MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

MARYLAND STATE HIGHWAY MOBILITY REPORT 2023

2023

MARYLAND STATE HIGHWAY MOBILITY REPORT

Twelfth Edition

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EXECUTIVE **SUMMARY**

Since the end of the pandemic, federal and state agencies have been working to define what the new normal is for transportation and what it will look like moving forward. Traffic volumes have grown substantially since 2020 but have not returned to 2019 levels. Different travel patterns have developed with more people working from home which has caused a lower percentage of motorists to travel in the morning peak period and an increase in vacant parking spots at MDOT's park and ride lots.

The Maryland State Highway Administration (SHA) understands these trends will require adjustments to be made to projects, programs, and policies to better meet the future needs of its citizens and the traveling public. To achieve this goal, 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 organizational excellence. The 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 equitable and sustainable transportation system.

The 2023 Maryland Mobility Report summarizes our performance, successes, opportunities, and future strategies based on the data collected and events that transpired over the 2022 calendar year.

HIGHLIGHTS		
2022 METRIC	**2021**	**2019**
Traffic volumes at 56.8 billion VMT	56.6	60.1
5 interstates carry over 200,000 vehicles per day	5	5
Total mileage on freeway system experiencing heavy to severe congestion: 118 miles AM/232 miles PM peak hour	51 miles AM 164 miles PM	177 miles AM 286 miles PM
Statewide congestion costs were $5.29 billion	$4.48 billion	$4.96 billion
76,000 responses to incidents and stranded motorists	66,000 responses	71,000 responses
7 miles of new sidewalks located in 13 Counties	8 miles of sidewalk	7 miles of sidewalk
11 capacity improvement projects competed	12 capacity improvements	11 capacity improvements
15 corridor signal system retimed	7 systems retimed	19 systems retimed

CONGESTION AND RELIABILITY TRENDS

As congestion increases in Maryland, the challenge of effectively moving people and goods throughout the state becomes more difficult. To address this challenge, it is important to first understand Maryland's congestion trends and how they affect travelers and freight movement in terms of cost, time, and efficiency. This includes both recurring congestion along over-capacity roadway sections and non-recurring congestion due to incidents or events. The following summarizes the mobility and reliability trends on the Maryland highway system in 2022.

Vehicle Miles Traveled (VMT)[1]:

- The VMT along Maryland roadways increased by 0.3% to 56.8 billion in 2022 from 56.6 billion in 2021. The added mileage occurred in urban areas while rural areas saw a small decrease in VMT.
- Approximately 71% of statewide vehicular travel occurred on MDOT roadways. This percentage stayed the same from 2021.
- Countywide VMT varied with nine Counties and Baltimore City showing an increase while the remaining 14 counties stayed approximately the same or decreased. The greatest increases occurred in Montgomery, Prince George's, and Baltimore Counties, each growing by over 45 billion VMT. Decreases in St. Mary's and Queen Anne's Counties amounted to over 20 billion in both counties which were the most statewide.

Annual Average Daily Traffic (AADT)[2]:

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

RANGE OF HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) FREEWAY/EXPRESSWAY SECTIONS		
ROUTE	LIMITS	2022 AADT RANGE (THOUSANDS)
I-495	Virginia State Line to MD 190	207-234
I-495	I-270 East Leg to I-95	191-234
I-270	I-270 Split to I-370	186-219
I-95/I-495	Ritchie Marlboro Rd to I-95/495 Split	192-217
I-695	MD 122 to I-83 North	163-215

RANGE OF HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) ARTERIAL SECTIONS		
ROUTE	LIMITS	2022 AADT RANGE(THOUSANDS)
US 301	MD 5 (Mattawoman-Beantown Rd) to US 301/MD 5 Split	100
MD 3	US 50 to I-97	69-79
MD 185	MD 410 to I-495	75
MD 650	Adelphia Rd to I-495	70
US 29	I-495 to MD 650	69

1 - See definition pg. 14
2 - See definition pg. 13

FREEWAYS

The worst levels of congestion (heavy and severe) occurred for 7% (118 miles) of the freeway/expressway system in the AM peak hour. This was an increase from approximately 3% (51 miles) in 2021. The percentage of freeway/expressway miles that motorists experienced heavy to severe congestion in the PM peak hour increased from 10% (164 miles) to 14% (232 miles) in 2022. The locations with higher volumes and greater VMT on the freeway/expressway system experienced greater congestion. In 2022, 15% of the AM peak hour and 26% of the PM peak hour statewide VMT occurred in congested conditions. These values were 6% and 19% in the AM and PM peak hours, respectively, in 2021.

MAJOR ARTERIALS

Motorists experienced heavy to severe congestion in the AM peak hour along 20% (104 miles) of major arterial roadways in 2022 compared to 10% (57 miles) in 2021. The percentage of major arterial miles that drivers experienced heavy to severe congestion in the PM peak hour increased from 34% (203 miles) to 44% (230 miles) of the major arterial system in 2022.

COST OF CONGESTION

The statewide cost of congestion along all roadways is estimated to be $5.29 billion which is an increase of $0.81 billion or 18% over 2021. This cost includes delays experienced by motorists and truck drivers and wasted fuel. The majority of the cost associated with congestion occurs by drivers along arterial roadways, amounting to approximately 77% of the total.

INTERSECTIONS

Intersection analysis of locations where traffic counts have been conducted in the last four years determined that 19 state highway intersections operated at a failing level of service (LOS F)[3], including three intersections that failed during both the AM and PM peak hours. On a summer weekend, there are two additional failing intersections located on the Eastern Shore.

MOST CONGESTED LOCATIONS

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

2022 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS (AVERAGE WEEKDAY)[4]	
AM PEAK HOUR (8-9 AM)	PM PEAK HOUR (5-6 PM)
I-495 Outer Loop – I-95 to US 29	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-270 West Spur Southbound – I-270 Split to I-495	MD 295 Southbound – MD 175 to MD 198
US 50 Westbound – MD 410 to MD 295	I-695 Inner Loop – US 1 to MD 144
I-95/I-495 Local Inner Loop – MD 414 to I-295	I-495 Inner Loop – Virginia Line to I-270 West Spur
I-695 Inner Loop – MD 129 to I-83 South	MD 295 Northbound – MD 450 to I-95/I-495
I-695 Outer Loop – I-795 to I-70	I-95/I-495 Inner Loop – I-95 to MD 201
I-270 Southbound – Father Hurley Blvd to MD 124	MD 295 Northbound – MD 193 to MD 197
I-495 Outer Loop – MD 187 to MD 190	I-95/I-495 Outer Loop – MD 450 to MD 201
MD 295 Southbound – MD 198 to MD 197	I-270 Northbound – MD 117 to Middlebrook Rd

3 - See definition pg. 48

2022 MOST CONGESTED ARTERIAL SECTIONS (AVERAGE WEEKDAY)[4]	
AM PEAK HOUR (8-9 AM)	PM PEAK HOUR (5-6 PM)
US 29 Southbound – MD 650 to Franklin Ave	US 301 Southbound – MD 381 to McKendree Road/ Cedarville Road
MD 185 Southbound – I-495 to MD 191	MD 3 Northbound – MD 450 to MD 424
MD 28 Southbound – MD 97 to Baltimore Rd	MD 210 Southbound – Livingston Rd (North) to Palmer Rd
MD 97 Southbound – Forest Glen Rd to 16th St/MD 390	MD 3 Southbound – MD 32 to St Stephen's Church Rd
MD 355 Southbound – Cedar Ln to MD 191	MD 2 Northbound – College Pkwy to Robinson Rd
MD 189 Southbound – Wootton Parkway to Glen Road	MD 5 Southbound – MD 223 to Burch Hill Rd
MD 210 Northbound – East Swan Creek Rd to Palmer Rd	MD 355 Northbound – MD 191 to Cedar Lane
MD 187 Southbound – I-270 East Spur to Oakmont Ave	MD 185 Northbound – Washington D.C. Line to Jones Bridge Road
MD 3 Southbound – I-97 to Waugh Chapel Rd	MD 45 Southbound – Ridgely Rd to Allegheny Ave
MD 2 Southbound – Whites Rd to College Pkwy	MD 28 Eastbound – MD 586 to Bel Pre Rd

4 - See mapping pg. 25, 27, 29 and 31 for locations

Traffic congestion varies by season. Several locations in the summer experience congested conditions that normally operate at an acceptable level, such as the I-95 northeast corridor, US 50/301 on the Eastern Shore, and I-70 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 some of the most congested freeway or arterial sections:

- US 50/US 301 Eastbound – MD 179 to Chesapeake Bay Bridge
- US 50/ US 301 Westbound – Chester Station Lane to Chesapeake Bay Bridge
- I-95 Southbound – MD 22 to MD 24
- I-95 Northbound – MD 152 to MD 24
- US 50 Eastbound – MD 589 to MD 528
- I-70 Westbound – MD 144 to US 15/US 340

CONGESTION REDUCTION ACCOMPLISHMENTS

SHA has advanced numerous projects, established policies, and administered programs to tackle congestion and improve mobility and reliability. The benefits of these actions include additional facilities for pedestrians and bicyclists, delay reductions and improved travel time, safety improvements, decreased fuel consumption, and decreased emissions to all multi-modal system users. The combined efforts resulted in almost $5 billion in estimated annual user savings.

CHART

The Coordinated Highways Action Response Team (CHART) program cleared almost 39,000 incidents and assisted more than 37,000 stranded motorists on Maryland roadways.

SIGNAL SYSTEMS

Traffic signal timings were reviewed for 15 systems consisting of 79 signals to improve mobility. The re-timing of these signals resulted in more than $30 million in annual user savings and will continue to provide recurring benefits for years. A new adaptive signal system that allows for real-time adjustments to signal timings was implemented along MD 45 in Timonium.

CAPITAL PROJECTS

The following capital projects were completed in 2022:

- Major projects included the dualization of the US 301 Nice/Middleton Bridge and the I-270 Innovative Congestion Management project.
- SHA completed three intersection improvements including MD 30 and Mt. Gilead Road, MD 147 at Joppa Road, and MD 190 at Braeburn Parkway.
- Roadway widening projects to improve mobility were MD 424 from Duke of Kent Drive to MD 450, MD 32 from Linden Church Road to I-70, and MD 376 from US 113 to Flower Street
- A new interchange project was constructed at MD 210 and Livingston Road/Kerby Hill Road.
- Modifications to interchanges occurred at I-83/Padonia Road and I-270/MD 85.

These projects resulted in $4.8 billion in annual user savings.

2022 ANNUAL USER SAVINGS DUE TO MDOT CONGESTION MANAGEMENT	
CHART	$2,030 million
Traffic Signal Timing Reviews[1]	$30 million
Capital Projects[1]	$2,734 million
Park and Ride Program[2]	$32 million
TOTAL	**$4,826 million**

[1]**- Projects completed in 2022**
[2]**- All park and ride facilities**

MAJOR MOBILITY IMPROVEMENT PROJECTS UNDER CONSTRUCTION OR RECENTLY COMPLETED
I-695 TSMO Widening
I-95 Express Toll Lanes from MD 43 to North of MD 24
MD 97 Brookeville Bypass
MD 175 from Sellner Road to McCarron Court Widening

IMPROVED MOBILITY ACCOMPLISHMENTS

- SHA's emphasis on the most vulnerable users is shown through the number of new and reconstructed sidewalks, paths, and on-road bike facilities constructed in 2022. These projects were constructed either as part of other roadway improvements or as stand-alone projects. This included more than 7 miles of new sidewalks and 5 miles of reconstructed sidewalks in 13 counties. Statewide, marked bike facilities increased by approximately 15 directional miles through SHA efforts.
- Approximately 71% of all sidewalks are ADA-compliant.
- Commuter parking at the 112 SHA and MDTA park and ride lots remains substantially below pre-COVID volumes. Approximately 2,800 commuters on an average weekday in 21 Counties use SHA or MDTA lots to connect to transit or ride with other commuters. These commuter connections provide an annual user savings of approximately $31 million.
- The I-95 express toll lanes average more than 25,500 vehicles per day, with as many as 3,000 motorists using them in one hour. This increased by over 3,500 vehicles per day in 2021. The Intercounty Connector (MD 200) Managed Facility AADT between I-370 and I-95 averages approximately 53,600 vehicles per day, which is 4,000 vehicles higher than in 2021.

FREIGHT MOVEMENT

- Virtual weigh stations (VWS) were commissioned at two locations along MD 213 in Galena bringing the statewide total to 18 operational sites. Two additional VMS at the US 301 Nice/Middleton Bridge are ready to become active.
- The National Highway Freight Network through the FAST-ACT Freight Formula Fund allows for support for the reconstruction of crucial locations along designated truck routes. Bridge reconstruction is a major emphasis on the use of these funds including ongoing projects at I-70 at MD 65/CSX Hagerstown Branch, I-695 at Putty Hill Road, I-95/I-495 at MD 4, and I-70 over Crystal Fall Drive.
- Two at-grade railroad crossings were modified to improve safety in Carroll County along MD 27/Main Street and MD 75 in Union Bridge. In addition, the Maryland Operation Lifesaver Program was reestablished to focus on rail safety education.

TRANSPORTATION SYSTEMS MANAGEMENT & OPERATIONS (TSMO)

- Initiated the development of incident timing plans for six systems in TSMO System 1 (I-70, US 29, US 40, MD 144, and MD 99).
- Installed CCTV, dynamic message signs, and dedicated short-range communication along the US 1 Innovative Technology corridor.
- Began signal upgrades and deploying ATMS along US 50 from the Chesapeake Bay Bridge to Ocean City.

MARYLAND
MOBILITY STATISTICS

I-695 at I-83

INTRODUCTION

As Maryland aims to improve transportation equity, it is vital to provide mobility and access to jobs, goods, and services. This undertaking includes providing new choices and evaluating existing facilities. The Maryland Department of Transportation State Highway Administration (SHA) conducts a comprehensive review of performance to determine mobility trends and how programs are working.

The 2023 Maryland Mobility Report summarizes results and accomplishments during the 2022 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 SHA Doing?**
- **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

Among the major highlights of the 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 2022 and their benefits
- Past projects and the benefits they provide
- Programs to address mobility and their results
- Transportation Systems Management and Operations (TSMO) activities

The Maryland Mobility Report is a yearly product of the SHA's Office of Planning and Preliminary Engineering (SHA OPPE) with support from numerous other SHA offices and other Maryland Department of Transportation and county agencies.

TRANSPORTATION **INFRASTRUCTURE**

In Maryland, there are a multitude of transportation options. Whether it is by rail, bus, bike, walking, airplane, ship, or roadway, residents and visitors can travel from the Atlantic Ocean to the Appalachian Mountains, in a manner of hours. This network exists not only for the movement of people but also to provide access to goods and services, which is vital to the economy. The multi-modal infrastructure network that supports safe and effective access and mobility for all types of statewide transportation includes:

- Rail service is provided through subways, commuter rail, light rail, heavy rail, and buses. Passenger services are operated by the Maryland Transit Administration (MTA), the Washington Metropolitan Area Transit Authority (WMATA), and local transit operators. Regional train service is provided by Amtrak in the Northeast Corridor. The commuter MARC system provides service along the Brunswick, Penn, and Camden lines from Aberdeen to Baltimore, Washington, and Frederick. Buses are operated by MTA, WMATA, and local transit operators.
- Pedestrian and bicycle facilities are provided through sidewalks, on-street bike lanes, and off-road trails, including major trails such as: the Indian Head Rail Trail, the Torrey C Brown Rail Trail, the Three Notch Trail, and the Baltimore and Annapolis (B&A) Trail.
- Air travel has continued to increase to near pre-COVID levels led by the state's flagship location at Baltimore-Washington Thurgood Marshall International Airport (BWI). In 2022, there were 22.8 million passenger arrivals and departures, a 21% increase over 2021. In addition, there were over 566 million pounds of cargo transported.
- Major water cargo activity is overseen at the Helen Delich Bentley Port of Baltimore. This amounts to more than 43.3 million tons of cargo including $74.3 billion of foreign cargo.
- Roadways account for approximately 31,700 miles of Maryland's surface transportation infrastructure.

