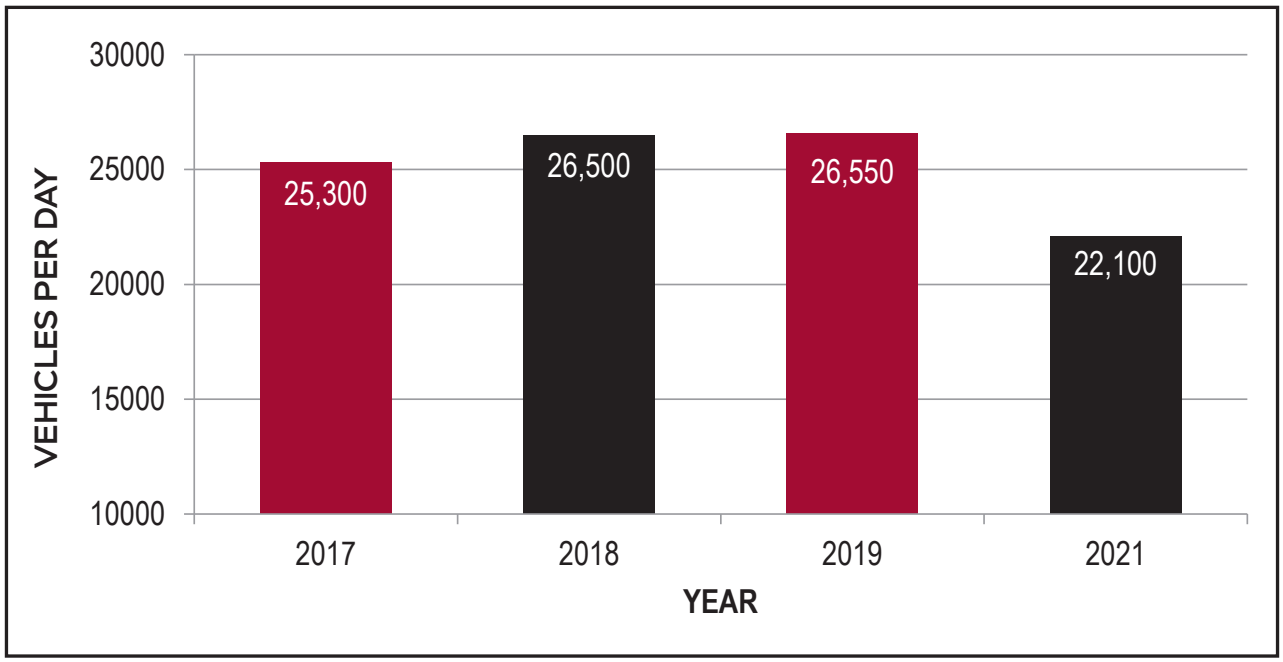


In December 2014, MDOT SHA introduced a second type of managed lane project along I-95—from south of I-895 in Baltimore City—to north of MD 43 in Baltimore County. Instead of tolling the entire facility—as with MD 200—motorists have a choice to use either the four free general-purpose lanes or pay an E-ZPass® toll, based on when they can travel in the free flow express toll lanes (ETLs). 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 2021, more than 22,000 motorists per day used the express toll lanes which is lower than 2019 **(Figure 40)**. This was due to less usage early in the year because of COVID-19. In fact, volumes rose to approximately 25,000 vehicles per day for the second half of the year. The second section of express toll lanes stretches from I-95 north of MD 43 to south of MD 543 and is under construction.

Figure 40

I-95 EXPRESS TOLL LANE AVERAGE DAILY TRAFFIC VOLUMES



Note: Data was not available for 2020

I-95 ETL at MD 43

Traffic volumes increased by about 10,000 vehicles per day on MD 200. In the highest hours more than 3,000 vehicles use the I-95 ETLs.