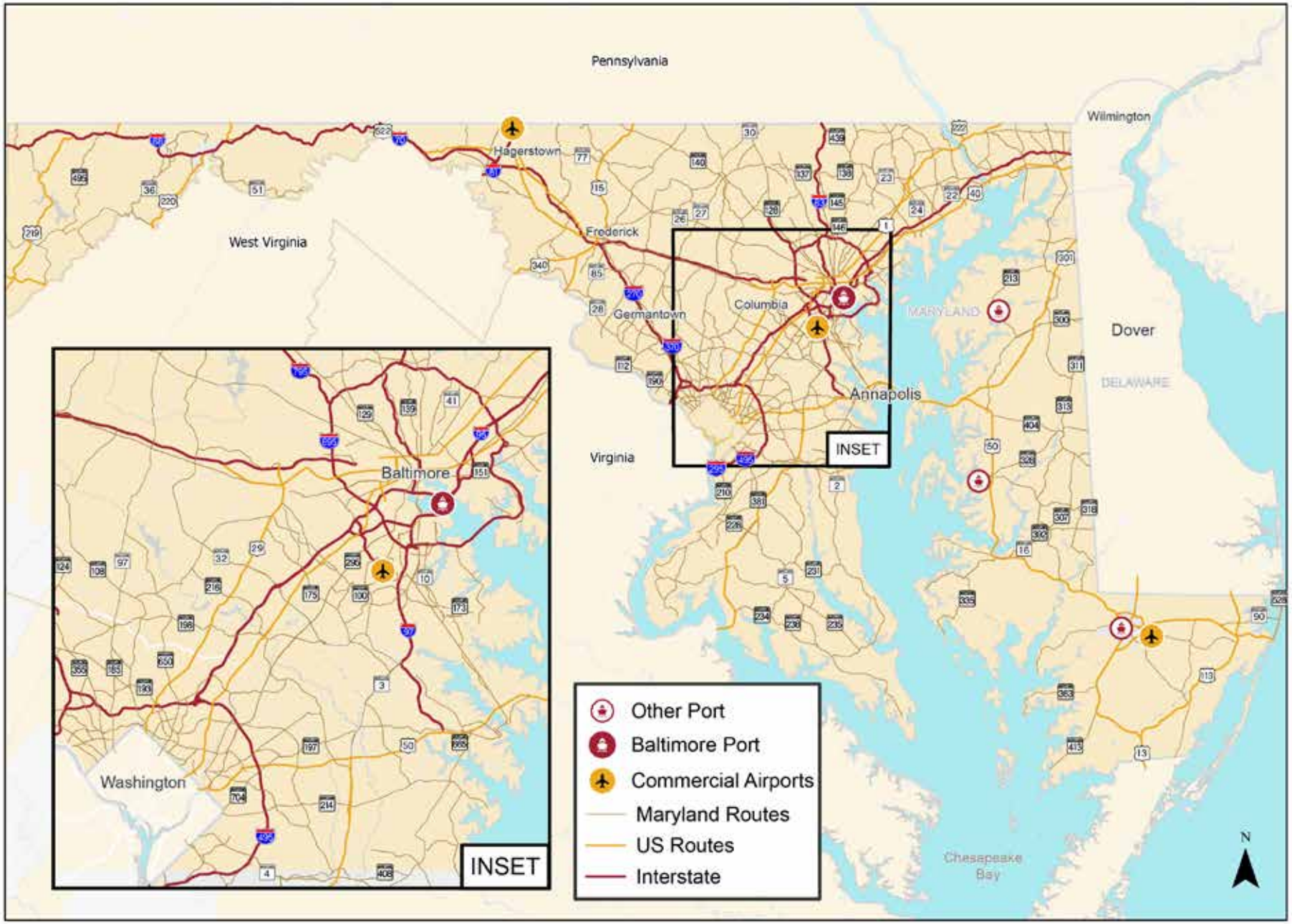
ROADWAYS

The backbone of travel in Maryland is through its system of roadways. These range from two-lane low-volume residential streets to high-volume 12-lane freeways. MDOT operates the state's major roadway facilities. SHA maintains interstates, US routes, and numbered Maryland routes, except 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 as a connection to adjacent land uses and traffic circulation.
Locals	Provide direct access to adjacent land use and does not carry through traffic.

Figure 1 - Maryland Statewide Infrastructure



The majority of Interstate, US, and Maryland routes are operated and maintained by MDOT. 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.

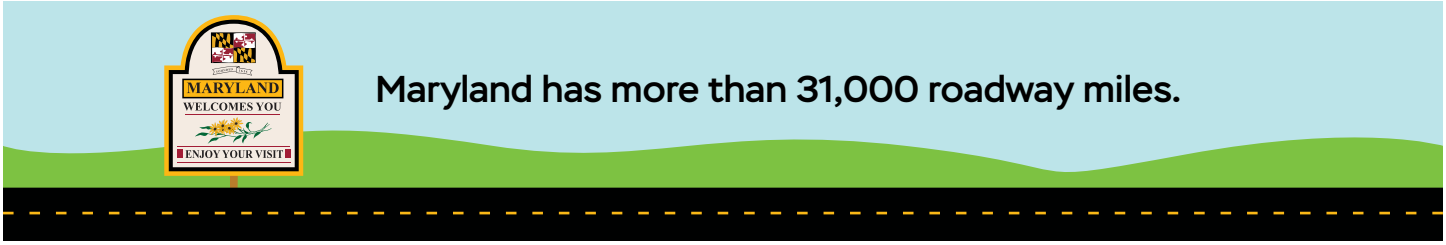
Table 2

MILEAGE STATISTICS					
ROAD TYPE	ROADWAY MILES	PERCENTAGE OF ROADWAY MILES	MAINLINE LANE MILES[1]	AVERAGE NUMBER OF LANES/MILE	OWNERSHIP
Interstate Routes	486	2%	2,846	5.9	SHA, MDTA, Baltimore City
US Routes	760	2%	2,711	3.6	SHA, MDTA, Baltimore City
Maryland Routes	4,236	13%	10,683	2.5	SHA, MDTA, Baltimore City
Other Roadways	26,064	83%	53,292	2.0	Counties, Municipalities

1 - Mainline Lane Miles = Roadway Miles x Number of Lanes

Note: Does not include ramp and service road mileage

I-495 east of US 29



MAJOR STRUCTURES – BRIDGES AND TUNNELS

There are several significant bridges and tunnels in Maryland. These structures are very recognizable to the public, from passing over the William Preston Lane Memorial Bridge (Bay Bridge) on their way to and from the Eastern Shore and the Atlantic Ocean to crossing the American Legion or Woodrow Wilson Bridge into Virginia around Washington D.C. In 2022, a new major structure was completed with the opening of the four-lane Harry W. Nice Memorial/Senator Thomas "Mac" Middleton Bridge (Nice/Middleton Bridge) over the Potomac River between Charles County and Virginia. Maryland has constructed more than 5,000 bridges over waterways, roads, and railroads; most are owned by MDOT SHA (**Table 3 and Figure 2**). There are also two tunnels in Maryland operated by MDTA. 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 operates parallel to the Fort McHenry Tunnel.

MARYLAND'S SIGNATURE BRIDGES AND TUNNELS

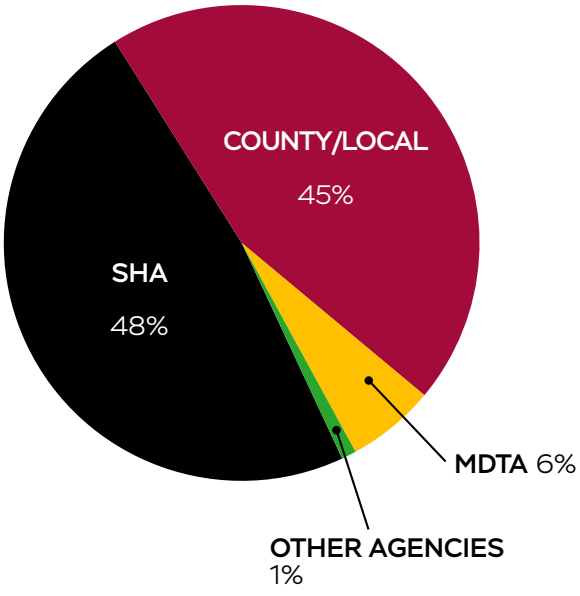
- American Legion Bridge (I-495)
- Fort McHenry Tunnel (I-95)
- Harbor Tunnel (I-895)
- Nice/Middleton Bridge (US 301)
- Hatem Bridge (US 40)
- Key Bridge (MD 695)
- Thomas Johnson Memorial Bridge (MD 4)
- Tydings Memorial Bridge (I-95)
- William Preston Lane Memorial (Bay) Bridge (US 50/301)
- Woodrow Wilson Memorial Bridge (I-95/I-495)

Table 3

MARYLAND BRIDGES BY OWNERSHIP	
OWNER	NUMBER OF BRIDGES
SHA	2,565
County/Local	2,416
MDTA	358
Other Agencies (Federal, Railroad, Other State Agencies)	26
TOTAL	**5,365**

Figure 2

BRIDGE OWNERSHIP BY AGENCY



TRAFFIC VOLUMES-ANNUAL AVERAGE DAILY TRAFFIC (AADT)

Traffic volumes vary on roadways ranging from a few hundred vehicles to over 225,000 vehicles per day. Maryland SHA determines traffic volume through a robust traffic data collection program. SHA uses equipment and personnel to collect data on numerous sections of roadway. Annual average daily traffic measures the volume of traffic for the year, divided by the number of days in a year. The highest sections occur along freeways in Montgomery and Prince George's Counties (**Table 4**).

Table 4

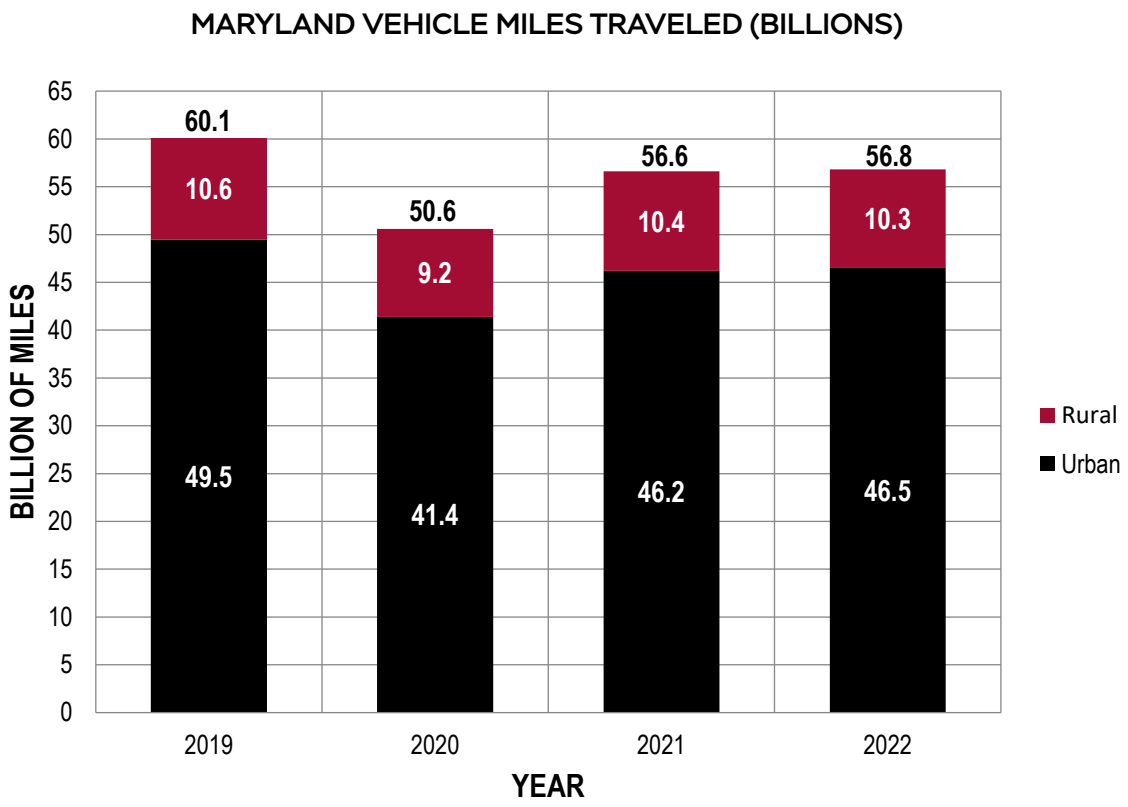
HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) VOLUMES (VEHICLES PER DAY)	
FREEWAY SECTION	**2022 AADT**
I-495 N of MD 190	234,300
I-495 W of MD 650	233,800
I-95/I-495 at Virginia State Line (American Legion Bridge)	227,500
I-495 at Virginia State Line (Wilson Bridge)	223,300
I-270 S of MD 200	218,700
ARTERIAL SECTION	**2022 AADT**
US 301 N of Charles County Line	100,400
MD 5 S of MD 223	81,200
MD 3 N of MD 450 South	79,100
MD 3 N of MD 450 North	75,400
MD 185 S of I-495	74,500
MDTA TOLL FACILITY CROSSINGS	**2022 AADT**
I-95 Ft. McHenry Tunnel	118,300
I-95 Tydings Bridge	86,400
I-895 Harbor Tunnel	77,000
US 50/US 301 Bay Bridge	72,600

VEHICLE MILES TRAVELED – TOTAL/URBAN/RURAL

Normally, when the economy is headed into a recession or while already in one, travel along roadways will decrease. Whereas increases in economic activity and prosperity correlate with increases in roadway travel. SHA monitors traffic volumes using counts and other sources to identify annual variations in travel, which can be used to confirm or deny this general relationship between roadway travel and economic activity. One of the best metrics for assessing this relationship is 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 the roadway. The state calculates VMT on local, state, US, and interstate roadways. The measurement of VMT is an effective method for tracking the growth and demands of the roadway network.

In Maryland for 2022, VMT remained flat in comparison to 2021. Travel in urban areas increased slightly while rural area travel was slightly lower (**Figure 3**). VMT remains below pre-Covid levels.

Figure 3



VEHICLE MILES TRAVELED - BY AGENCY OWNERSHIP AND FACILITY TYPE

Motorists use all types of roadways to facilitate travel in Maryland. These are owned and operated by different agencies; however the most used roadways are operated by the SHA and MDTA. These roadways account for 71% of VMT, despite SHA and MDTA facilities only accounting for 17% of roadway miles (**Table 5 and Figure 4**). The highest amount of VMT occurs on Maryland routes, with almost eighteen billion miles. This total is closely followed by Interstate highway travel with approximately one billion fewer miles (**Table 6 and Figure 5**). The percentages have stayed the same from 2021 to 2022 for VMT by agency and roadway classification.