MOBILITY **INITIATIVES**

BICYCLE AND PEDESTRIAN

Pedestrians and bicyclists are the most vulnerable users of our transportation network. MDOT SHA has developed the "*Context Driven: Access and Mobility for All Users*" guide to improve pedestrian and bicycle safety and provide for a balanced and sustainable multi-modal transportation system. Using innovative treatments and strategic investments framed by complete streets and practical design principles, this guide helps MDOT SHA improve safety, accessibility, and mobility for multi-modal users. Additionally, MDOT SHA incorporates bicycle and pedestrian facilities into roadway projects and provides grants for the planning, design, and construction of bicycle and pedestrian facilities on non-state-owned facilities.

PROGRAMS

The MDOT SHA, MDOT MTA, Maryland Department of Natural Resources, along with many federal agencies, have established programs to expand pedestrian and bicycle facilities. These programs have been established to implement planning, design, and construction. These 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 pavement marking upgrades. These initiatives provide funding in the following programs: (2022-2027 $ in millions[1] – example project and County):

- Bicycle Retrofit Program ($36.3 – US 1 Trolley Trail – Prince George's)
- Retrofit Sidewalk Program ($41.6 – MD 424 Duke of Kent Dr to MD 450 – Anne Arundel)
- ADA Program ($40.2 – Talbot St – Talbot)
- Recreational Trails Program ($6.7 - Gunpowder Hereford Trail Connector – Baltimore)
- Kim Lamphier Bikeways Network Program ($9.2 – New Hampshire Ave Bikeway – Montgomery)
- Transportation Alternatives Program ($87.8 – Golden Mile Multimodal Access – Frederick)
- Primary/Secondary Program ($1.7 – MD 39 over Youghiogheny River – Garrett)
- Neighborhood Conservation Program ($29.2 - MD 291- School Street to Crane St – Kent)
- Maryland Highway Safety Office Bicycle Programs ($0.1)
- Other State grant programs include the Community Legacy Program, Program Open Space, Maryland Heritage Areas Program, Community Parks, and Playgrounds, Federal Lands Access Program, the Transportation Land Use Connections Program and Statewide Transit Innovation grants. There are numerous Federal grant programs including BUILD, Rivers, Trails, and Conservation Assistance Program.

Bicycle and pedestrian project funding for the fiscal years 2022-2027 amounts to over $252 million.

1 - Consolidated Transportation Program 2022-2027

BICYCLE AND PEDESTRIAN MASTER PLAN

Improving pedestrian and bicycle facilities requires a thorough and innovative plan. "The 2040 Maryland Bicycle and Pedestrian Master Plan 2019 Update" provides this vision, encouraging active transportation and offering solutions to Maryland's current challenges regarding bicycle/pedestrian facilities and safety. The 2040 Maryland Bicycle and Pedestrian Plan 2019 Update documents the 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 analyzing and planning.
- Form partnerships.
- Encourage economic development.

Safety is vital to encourage and expand pedestrian and bicycle usage. Furthermore, the 2040 Maryland Pedestrian and Bicycle Master Plan 2019 Update aligns with the goals of the Towards Zero Deaths campaign to enhance safety. In 2021, there were approximately 130 pedestrians and six bicyclists involved in fatal crashes in Maryland. This decreased by seven pedestrian and nine bicyclists since 2020. 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 like "A Cyclist Could Be Someone You Know" and "Look Alive".
- Evaluate innovative treatments such as green pavement, cycle tracks, and bicycle signal heads.
- Promote use of connected vehicle technology and emergency response personnel technology to prevent and reduce collision severity.
- Implement legislation and training.
  Various ongoing initiatives to improve bicyclist and pedestrian safety and mobility in 2021 include:
- Developing the 2021-2025 Strategic Highway Safety Plan, which included six strategies to improve pedestrian and bicycle safety.
- Incorporating the "*Context Driven: Accessibility and Mobility for all Users*" guide into projects and developing a web portal for resources and a statewide progress project map.
- Promoting pedestrian and bicycle campaigns such as Look Alive, Street SMART and High Visibility Enforcement.
- Reducing speed limits and lane widths on several corridors.
- Introducing continental crosswalks treatments at various intersections.
- Installing safety improvements including accessible pedestrian signals, countdown signals, ADA improvements, lighting enhancements, and signing and pavement marking upgrades.
- Allowing full-size bicycles on board all MARC trains.
- Developing a month-long list of events to promote. WALKTOBER
- Developing a pedestrian safety action plan.
- Changing the method for evaluating ease of bicycling on roadways from "bicycle level of comfort" to "level of traffic stress". A new database has been developed for this.

TRANSIT ORIENTED DEVELOPMENT (TOD)

Since 2008, the state of Maryland has significantly encouraged development at or near transit stations—something commonly referred to as Transit-Oriented Development (TOD). The state defines TOD as designing high-density places where people live, play, and work in a way that encourages easy multi-modal access to the station. The new administration aims to expand transit-oriented communities in the near future.

The MDOT has actively sought to promote TOD as a tool to support economic development, promote transit ridership, and maximize the efficient use of transportation infrastructure, while also addressing congestion, environmental issues, and sprawl. There are 19 TOD sites along the major fixed rail transit lines of the Baltimore/ Washington, D.C. region **(Figure 41)**. Bowie State University and Martin State Airport were added in the last year.

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)
- Bowie State University (MARC)
- Martin State Airport (MARC)
- Laurel (MARC)
- Dorsey (MARC)
- Shady Grove (Washington METRO)
- Twinbrook (Washington METRO)
- North Bethesda (Washington METRO)
- Wheaton (Washington METRO)
- Greenbelt (Washington METRO)
- New Carrolton (Washington METRO)
- Branch Avenue (Washington METRO)
- Naylor Road (Washington METRO)

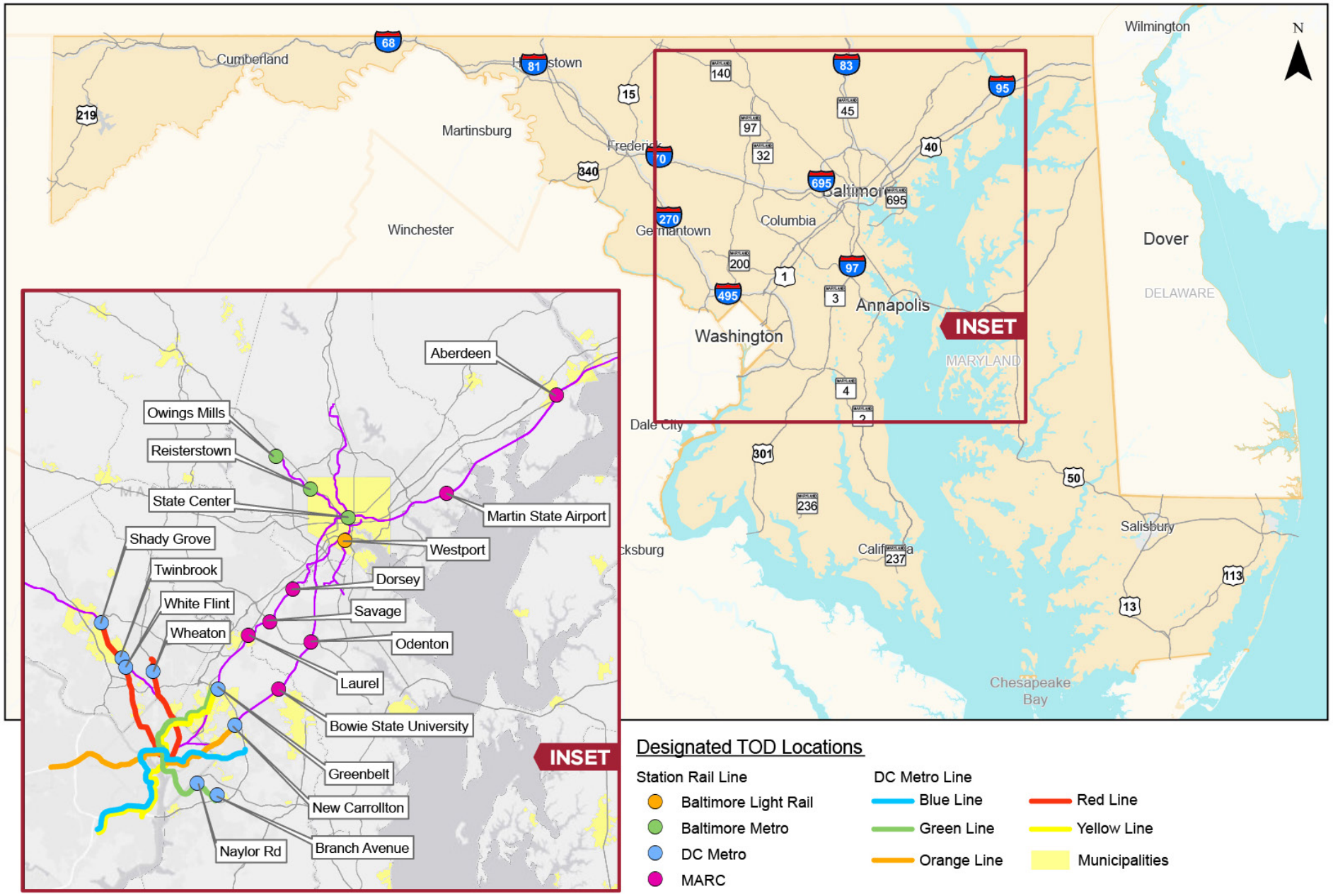
Each of the 19 sites are at various levels of development. Certain locations are much more active with on-going construction, while market conditions will determine when development occurs at other sites. The most active sites include a combination of retail, residential, and office uses **(Table 34)**.