Table 5

2022 VMT BY AGENCY	
AGENCY	VMT (BILLIONS)
SHA	37.12
County/Local/Others	16.27
MDTA	3.39

Figure 4

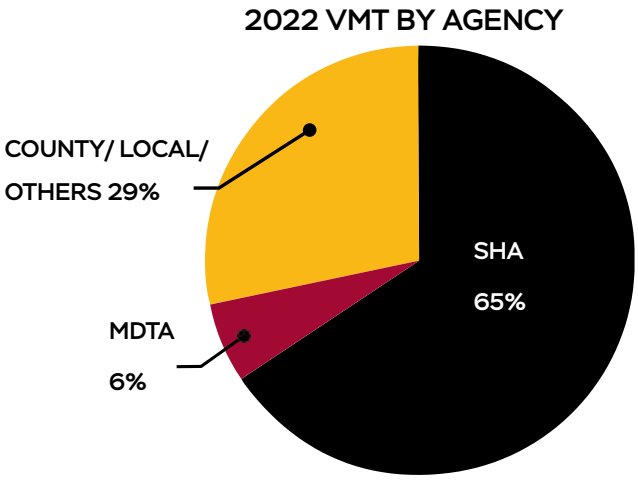
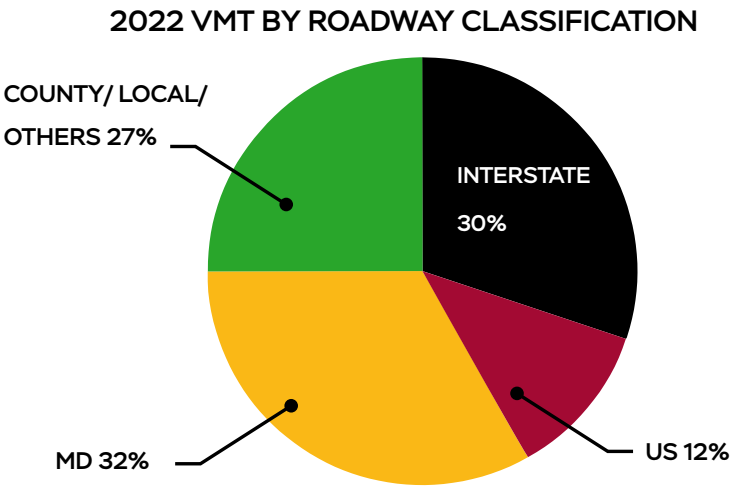


Table 6

2022 VMT BY ROADWAY CLASSIFICATION	
ROADWAY DESIGNATION	VMT (BILLIONS)
Maryland Routes	17.97
Interstate Routes	16.79
County/Local/Others	15.27
US Routes	6.76

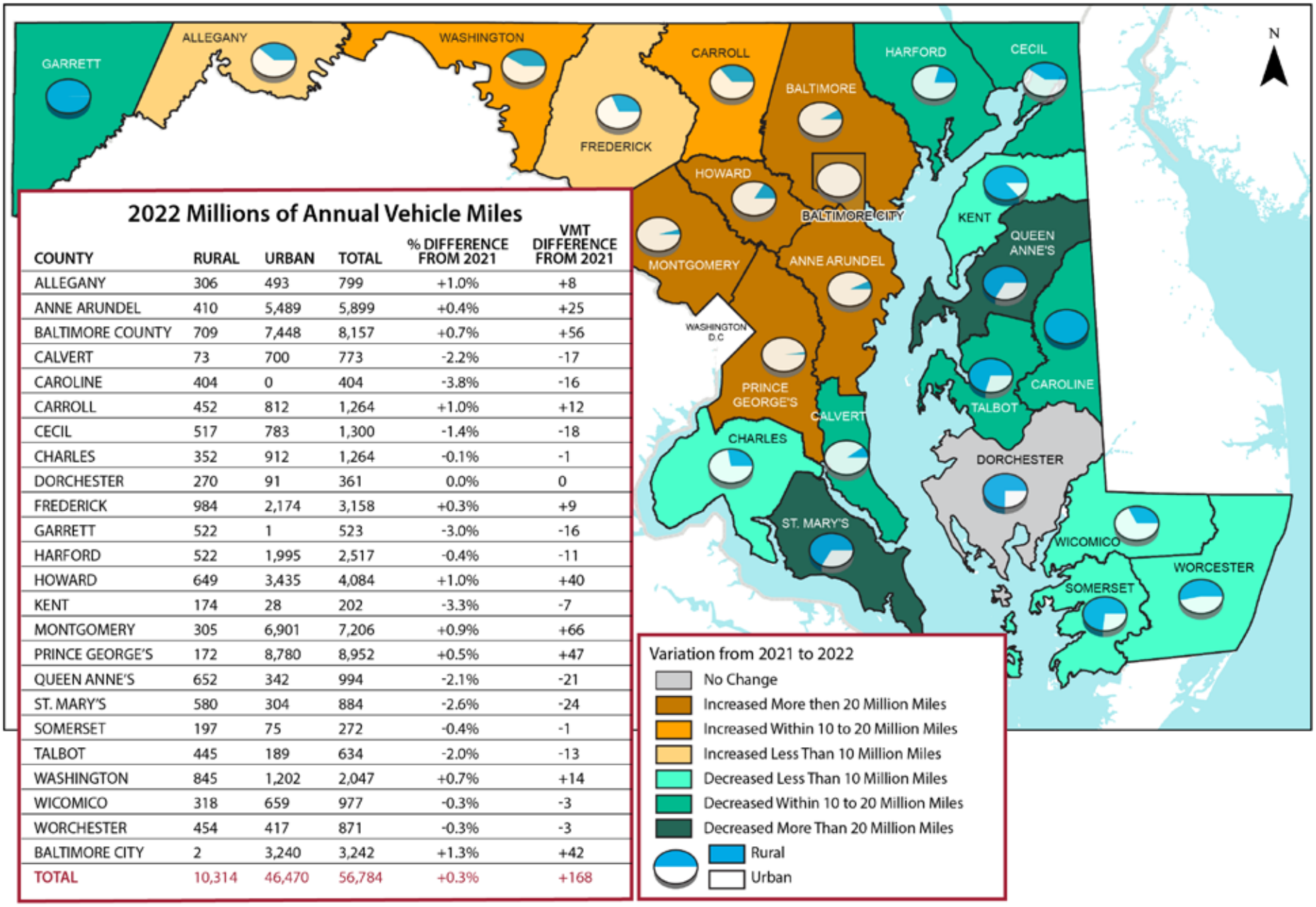
Figure 5



VEHICLE MILES TRAVELED – BY COUNTY

It was an even split between counties increasing and decreasing in VMT between 2021 and 2022. The biggest mileage increases occurred in the urban areas of Montgomery and Baltimore County while St Mary's and Queen Annes Counties had the largest decreases in VMT. Percentage-wise, Baltimore City, Allegany, Carroll, and Howard Counties saw a 1% or greater increase while Caroline, Kent, and Queen Anne's Counties had the highest decreases (**Figure 6**).

Figure 6 – Vehicle Miles of Travel by County



2022 Millions of Annual Vehicle Miles

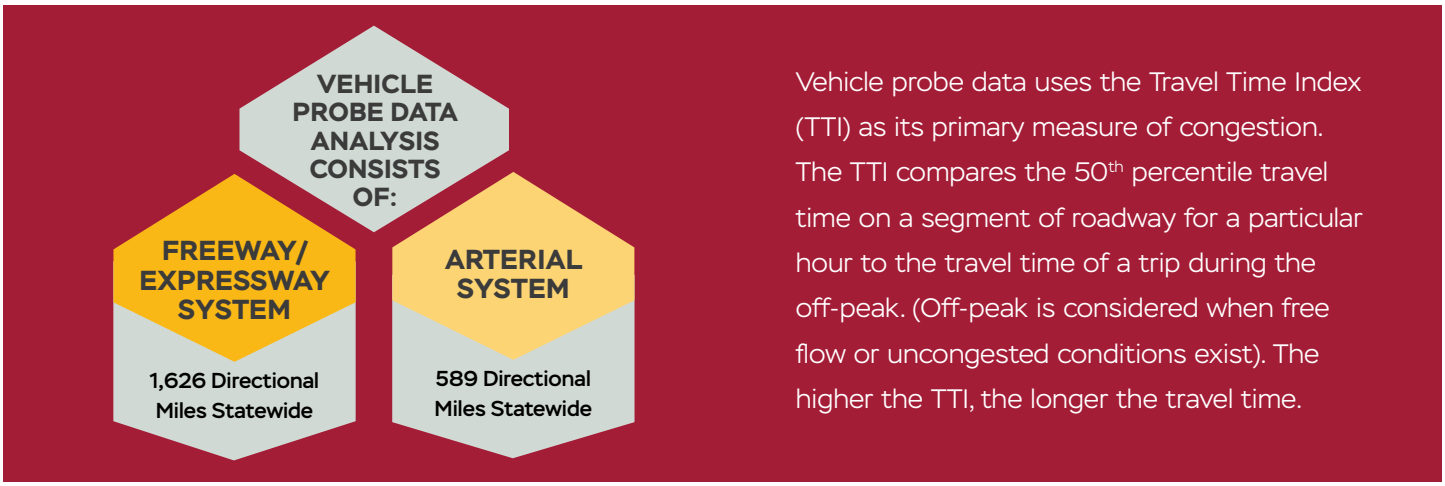
COUNTY	RURAL	URBAN	TOTAL	% DIFFERENCE FROM 2021	VMT DIFFERENCE FROM 2021
ALLEGANY	306	493	799	+1.0%	+8
ANNE ARUNDEL	410	5,489	5,899	+0.4%	+25
BALTIMORE COUNTY	709	7,448	8,157	+0.7%	+56
CALVERT	73	700	773	-2.2%	-17
CAROLINE	404	0	404	-3.8%	-16
CARROLL	452	812	1,264	+1.0%	+12
CECIL	517	783	1,300	-1.4%	-18
CHARLES	352	912	1,264	-0.1%	-1
DORCHESTER	270	91	361	0.0%	0
FREDERICK	984	2,174	3,158	+0.3%	+9
GARRETT	522	1	523	-3.0%	-16
HARFORD	522	1,995	2,517	-0.4%	-11
HOWARD	649	3,435	4,084	+1.0%	+40
KENT	174	28	202	-3.3%	-7
MONTGOMERY	305	6,901	7,206	+0.9%	+66
PRINCE GEORGE'S	172	8,780	8,952	+0.5%	+47
QUEEN ANNE'S	652	342	994	-2.1%	-21
ST. MARY'S	580	304	884	-2.6%	-24
SOMERSET	197	75	272	-0.4%	-1
TALBOT	445	189	634	-2.0%	-13
WASHINGTON	845	1,202	2,047	+0.7%	+14
WICOMICO	318	659	977	-0.3%	-3
WORCHESTER	454	417	871	-0.3%	-3
BALTIMORE CITY	2	3,240	3,242	+1.3%	+42
TOTAL	10,314	46,470	56,784	+0.3%	+168

CONGESTION **TRENDS**

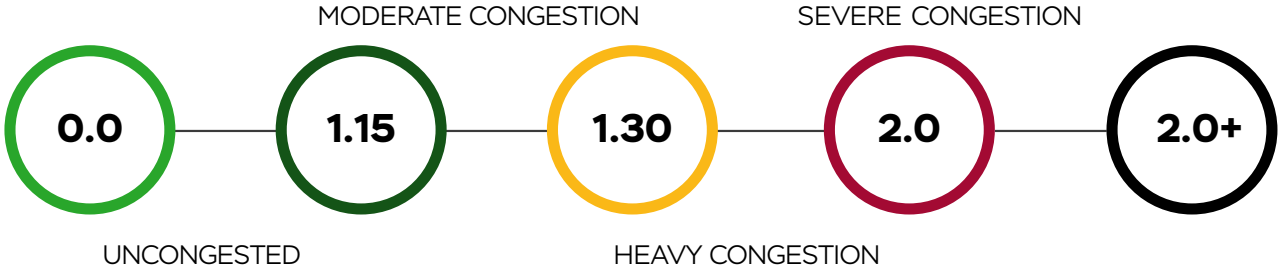
There are two distinct types of congestion. Recurring congestion is the normal traffic congestion that occurs every day, especially during the AM and PM peak periods. Certain locations experience recurring congestion but are limited to other periods such as Fridays, Saturdays, and Sundays during the summer when motorists either traveling to the Atlantic Ocean or returning encounter delays. This type of congestion is influenced by high automobile and truck 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. The second type of congestion is referred to as non-recurring congestion. The sources of congestion include crashes, vehicle breakdowns, work zones, major sporting events or other unique occurrence, and inclement weather which can cause motorists to experience slowing or stop-and-go traffic conditions.

There are multiple methods of measuring traffic operations or congestion. One method of measurement 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 SHA by INRIX, a company that collects traffic speed data from an estimated one hundred 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 7**). In addition, to probe data other theoretical methods exist such as the Highway Capacity Manual analysis.

Figure 7



MEASUREMENT OF CONGESTION WITH THE TRAVEL TIME INDEX



CONGESTION MEASURES

The changes in the levels of congestion statewide are compared annually through a set of metrics. These metrics include 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**). In addition, 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 the number of motorists that experienced these conditions, along with the distance they traveled during the peak hour. All metrics show that the levels of congestion have increased in 2022.

Table 7

STATEWIDE FREEWAY/EXPRESSWAY SYSTEM (AVERAGE WEEKDAY AM/PM PEAK HOUR HEAVY TO SEVERE CONGESTION SUMMARY)								
HEAVY TO SEVERE CONGESTION	2020		2021		2022		CHANGE FROM 2021 TO 2022	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Roadway Miles	12	34	51	164	118	232	+67	+68
Percent of Roadway Miles	1	2	3	10	7	14	+4	+4
Percent of Peak Hour VMT Impacted	2	4	6	19	15	26	+9	+7

Table 8

STATEWIDE MAJOR ARTERIAL SYSTEM (AVERAGE WEEKDAY AM/PM PEAK HOUR HEAVY TO SEVERE CONGESTION SUMMARY)								
HEAVY TO SEVERE CONGESTION	2020		2021		2022		CHANGE FROM 2021 TO 2022	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Roadway Miles	8	89	57	203	104	230	+47	+27
Percent of Roadway Miles	1	15	10	34	17	39	+7	+5

The average weekday AM and PM peak hour TTI results were developed into congestion maps. In addition to AM and PM peak hour analysis, Maryland has certain areas that experienced much greater congestion on summer weekends. Therefore, as a result, congestion trend maps were also developed for the 4-5 PM Friday, 1-2 PM Saturday, and 2-3 PM Sunday hours. The congestion trend maps are outlined in the following figures:

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

Figure 8 – Maryland Congestion Map: 2022 AM Peak Hour (8-9) AM

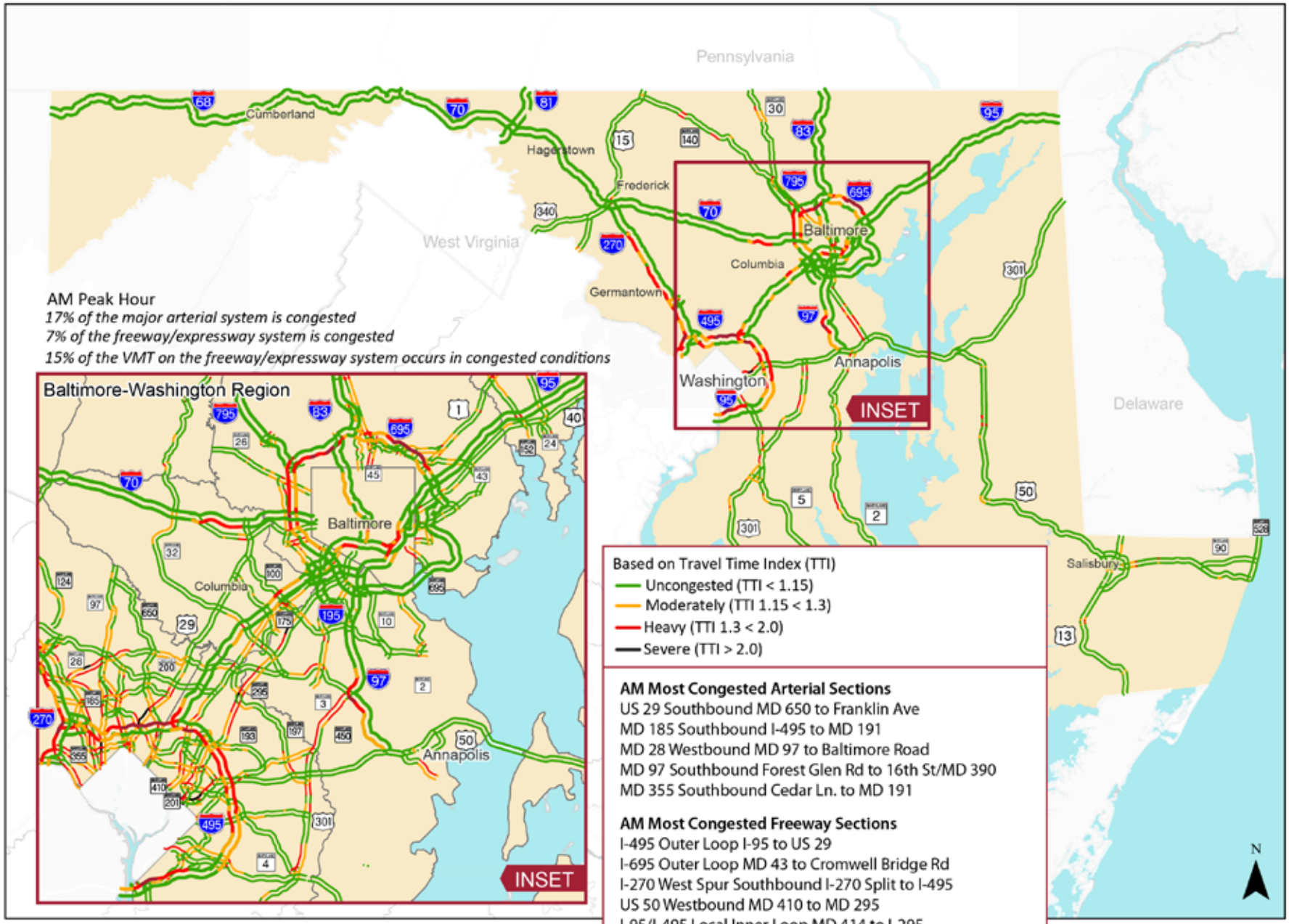


Figure 9 - Maryland Congestion Map: 2022 PM Peak Hour (5-6) PM

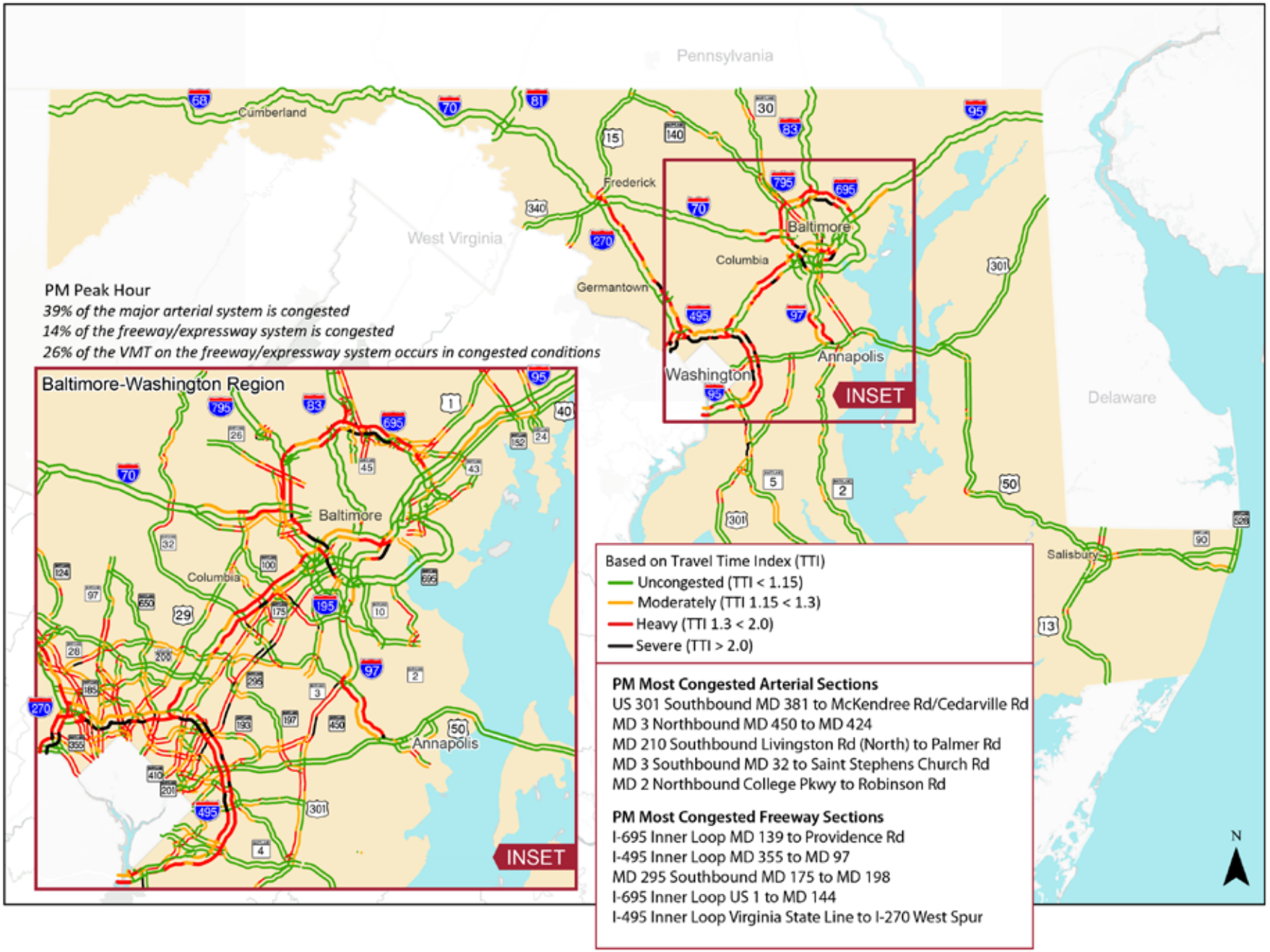


Figure 10 - Maryland Congestion Map: 2022 Friday Summer Hour (4-5) PM

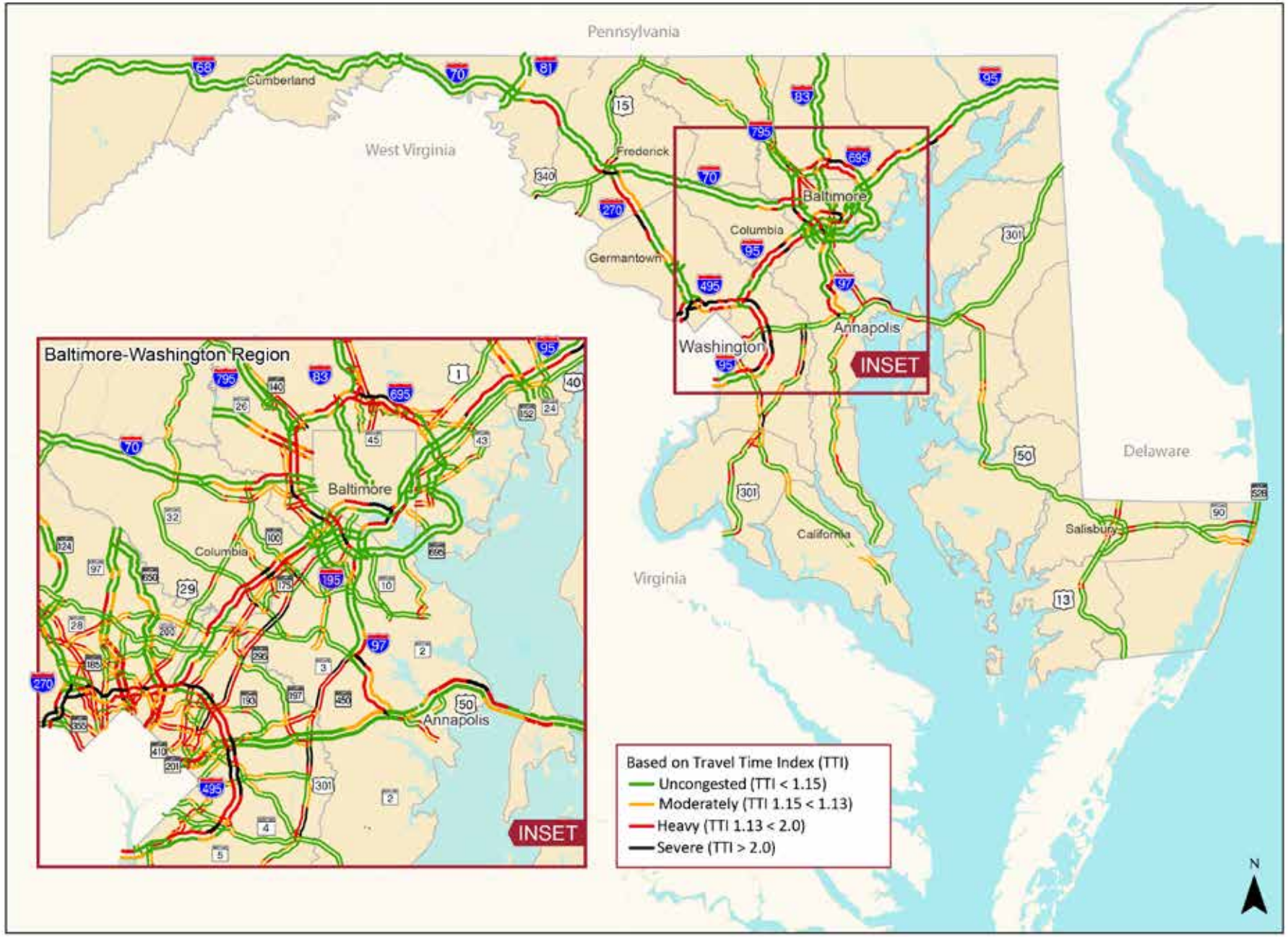


Figure 11 - Maryland Congestion Map: 2022 Saturday Summer Hour (1-2) PM

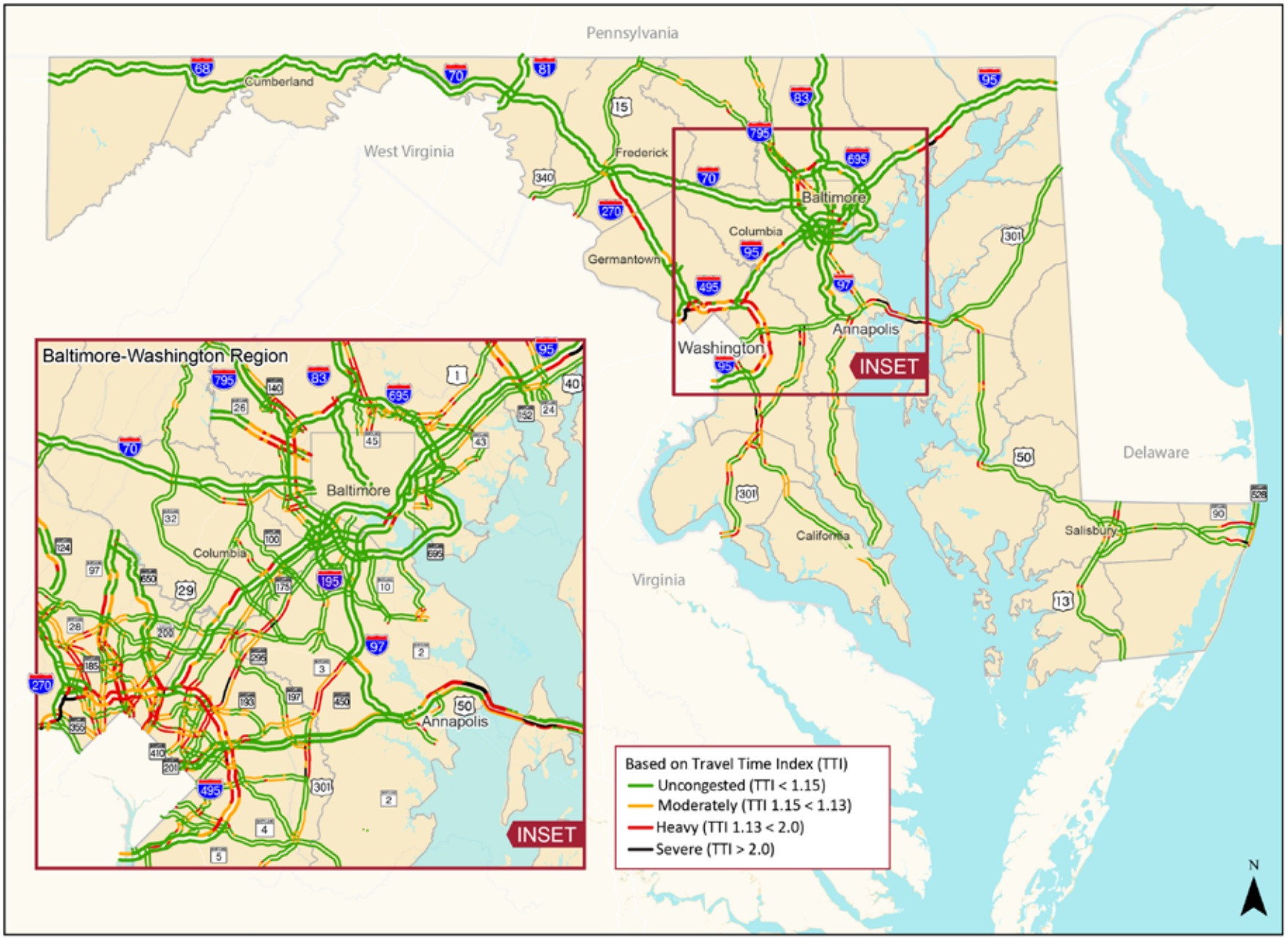
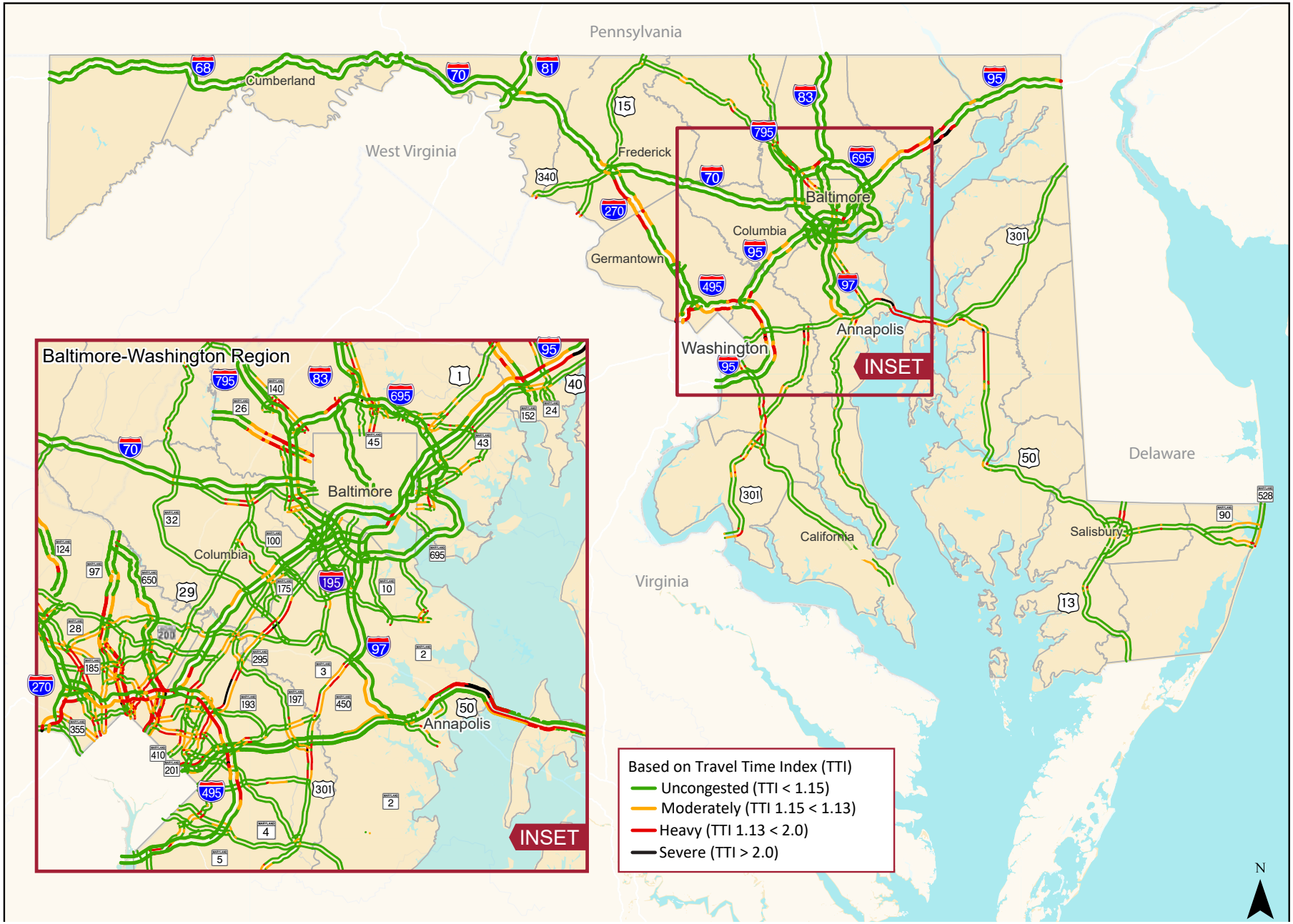


Figure 12 - Maryland Congestion Map: 2022 Sunday Summer Hour (2-3) PM



TOP 15 CONGESTED CORRIDOR SECTIONS

The segments of TTI data for freeways and arterials can range from less than 0.1 miles to 10 miles in rural areas. Small segments do not represent a good overall picture of the way motorists perceive congestion. Therefore, the individual segments were combined to develop the top fifteen most congested freeways/expressway corridors and arterial sections for the AM and PM peak hours. Freeway/expressway corridors 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 fifteen most congested locations during the AM and PM peak hours are shown in **Tables 9 through 12**.