Table 34

ACTIVE DEVELOPMENT AT TODS		
TOD LOCATION	MULTI-MODAL CONNECTION	DEVELOPMENT STATUS
Metro Centre @ Owings Mills	MDOT MTA-METRO	· 227 Unit residential building scheduled for completion in summer 2022. · 229 room hotel and conference center. · Additional proposed development includes residential, office, retail, and parking facilities.
Annapolis Junction/ Savage	MARC	· Planning for: 6-story residential building with 300 apartments, 11-story 110 key hotel with 2 restaurants, 100 spaces added to existing parking deck and new structured garage with 300 spaces.
New Carrollton	WMATA-METRO	· 282-unit multi-family residential building recently completed. · WMATA's 275,000 sf office building under construction including a 1,900 space garage. · Construction starting Summer 2022 on a 286-unit multi-family building.
North Bethesda (Formerly White Flint)	WMATA-METRO	· Additional residential building is planned. · Montgomery County and WMATA have entered a MOU to develop 2 to 3.9 million square feet of a mixed-use life sciences community.

TOD sites are located in six counties and Baltimore City.

Transit Oriented Development Locations



FREIGHT

The movement of goods is vital to the economy in Maryland. It is a necessity to meet the needs of the public and business demands. Using truck probe data and TSMO methods, MDOT SHA has been able to assess freight performance and system needs. Through this effort, they are helping the nation understand the magnitude of freight-related issues.

Trucks are the major conveyor of freight in Maryland. They are able to move goods using a designated system of roadways that are conducive to commercial vehicles and which link to multi-modal connections. MAP-21 established a national freight network and has begun requiring that other states measure their freight performance. This network was further refined by the Fixing America's Surface Transportation (FAST) Act. The FAST Act set forth a national highway freight network (NHFN) that consists of:

- The primary highway freight system (PHFS) – Interstates selected by FHWA as a primary freight network for the entire United States.
- Other interstates not on the PHFS – Non-PHFS Interstates are part of the NHFN even though they are not considered primary for freight.
- Critical urban freight corridors (CUFC) – 75 miles of metropolitan planning organization (MPO) designated urban roadways.
- Critical rural freight corridors (CRFC) – 150 miles of state designated roadways.

The CUFC was developed through a joint effort by MDOT SHA and the state's MPOs based on methodology from the Metropolitan Washington Council of Governments (MWCOG). Twenty-five miles of the CUFCs occur in both the MWCOG and the Baltimore Metropolitan Council MPO areas. The remaining miles are split between the five other MPOs in Maryland.

The CRFCs were selected based on criteria developed by MDOT SHA. These criteria considered FHWA guidance and additional freight data developed during the state freight planning process to identify the most critical corridors.

I-97 South of MD 3

The Maryland's Highway Freight Networks, which consist of the PHFS, Interstates, CUFCs and CRFCs, along with the freight planning network, was developed as required by MAP-21. The freight networks encompass roadways in Western Maryland, Central Maryland, Southern Maryland, and the Eastern Shore **(Figure 42)**. MDOT SHA is working with new data tools and regional stakeholders to identify options to increase required CUFC and CRFC mileage. This effort should be complete in 2023.

To improve awareness of freight performance on the Maryland Freight Network, MDOT SHA is engaged in freight planning, connected and automated vehicles, new analytic methods and data tools, emerging technology assessments, and improved safety.

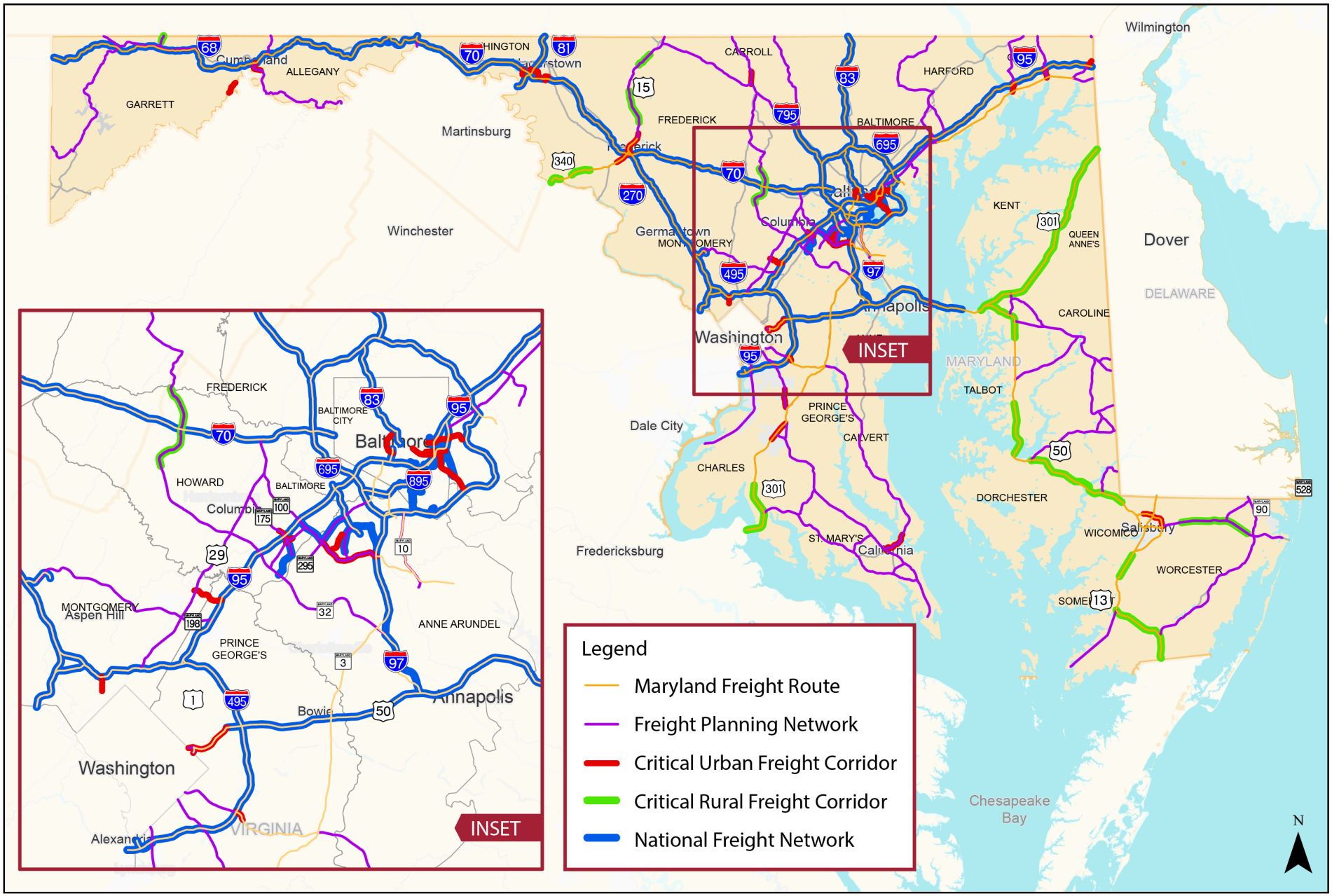
For example, the Maryland Roadway Performance Tool (MRPT) and Maryland truck parking tool visually engage stakeholders to demonstrate freight issues more effectively. This helps identify the type of bottleneck remediation to best support freight fluidity through capacity improvements or transportation management and operations (TSMO) solutions. Additionally, looking at data using new analytic and visual methods helps engage stakeholders on complex topics like truck parking to identify options for expansions or operational improvements.