- Freeway/Expressway Sections AM Peak Hour – Table 9, Figure 13
- Freeway/Expressway Sections PM Peak Hour – Table 10, Figure 14
- Arterial Sections AM Peak Hour – Table 11, Figure 15
- Arterial Sections PM Peak Hour – Table 12, Figure 16

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

Table 9

2022 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS – AM PEAK HOUR					
AM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	I-495 Outer Loop	I-95 to US 29	3.21	Montgomery/ Prince George's	3.83
2	I-695 Outer Loop	MD 43 to Cromwell Bridge Rd	3.07	Baltimore	2.81
3	I-270 West Spur Southbound	I-270 Split to I-495	2.98	Montgomery	2.16
4	US 50 Westbound	MD 410 to MD 295	3.25	Prince George's	2.04
5	I-95/I-495 Local Inner Loop	MD 414 to I-295	3.38	Prince George's	2.04
6	I-695 Inner Loop	MD 129 to I-83 South	3.51	Baltimore	2.02
7	I-695 Outer Loop	I-795 to I-70	5.51	Baltimore	1.88
8	I-270 Southbound	Father Hurley Blvd to MD 124	3.00	Montgomery	1.84
9	I-495 Outer Loop	MD 187 to MD 190	3.11	Montgomery	1.79
10	MD 295 Southbound	MD 198 to MD 197	3.46	Anne Arundel/ Prince George's	1.78
11	I-95/I-495 Mainline Inner Loop	MD 414 to Virginia State Line	3.63	Prince George's	1.77
12	I-95/I-495 Inner Loop	I-495 to MD 201	3.23	Prince George's	1.73
13	I-97 Southbound	Benfield Blvd to MD 178 Off Ramp	3.60	Anne Arundel	1.70
14	MD 295 Southbound	Arundel Mills Blvd to MD 32	3.25	Anne Arundel	1.63
15	I-95/I-495 Outer Loop	MD 202 to MD 450	3.02	Prince George's	1.58

Figure 13 – Maryland's Most Congested Freeway Corridor Sections: 2022 AM Peak Hour (8-9)

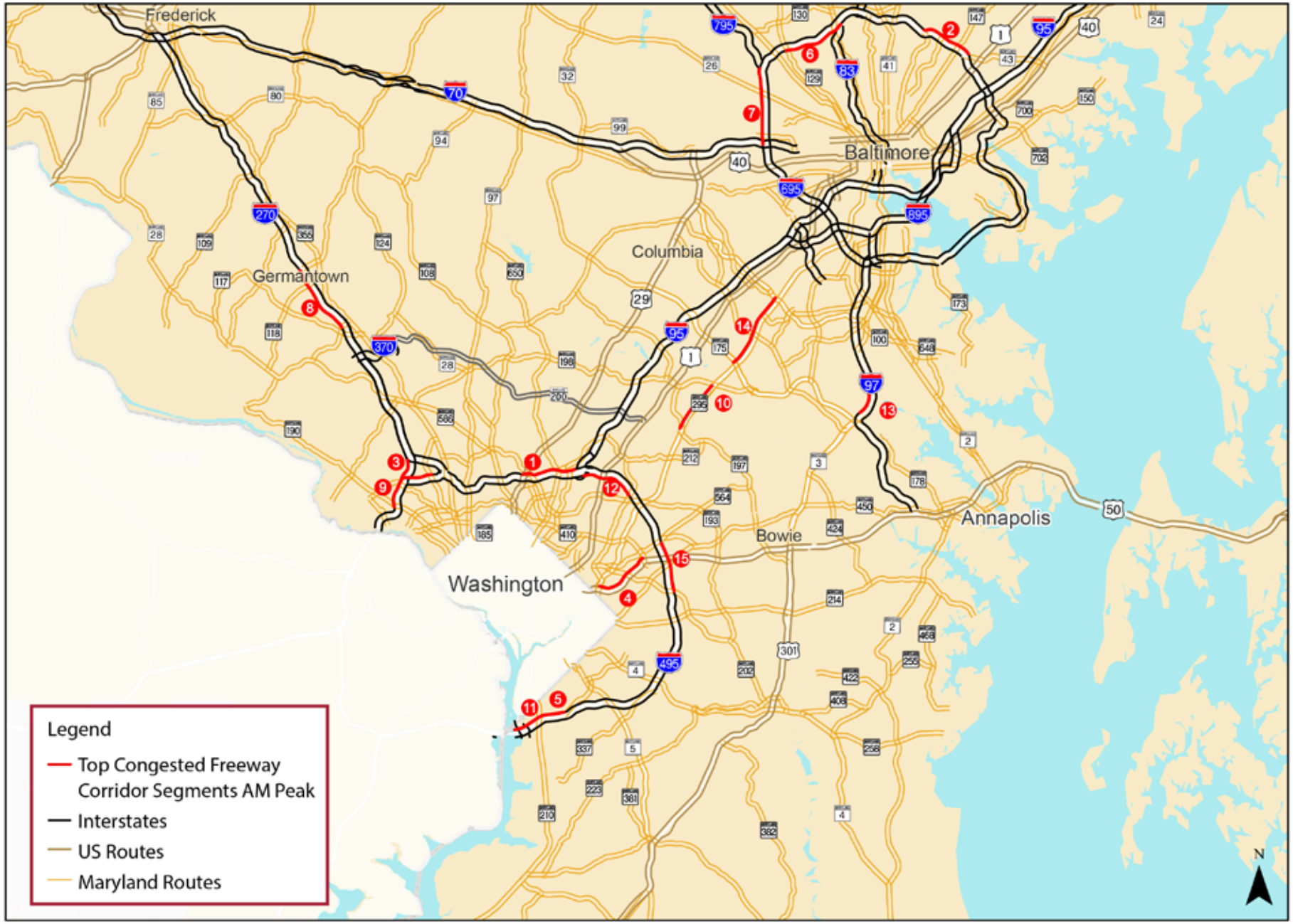


Table 10

2022 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	3.25
2	I-495 Inner Loop	MD 355 to MD 97	3.44	Montgomery	3.08
3	MD 295 Southbound	MD 175 to MD 198	3.56	Anne Arundel	2.55
4	I-695 Inner Loop	US 1 to MD 144	3.22	Baltimore	2.48
5	I-495 Inner Loop	Virginia Line to I-270 West Spur	3.74	Montgomery	2.40
6	MD 295 Northbound	MD 450 to I-95/I-495	3.56	Prince George's	2.25
7	I-95/I-495 Inner Loop	I-95 to MD 201	3.23	Prince George's	2.20
8	MD 295 Northbound	MD 193 to MD 197	3.25	Prince George's	2.12
9	I-95/I-495 Outer Loop	MD 450 to MD 201	3.45	Prince George's	2.10
10	I-270 Northbound	MD 117 to Middlebrook Rd	3.27	Montgomery	2.06
11	I-695 Outer Loop	US 1 to MD 295	3.10	Anne Arundel/ Baltimore	1.99
12	I-95/I-495 Inner Loop	Arena Dr to Ritchie Marlboro Rd	3.21	Prince George's	1.97
13	MD 295 Northbound	MD 198 to MD 175	3.41	Anne Arundel	1.96
14	MD 100 Westbound	Arundel Mills Blvd to I-95	3.11	Anne Arundel/ Howard	1.94
15	I-495 Outer Loop	I-270 West Spur to Clara Barton Pkwy	3.36	Montgomery	1.89

Figure 14 – Maryland's Most Congested Freeway Corridor Sections: 2022 PM Peak Hour (5-6)

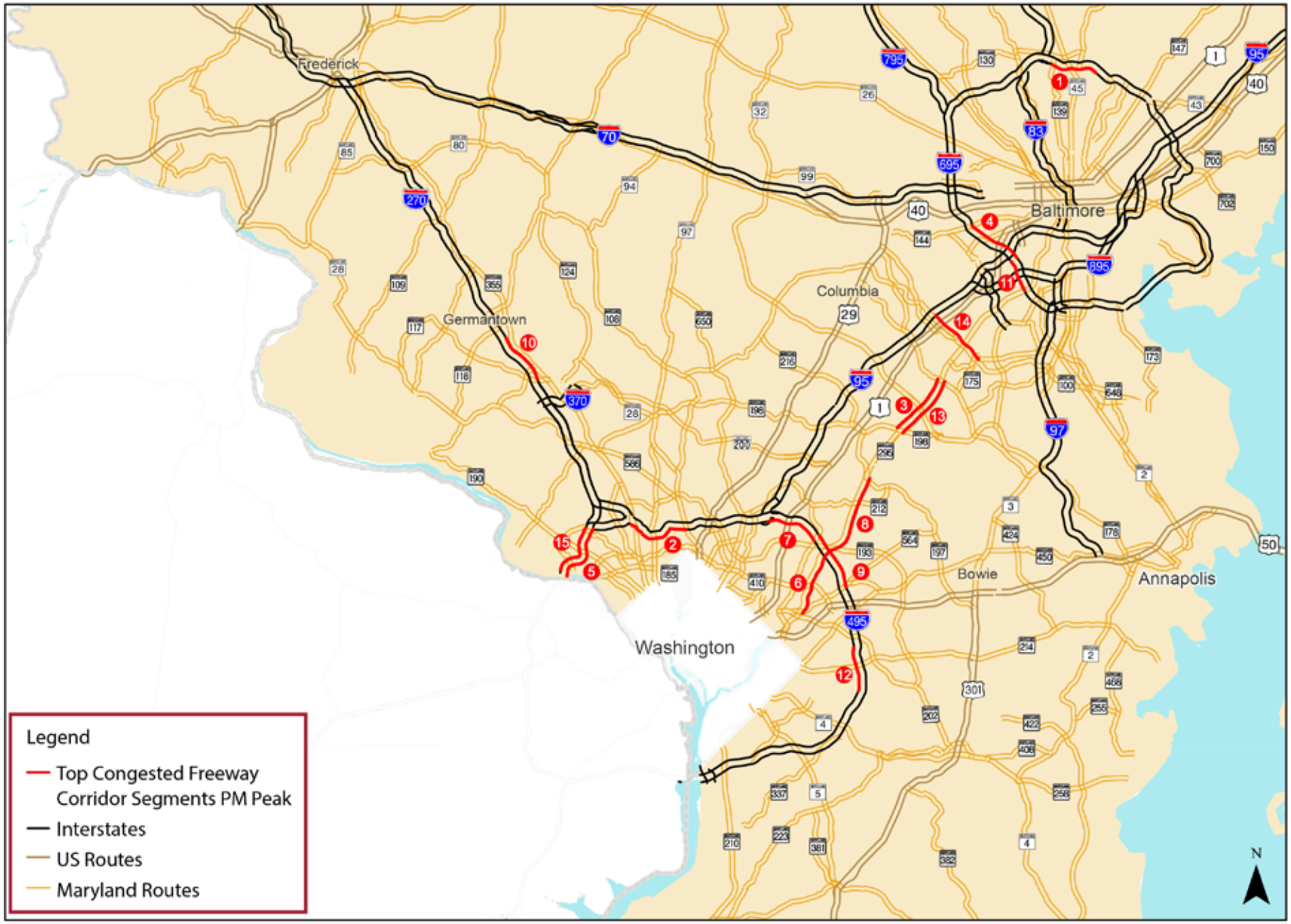


Table 11

2022 MOST CONGESTED ARTERIAL SECTIONS – AM PEAK HOUR					
AM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	US 29 Southbound	MD 650 to Franklin Ave	3.05	Montgomery	1.87
2	MD 185 Southbound	I-495 to MD 191	2.08	Montgomery	1.84
3	MD 28 Westbound	MD 97 to Baltimore Rd	2.20	Montgomery	1.60
4	MD 97 Southbound	Forest Glen Rd to 16th St/MD 390	2.02	Montgomery	1.58
5	MD 355 Southbound	Cedar Ln to MD 191	2.07	Montgomery	1.52
6	MD 189 Southbound	Wootton Parkway to Glen Rd	2.08	Montgomery	1.52
7	MD 210 Northbound	East Swan Creek Rd to Palmer Rd	2.82	Prince George's	1.51
8	MD 187 Southbound	I-270 East Spur to Oakmont Ave	2.10	Montgomery	1.50
9	MD 3 Southbound	I-97 to Waugh Chapel Rd	3.43	Anne Arundel	1.50
10	MD 2 Southbound	Whites Rd to College Pkwy	2.95	Anne Arundel	1.47
11	MD 5 Northbound	Burch Hill Rd to Surratts Rd	3.34	Prince George's	1.47
12	MD 410 Westbound	MD 650 to US 29	2.06	Montgomery	1.46
13	MD 202 Northbound	US 50 to 47th St	2.14	Prince George's	1.46
14	MD 190 Eastbound	I-495 to Goldsboro Rd	2.42	Montgomery	1.44
15	MD 28 Eastbound	Darnestown Rd to MD 355	2.22	Montgomery	1.42

Figure 15 – Maryland's Most Congested Arterial Corridor Sections: 2022 AM Peak Hour (8-9)

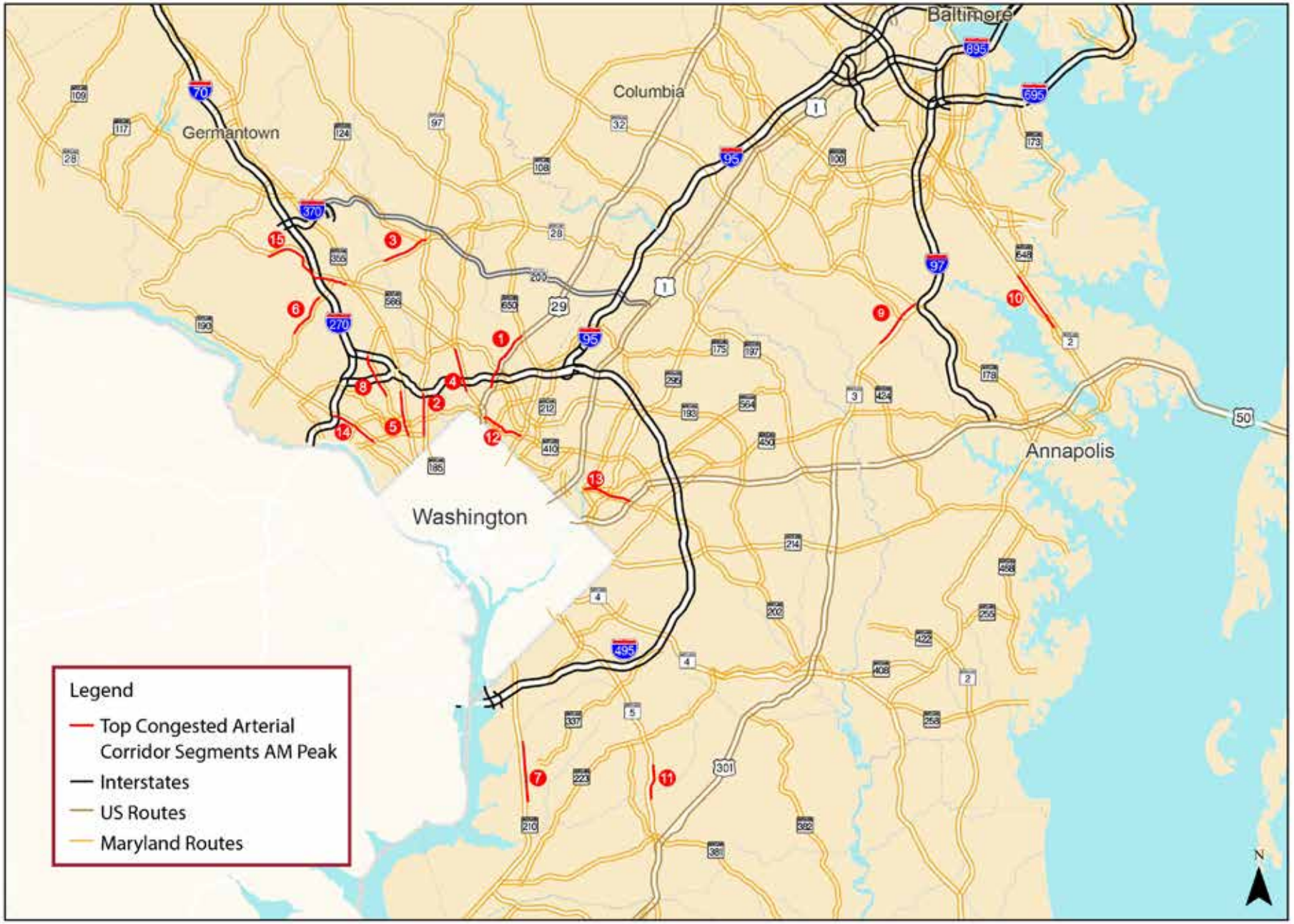
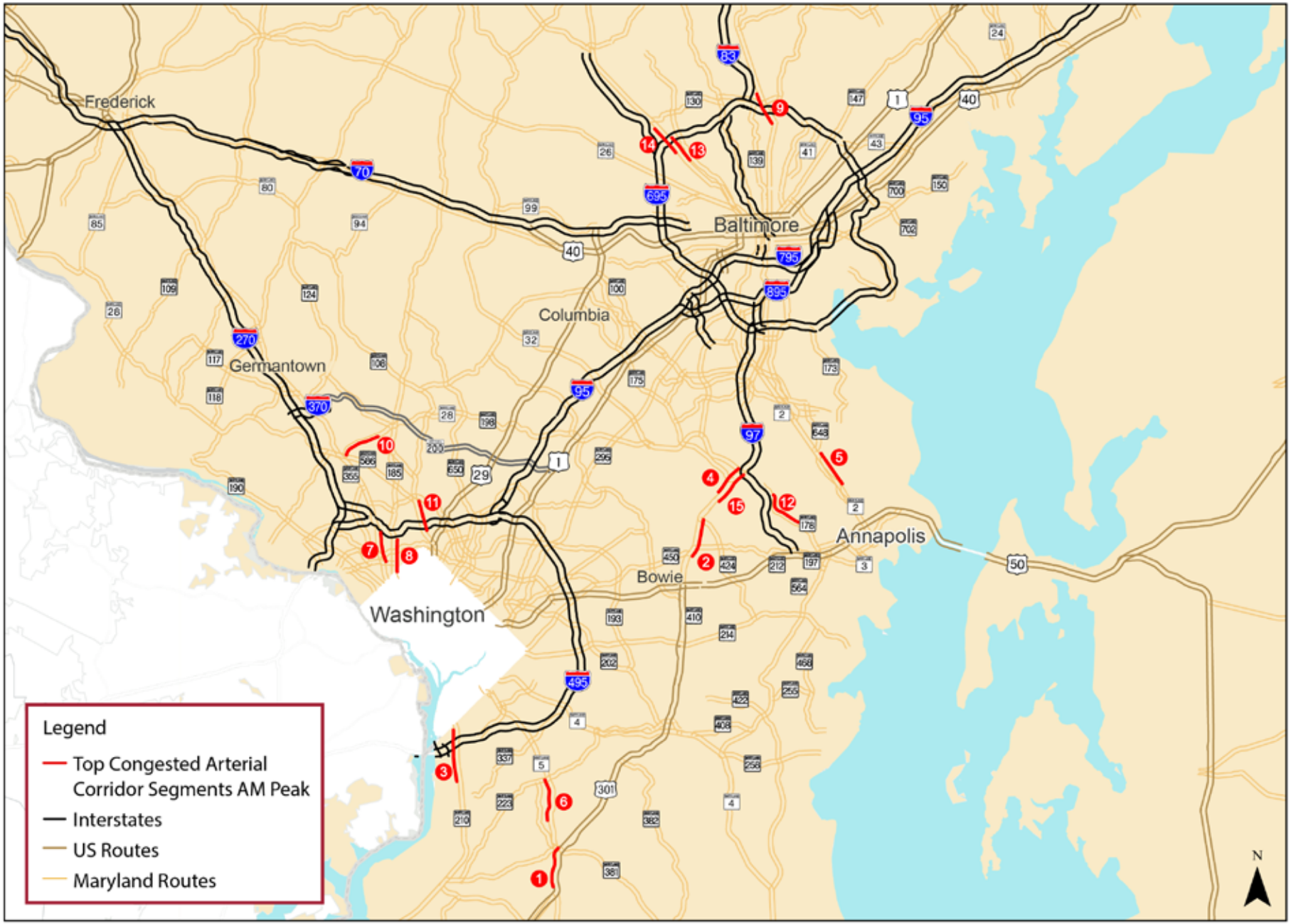


Table 12

2022 MOST CONGESTED ARTERIAL SECTIONS – PM PEAK HOUR					
PM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	US 301 Southbound	MD 381 to McKendree Rd/Cedarville Rd	2.52	Prince George's	2.28
2	MD 3 Northbound	MD 450 to MD 424	2.01	Anne Arundel	1.98
3	MD 210 Southbound	Livingston Rd (North) to Palmer Rd	3.40	Prince George's	1.95
4	MD 3 Southbound	MD 32 to St Stephens Church Rd	2.36	Anne Arundel	1.92
5	MD 2 Northbound	College Pkwy to Robinson Rd	2.41	Anne Arundel	1.85
6	MD 5 Southbound	MD 223 to Burch Hill Rd	2.58	Prince George's	1.85
7	MD 355 Northbound	MD 191 to Cedar Lane	2.07	Montgomery	1.85
8	MD 185 Northbound	Washington D.C. Line to Jones Bridge Rd	2.20	Montgomery	1.82
9	MD 45 Southbound	Ridgely Rd to Allegheny Ave	2.21	Baltimore	1.79
10	MD 28 Eastbound	MD 586 to Bel Pre Rd	2.61	Montgomery	1.77
11	MD 97 Northbound	16th St/MD 390 to MD 586	2.13	Montgomery	1.74
12	MD 178 Northbound	Honeysuckle Ln to I-97 Ramps	2.78	Anne Arundel	1.72
13	MD 140 Westbound	Baltimore City Line to I-695	2.08	Baltimore	1.71
14	MD 140 Eastbound	McDonough Rd to Sudbrook Ln	2.13	Baltimore	1.71
15	MD 3 Northbound	Waugh Chapel Rd to MD 32	2.06	Anne Arundel	1.68

Figure 16 – Maryland's Most Congested Arterial Corridor Sections: 2022 PM Peak Hour (5-6)



SUMMER WEEKEND CONGESTION

Maryland travel shifts during the summer. From the western mountains to the Atlantic Ocean 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 the 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, SHA 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 13 and Figure 17**). According to the analysis, the Eastern Shore and sections of I-95 in Harford County experienced more congestion on the weekends than on the weekdays, particularly in areas that normally experience minimal weekday congestion (**Table 14 and Figure 18**). The rankings represent the most congested sections of roadway for those time periods.

Table 13

2022 MOST CONGESTED SUMMER-WEEKEND FREEWAY AND ARTERIAL LOCATIONS						
FACILITY	DAY	ROUTE/ DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
Freeway	Friday	I-495 Outer Loop	MD 187 to MD 190	3.1	Montgomery	4.0
Arterial	Friday	US 301 SB	MD 381 to McKendree Rd/Cedarville Rd	2.5	Prince George's	2.6
Freeway	Saturday	US 50/US 301 WB	Chester Station Ln to Chesapeake Bay Bridge	3.2	Queen Anne's	2.9
Arterial	Saturday	US 50 EB	MD 589 to MD 528	4.6	Worcester	1.9
Freeway	Sunday	US 50/US 301 EB	Buschs Frontage Rd to Chesapeake Bay Bridge	3.1	Anne Arundel	3.2
Arterial	Sunday	US 301 SB	Short Cut Rd to MD 5 (Mattawoman Beantown Rd)	2.1	Prince George's/ Charles	1.8

Figure 17 – 2022 Most Congested Summer Weekend Freeway and Arterial Locations

Table 14

2022 MOST CONGESTED SUMMER-WEEKEND ARTERIAL LOCATIONS (THAT NORMALLY EXPERIENCE MINIMAL CONGESTION ON WEEKDAYS)						
STATEWIDE RANK/ FACILITY	DAY	ROUTE/ DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
3/Freeway	Friday	I-70 WB	MD 144 to US 15	3.1	Frederick	2.8
1 / Freeway	Saturday	US 50/US 301 WB	Chester Station Lane to Chesapeake Bay Bridge	3.2	Queen Anne's	2.9
3/ Freeway	Saturday	US 50/US 301 EB	Buschs Frontage Rd to Chesapeake Bay Bridge	3.1	Anne Arundel	2.4
5/ Freeway	Saturday	I-95 SB	Maryland House Service Area to MD 24	4.4	Harford	2.1
1/ Arterial	Saturday	US 50 EB	MD 589 to MD 528	4.6	Worcester	1.9
2/ Arterial	Saturday	US 301 NB	MD 214 to US 50	3.3	Prince George's	1.8
1/ Freeway	Sunday	US 50/US 301 EB	Buschs Frontage Rd to Chesapeake Bay Bridge	3.1	Anne Arundel	3.2
3/ Freeway	Sunday	I-95 SB	MD 22 to MD 543	4.1	Harford	2.1
4/ Freeway	Sunday	I-95 NB	MD 152 to MD 24	3.1	Harford	2.1

Figure 18 – 2022 Most Congested Summer Weekend Locations with Minimal Weekday Congestion

DAILY CONGESTION

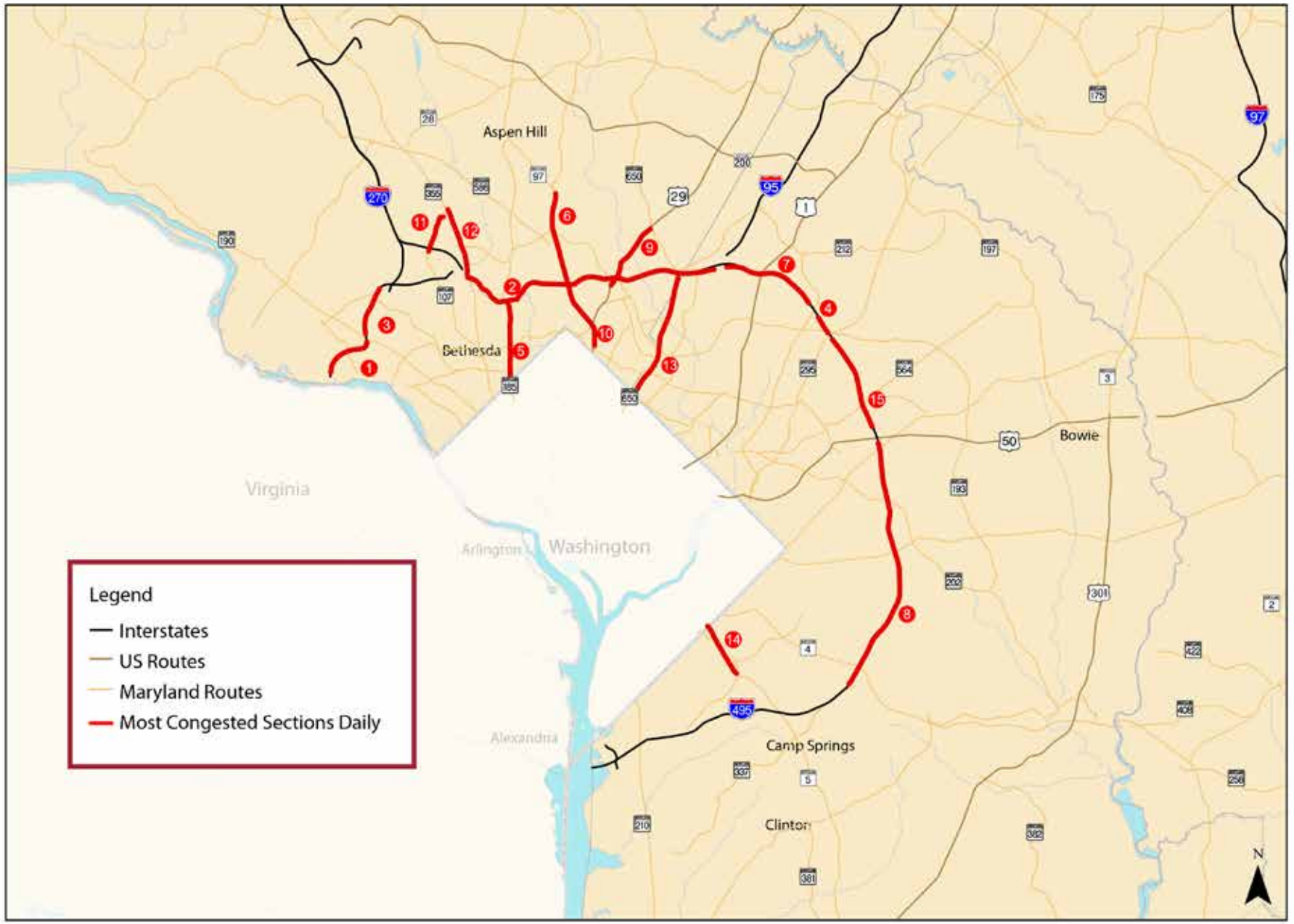
The SHA has developed a new tool to further identify traffic congestion along roadways. This is referred to as the Maryland Roadway Performance Tool (MRPT). This tool provides standard measures of congestion metrics such as TTI and PTI along with other variables. These other variables include person-hours of delay, person-hours of delay per mile, congestion costs, congested carbon dioxide (CO_2) and normal CO_2 values. The MRPT divides the freeways and arterials into segments and uses the same data relating to speeds along freeways and arterials for the TTI and PTI values.

The MRPT is a separate method from the congestion metrics provided by the University of Maryland CATT Lab. For example, the listing of the Top 15 most congested roadways, provided by the UMD CATT Lab, is based on AM and PM peak hour congestion by direction. Whereas the most congested roadways provided by MRPT is based on the average person-hours of delay per mile. This value is determined for the entire day instead of being limited to the peak hours and combining both directions of travel. The calculation considers the number of vehicles on the roadway and people in those vehicles along with the delay they experience on that section of roadway. These values can be compared throughout the State to determine the worst locations for delay throughout the day on the State roadway system. The Top 15 worst locations for average person hours of delay per mile are combined with many of the worst values being along the Capital Beltway and arterials in Montgomery County (**Table 15 and Figure 19**).

Table 15

2022 MOST CONGESTED SECTIONS – DAILY TRAFFIC				
MRPT RANK	ROUTE	LIMITS	COUNTY	PERSON HOURS OF DELAY/MILE
1	I-495	Clara Barton Parkway to MD 190	Montgomery	582,356
2	I-495	I-95 to MD 355	Montgomery	552,693
3	I-495	MD 190 to I-270	Montgomery	529,580
4	I-95/I-495	MD 295 to MD 201	Prince George's	503,192
5	MD 185	Grafton St to I-495	Montgomery	405,395
6	MD 97	I-495 to Randolph Rd	Montgomery	346,081
7	I-95/I-495	MD 201 to I-95	Prince George's	339,537
8	I-95/I-495	Suitland Pkwy to US 50	Prince George's	336,484
9	US 29	I-495 to MD 650	Montgomery	319,525
10	MD 97	MD 410 to I-495	Montgomery	310,929
11	MD 187	I-270 to MD 355	Montgomery	302,874
12	MD 355	I-495 to Georgetown Rd	Montgomery	293,265
13	MD 650	DC Line to I-495	Montgomery	292,163
14	MD 5	MD 414 to DC Line	Prince George's	290,342
15	I-95/I-495	US 50 to MD 295	Prince George's	284,554

Figure 19 – Maryland's Most Congested Sections – Daily Traffic: 2022



COST OF CONGESTION

The time spent waiting in traffic by motorists or truck drivers has a cost associated with it. For instance, congestion may cause late deliveries, force companies to pay for extra delivery time, or result in a person failing to make an event. This year and the previous two years, the cost of congestion has been developed based on the MRPT (**Table 16**). It should be noted that the MRPT considers all state and local roadways versus analyses published in previous reports that focused on state roadways. Overall, the annual statewide cost of congestion has increased from 2021 to 2022 by 18%. The change in congestion costs was propelled by the increases in inflation and congestion due to increased traffic volumes.