MDOT SHA is working to improve safety through permitting resources and coordination with law enforcement to support safe truck movements. MDOT SHA is working on emerging technology and developing concepts of operations to support connected and automated vehicles through data platforms and information systems.

Maryland receives an apportionment of freight formula funds from FHWA that can support capital projects on the defined NHFN. The following are just some of the projects MDOT has completed to support freight on the NHFN using these federal funds.

- I-70 Bridges at I-81 and the Winchester and Western Railroad
- I-70 Bridges at Crystal Falls Dr
- I-70 Bridges at MD 65 and CSX Hagerstown Branch
- I-95/I-495 Bridge at Suitland Parkway
- I-95/I-495 Bridge at Suitland Road
- I-695 at I-70 Interchange reconstruct
- I-695 Bridge at Putty Hill Road
- US 40 Bridges at the Big Gunpowder and Little Gunpowder Rivers
- MD 32 – North of Linden Church Rd to I-70 dualization
- MD 150/MD 151 B – Sparrows Point Boulevard

Freight Network



MDOT uses the freight formula program and other resources to support various projects and planning efforts. Projects completed or underway in 2021 include:

- Developing a truck parking tool and Maryland roadway performance tool.
- Establishing a freight automated vehicle implementation plan.
- Developing a freight EV charging pilot.
- Initiating freight data sharing platforms and traveler information systems.
- Deploying innovative technology including Driveways geofencing application for commercial vehicle pre-clearance at truck weigh and inspection stations.

Ongoing planning efforts include:

- Implementing the Maryland Statewide Truck Parking Study, which evaluated existing parking demand, needs and gaps in the system, and linked challenges and opportunities, while also identifying funding and grant options for innovative areas such as public-private partnerships, electric vehicles and connected and automated vehicles.
- Developing an update of the Strategic Goods Movement Plan.
- Creating TSMO concept of operations for freight movement.
- Updating the Maryland Freight Story Map to provide a visual overview of the Strategic Goods Movement Plan.
- Using an advanced data viewer for planning purposes.
- Coordinating multimodal freight.
- Meeting and collaborating with the State Freight Advisory Committee.

US 1

TRANSPORTATION SYSTEMS
MANAGEMENT & OPERATIONS (TSMO)

Despite additional funding through the Infrastructure and Jobs Act, there is no way to meet all the needs on the roadway network. A different perspective has been developed on how to manage the existing system. This perspective is called Transportation Systems Management and Operations (TSMO). TSMO involves maximizing the full-service potential of the facility. To accomplish this, all aspects of a project from planning and engineering to operations and maintenance are aligned with the same goal—improving the reliability, safety, and security of the transportation system. MDOT SHA's TSMO program is managing a 'system of 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:

TSMO
MARYLAND TRANSPORTATION SYSTEMS MANAGEMENT & OPERATIONS

GOAL 1

BUSINESS PROCESSES & COLLABORATION

GOAL 3

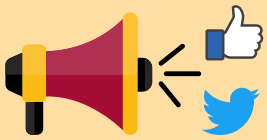
DATA ANALYSIS & PERFORMANCE MANAGEMENT

GOAL 2

SYSTEMS & TECHNOLOGY

GOAL 4

CUSTOMER EXPERIENCE & ENGAGEMENT



MDOT SHA uses various TSMO strategies to actively manage the multimodal transportation network, thereby achieving the program's goals. These strategies include:

Homeland Security Preparedness

Transit Priority/Integration

Connected and Automated Vehicle Technology

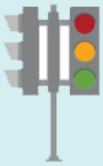
Work Zone Management

Emergency Response

Road Weather Management

Traffic Incident Management

Traffic Signal Coordination



Maintenance Fleet Management

Electronic Payment/ Toll Collection

Freeway/Arterial Management

Freight Management

The key to successfully implementing TSMO is through technology. To do this, we must meet customers' needs for real-time travel information and improve MDOT SHA's ability to react quickly to trends and travel-pattern changes. The data technologies 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

TSMO's goals are not just reviewing one corridor but to consider the entire system. MDOT SHA established and identified the following priorities to enhance the system using TSMO strategies:

- Improving coordination during incident management
- Decreasing incident duration and delay
- Allowing the 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 increasing safety for work zones and special events
- In 2021, various initiatives were undertaken, and several were completed. One major effort was the initiation of ramp metering on I-270. In addition to the development of these plans, other 2021 accomplishments include:

Developed training document for SOC to activate signal incident timing plans.

Deployed traffic detectors on Eastern Shore to offer more traffic monitoring and traveler information capabilities.

Geo-coded all traffic signals for better integration, search-ability, and visibility.

Completed TMC Signal Concept of Operations to integrate freeway and arterial management statewide.

Continued coordination/planning and preliminary design of TSMO System 1 (I-70/US 29/US 40/MD 144/MD 99).

Completed concept of operations for US 50 from the Bay Bridge to Ocean City.

Commenced work on the I-695 TSMO project.

MOBILITY ON DEMAND

The growth in the last ten years in mobility on demand services has been substantial. These services range from bicycles, electric bikes, and scooters to car and ride-share services. These services provide both challenges and opportunities for the transportation system. One challenge includes a rise in curbside demand, making it more difficult in urban areas for competing interests vying for the same space. Examples include transit vehicles, motorists parking, and mobility service providers dropping off and picking up customers. These services do create an opportunity by helping provide transportation equity. In Maryland, the following services exist:

- Uber – Ride sharing service throughout most of Maryland
- Lyft – Ride sharing service throughout most of Maryland
- Zipcar – Ride sharing vehicles throughout the Baltimore-Washington area
- Lime – Scooters, Bikes, and Mopeds in Baltimore City, Prince George's County, and Montgomery County, including Silver Spring
- Bird – Scooters in Salisbury and Montgomery County
- Jump – Electronic bikes and scooters in Baltimore City
- Spin – Electronic scooters and bikes in Howard County, Montgomery County, and Baltimore City
- Capital Bikeshare – Electronic bikes and scooters in Montgomery and Prince George's Counties

Uber/Lyft Vehicle

Capital Bikeshare US 29

This page left intentionally blank.

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

WES MOORE
Governor

ARUNA MILLER
Lt. Governor

PAUL J. WIEDEFELD
MDOT Secretary

TIM SMITH, P.E.
MDOT SHA Administrator

FOR FURTHER INFORMATION, PLEASE CONTACT:

ERIC BECKETT
DEPUTY DIRECTOR
Office of Planning
& Preliminary Engineering
707 N. Calvert Street
Baltimore, MD 21202
ebeckett@mdot.maryland.gov

LISA SHEMER, P.E.
DEPUTY DIRECTOR
Office of Planning & Preliminary Engineering
Travel Forecasting & Analysis Division
707 N. Calvert Street
Baltimore, MD 21202
lshemer@mdot.maryland.gov

800-323-MSHA
TTY 800-735-2258

roads.maryland.gov

This document is available in
alternative formats upon request.