Table 16

TOTAL COST OF CONGESTION STATEWIDE ($ MILLIONS)[1]				
FACILITY TYPE	2020	2021	2022	CHANGE FROM 2021 TO 2022
Interstate	$214	$570	$743	+173
Other Freeways/Expressways	$232	$382	$448	+66
Arterials	$2,714	$3,529	$4,095	+566
TOTAL	**$3,160**	**$4,481**	**$5,286**	**+805**

1 - Revised methodology based on the Maryland Reporting Performance Tool

I-270 at MD 189

FREEWAY/EXPRESSWAY AND MAJOR ARTERIAL CORRIDOR SUMMARY

The roadways where entry/exit is limited to interchanges are termed controlled access facilities. Controlled access facilities include freeways and expressways which 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 system and the most congested arterial corridors 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) (**Figures 20 and 21**).

Most roadways experienced an increase in congestion for both the freeway/expressway and arterial systems. Among the highlights include:

- The number of freeways/expressways that operated at the highest level of congestion (severe TTI >2.0) increased from 6 to 21 miles in the AM peak hour.
- Severe arterial congestion in the morning rose from 10 to 15 miles while heavy congestion (the next highest level) increased by 133 miles statewide.
- Freeway/expressway severe congestion in the PM peak hour grew from 17 miles to 43 miles with an increase of 43 miles in heavy congestion.
- The number of miles in heavy arterial congestion increased from 510 to 603 miles and from 19 to 28 miles in severe congestion for the PM peak hour.

Figure 20

NUMBER OF CONGESTED MILES

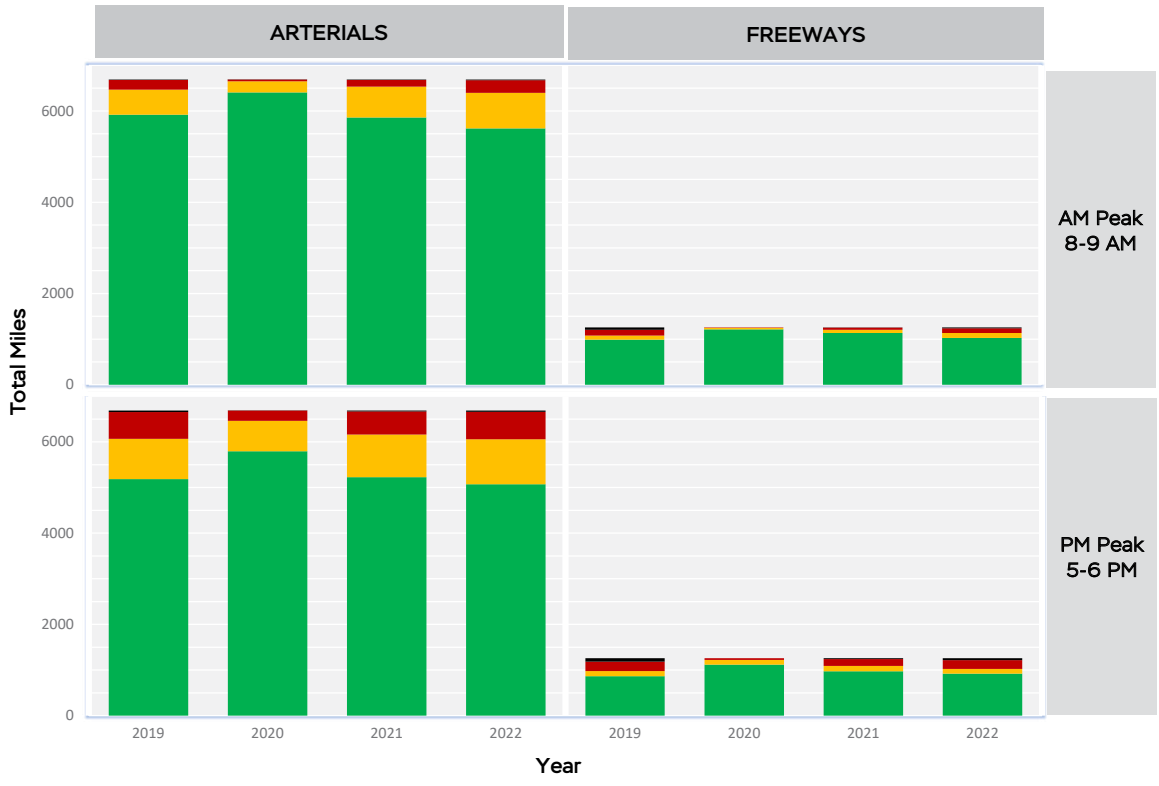
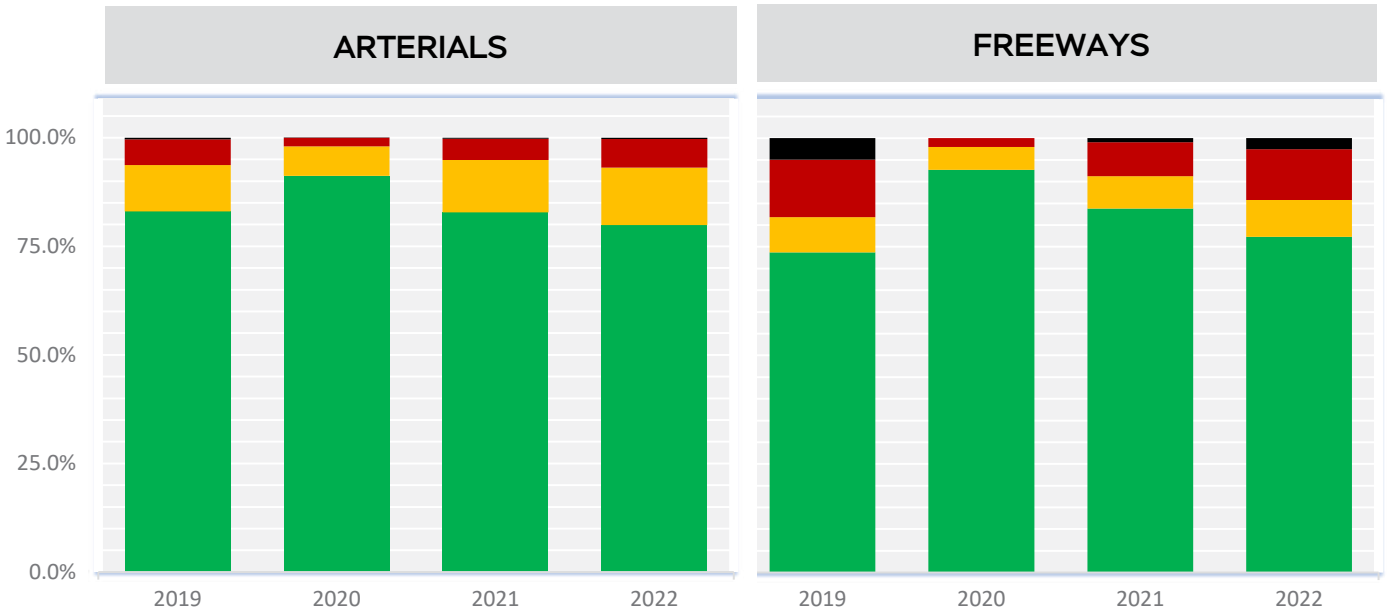


Figure 21

PERCENT OF CONGESTED MILEAGE FREEWAYS AND ARTERIALS



All of Maryland's freeways and expressways were analyzed to determine the number of miles that were recorded in the four levels of congestion (**Figure 22**).

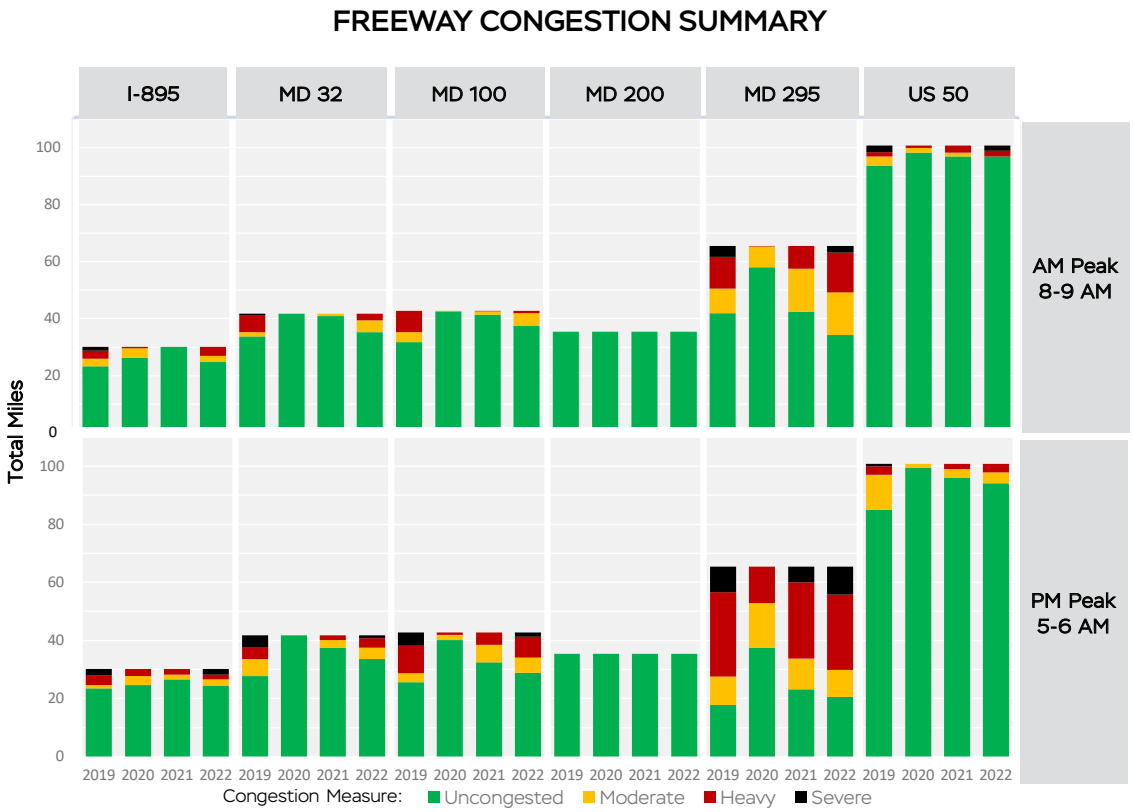
The major changes that occurred between 2021 and 2022 included:

- All freeways/expressways either stayed the same or increased in the number of miles operating at the worst congestion conditions.
- The largest change in severe congestion occurred along I-495 in the PM peak hour with an additional ten miles operating at that level.
- Both I-495 and MD 295 motorists experienced four more miles of severe congestion in the PM peak hour in 2022 over 2021.
- Heavy congestion along I-95 grew by six miles in the AM peak hour and seven miles in the PM peak hour.

Figure 22


FREEWAY CONGESTION SUMMARY
I-70
I-270
I-270 Local
I-81
I-83
AM Peak 8-9 AM
PM Peak 5-6 AM
Total Miles
0
50
100
150
200
2019
2020
2021
2022
Congestion Level: Uncongested Moderate Heavy Severe
I-95
I-97
I-495
I-695
I-795
Congestion Measure: Uncongested Moderate Heavy Severe

Figure 22 (Continued)



In addition to the freeway/expressway corridors, traffic analysis was performed on thirty-five major arterial corridors. These corridors were chosen based on observed traffic operations, traffic volumes, regional significance, and data availability to analyze in further detail. The TTI values were used to determine the number of miles that each arterial operated in uncongested, moderate, heavy, and severe congestion. The results were compared to 2019, 2020, and 2021 for the thirty-five arterial corridors. Most of the arterials showed a minor increase in the most severe congestion levels compared to 2021 (**Figure 23**). Among the changes between 2021 and 2022 for the thirty-five arterial corridors included:

- Motorists on most of the thirty-five arterial corridors experienced reduced operations in 2022 with the exception of US 40 in Hagerstown, MD 24 in Harford County and MD 32 in Howard and Caroll Counties (dualization of MD 32 improved performance).
- The largest increase in the number of severely congested miles was along MD 3 from US 50 to I-97 in the PM peak hour. Similarly, this section of roadway increased by seven miles of heavy congestion in the AM peak hour.
- MD 28 from Riffle Ford Rd to MD 97 motorists experienced an increase of five miles of heavy congestion in the AM peak hour. A six-mile increase in heavy congestion in the PM peak hour occurred along MD 355 from the Washington DC line to MD 27.

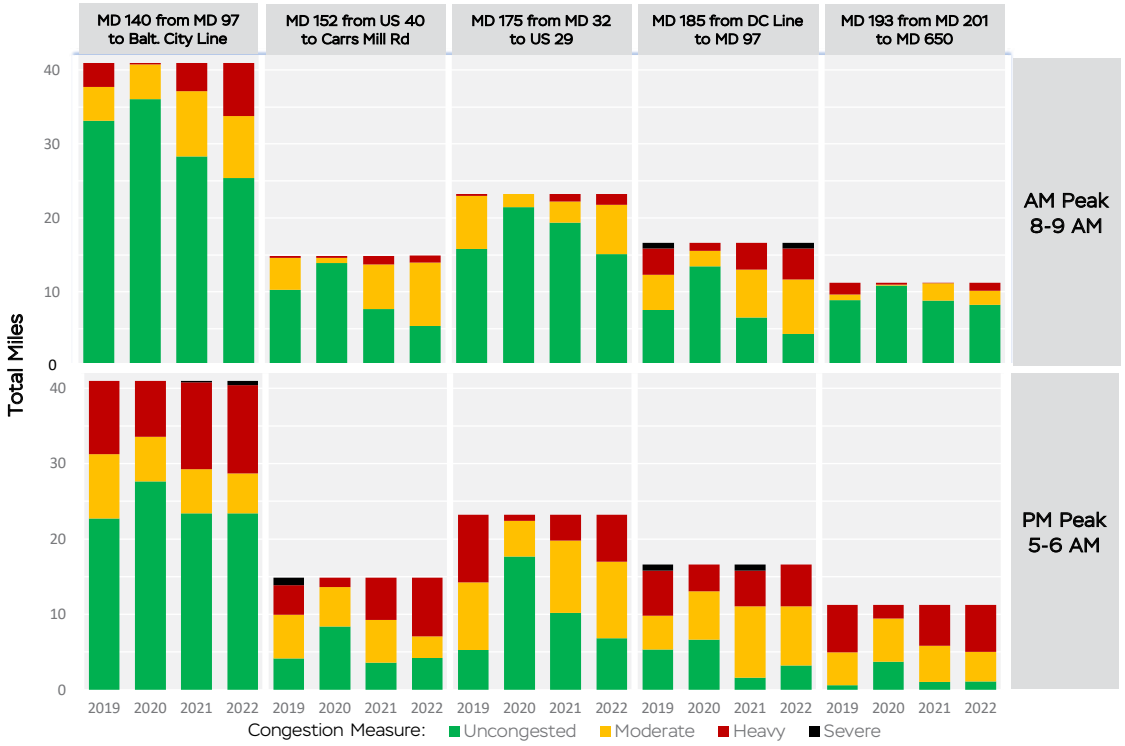
The Statewide Congestion maps show the overall operation of all freeways/expressways and arterials during the AM and PM peak hours (**Figures 9-10**). The Maryland Mobility Report Supplement Chapter A provides additional in-depth information about the mobility performance of these corridors including 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 average daily traffic. The arterial section also contains information on intersection operations and transit ridership.

Figure 23

ARTERIAL CONGESTION SUMMARY

Figure 23 (Continued)

ARTERIAL CONGESTION SUMMARY



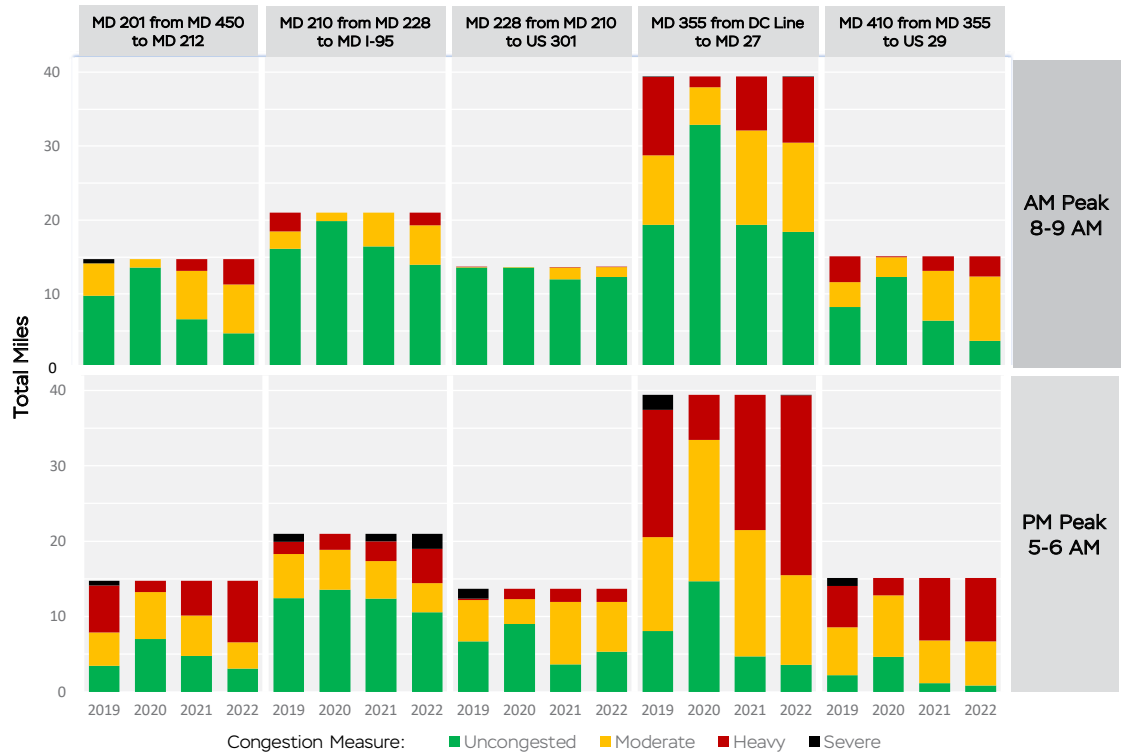
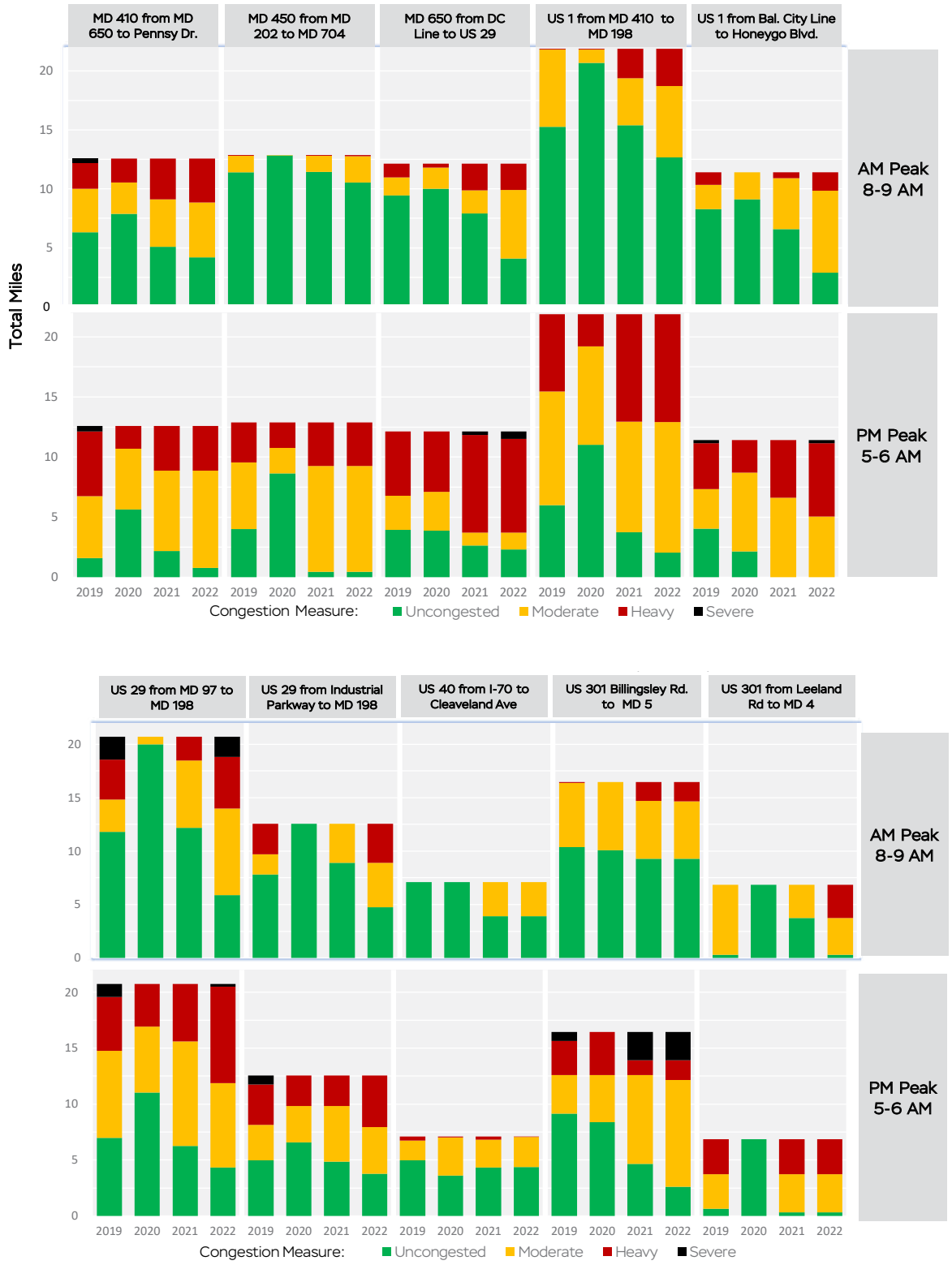


Figure 23 (Continued)

ARTERIAL CONGESTION SUMMARY



MAJOR PAST PROJECT BENEFITS

SHA has constructed several major projects such as the widening of freeways/expressways and arterial roadways to better meet the demands of the traveling public. The benefits these projects provide are not limited to the immediate time after the construction is complete. The use of vehicle probe data allows for a comparison between traffic operations before the projects were constructed with 2022 data to determine mobility benefits. The before and 2022 travel times were compared based on the TTI. The projects are providing major travel time savings even for projects completed over ten years ago (**Table 17**).

Table 17

PAST PROJECT BENEFITS							
ROUTE/ PEAK HOUR/ DIRECTION	LIMITS	LENGTH (MILES)	COUNTY	PRECONSTR. YEAR	PRECONSTR. TTI	2022 TTI	% REDUCTION IN DELAY
MD 295/AM/ SB	I-695 to W. Nursery Road	1.1	Anne Arundel	2011	1.45	1.06	26%
MD 295/PM/ NB	I-195 to W. Nursery Road	1.8	Anne Arundel	2011	1.73	1.13	35%
US 50/PM/EB	MD 450 to MD 2	2.7	Anne Arundel	2017	2.08	1.12	46%
MD 175/AM/ NB	Mapes Road to Disney Road	1.8	Anne Arundel	2015	1.28	1.13	12%
MD 175/AM/ SB	Mapes Road to Disney Road	1.8	Anne Arundel	2015	1.19	1.17	2%
MD 175/PM/SB	Mapes Road to Disney Road	1.8	Anne Arundel	2015	1.49	1.27	15%
I-95/AM/SB	MD 43 to S of I-695	4.3	Baltimore	2011	1.75	1.06	40%
I-95/PM/NB	US 40 to MD 43	6.9	Baltimore	2011	1.32	1.08	18%
I-695/Inner Loop/PM	I-895 to I-95	1.6	Baltimore	2011	1.32	1.16	12%
I-695/Inner Loop/PM	MD 41 to MD 147	1.8	Baltimore	2011	1.49	1.48	<1%

ROUTE/ PEAK HOUR/ DIRECTION	LIMITS	LENGTH (MILES)	COUNTY	PRECONSTR. YEAR	PRECONSTR. TTI	2022 TTI	% REDUCTION IN DELAY
I-695/Outer Loop/AM	US 40 to MD 372	1.9	Baltimore	2013	1.81	1.23	32%
I-695/Outer Loop/PM	US 40 to MD 372	1.9	Baltimore	2013	1.31	1.10	16%
I-95/AM/SB	I-895 to Fort McHenry Tunnel	4.8	Baltimore City	2017	2.02	1.19	41%
I-95/PM/NB	Fort McHenry Tunnel to I-895	4.8	Baltimore City	2017	1.19	1.04	13%
MD 32/AM/SB	MD 108 to I-70	8.9	Howard	2011	1.37	1.08	21%
MD 32/PM/NB	MD 108 to I-70	8.9	Howard	2011	1.49	1.16	22%
US 29/NB/PM	S of MD 32 to N of Broken Land Parkway	2.3	Howard	2011	1.97	1.04	47%
MD 5/AM/NB	Auth Way to I-95/I-495	1.0	Prince George's	2012	1.25	1.12	10%
MD 5/AM/SB	Auth Way to I-95/I-495	1.0	Prince George's	2012	1.14	1.07	6%
MD 5/PM/NB	Auth Way to I-95/I-495	1.0	Prince George's	2012	1.17	1.10	6%
MD 5/PM/SB	Auth Way to I-95/I-495	1.0	Prince George's	2012	1.35	1.29	5%
I-95/AM/SB	S of MD 200 to S of MD 212	1.9	Prince George's	2011	1.73	1.36	21%
MD 404/ Sat. Midday Summer/EB	Holly Road to US 50	11.3	Queen Anne's, Talbot, Caroline	2014	1.28	1.00	22%

INTERSECTIONS

Traffic signals have a major impact on the ability of motorists to be able to progress to their destinations. The longer the delays at these locations, the greater the possibility of crashes. The worst operating intersection locations force motorists to wait for multiple cycles before passing through on the green.

SHA evaluates traffic operations as part of their traffic count program. Intersection operations are graded from level of service (LOS) 'A' to 'F,' with 'A' being the best and 'F' being the worst (**Table 18**). For the purpose of this report, an intersection analysis was performed using the critical lane analysis technique. The critical lane analysis technique evaluates the volumes of the highest conflicting movements and the number of lanes.

Table 18

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 motorists clear in one green indication
E	Long queues and delays with some motorists having to wait more than one green indication
F	Most motorists have to wait more than one green indication

At LOS F intersections, a more in-depth method to quantify how poorly traffic is operating is used. 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, 19 operated in the AM peak hour or PM peak hour at LOS F (**Tables 19 and 20**). Three 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. Location maps of these failing intersections are included in the Maryland Mobility Report Supplement.

Table 19

LOS "F" INTERSECTIONS AM PEAK HOUR COUNTED IN THE LAST FOUR YEARS		
INTERSECTION	COUNTY	VOLUME/CAPACITY (SORTED HIGHEST TO LOWEST)
MD 202 at MD 202E/Brightseat Rd	Prince George's	1.61
MD 4 at MD 337/Presidential Pkwy	Prince George's	1.37
US 29 at Rivers Edge Rd	Howard	1.22

INTERSECTION	COUNTY	VOLUME/CAPACITY (SORTED HIGHEST TO LOWEST)
MD 4 at MD 235	St. Mary's	1.16
MD 210 at Livingston Rd/Palmer Rd	Prince George's	1.16
MD 4 at Dower House Rd	Prince George's	1.15
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[1]	Prince George's	1.03
MD 124 at Warfield Rd	Montgomery	1.02
MD 355 at MD 911/Wootton Pkwy	Montgomery	1.01

1 – The intersection has been upgraded to an interchange in 2022.

Table 20

LOS "F" INTERSECTIONS PM PEAK HOUR COUNTED IN THE LAST FOUR YEARS		
INTERSECTION	COUNTY	VOLUME/CAPACITY (SORTED HIGHEST TO LOWEST)
MD 4 at MD 235	St. Mary's	1.38
US 301 at Cedarville Rd/McKendree Rd	Prince George's	1.19
MD 4 at FDR Blvd	St. Mary's	1.17
MD 410 at MD 212	Prince George's	1.14
MD 500 at Eastern Ave	Prince George's	1.14
MD 119 at Sam Eig Hwy	Montgomery	1.09
MD 4 at MD 337/Presidential Pkwy	Prince George's	1.08
MD 3 (SB) at MD 175	Anne Arundel	1.07
MD 414 at Ramp 2 from I 95/I-495 SB	Prince George's	1.07
MD 3 (NB) at Riedel Rd	Anne Arundel	1.05
MD 4 at Patuxent Blvd	St. Mary's	1.04
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

RELIABILITY **TRENDS**

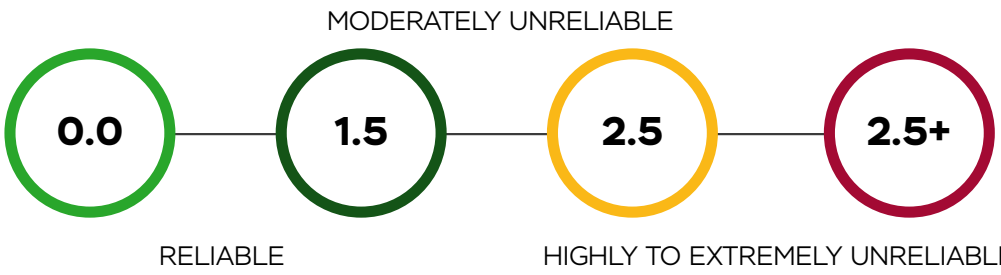
Most of the time a person makes a trip, their travel time varies. This may only be a minute, or it can be much greater. This variability traveling between the same two points demonstrates a level of unreliability of the roadway. When travel times vary greatly, this lack of dependability often frustrates motorists, truck drivers, and transit riders. The additional travel time due to network unreliability results in added costs for all travelers. The unreliability is often caused by specific events such as incidents, vehicular breakdowns, crashes, weather, or lane reductions through work zones. These travelers must add a buffer of additional time to ensure they arrive at their destination on time.

The significance of providing a reliable transportation system by delivering programs and projects is a benefit. By improving reliability, travelers can better plan their trips and daily schedules. The importance of a trip's reliability and the cost associated with it varies by purpose and type to that 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 for that person or business. The more consistent that travel times are, the better for all travelers.

Travel time reliability is measured by the Planning Time Index (PTI). The calculation of this metric varies throughout the country. This ranges in value from the 80th to the 95th percentile travel time. 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 an incident or major event occurred. For example, a PTI of 2.0 means that if it takes five minutes to traverse a roadway segment in free-flow conditions, a motorist should allow ten minutes for travel to ensure a 95% chance of on-time arrival. The lower the value, the more reliable the trip. Conversely, the higher the PTI value, the longer a trip could take. There are three levels of reliability; reliable, moderately reliable, and highly to extremely unreliable (**Figure 24**).

Figure 24

METRIC: MEASUREMENT OF RELIABILITY (PLANNING TIME INDEX)



RELIABILITY MEASURES ON THE MARYLAND FREEWAY/ EXPRESSWAY SYSTEM

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 by 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: 2022 AM Peak Hour (8-9) AM

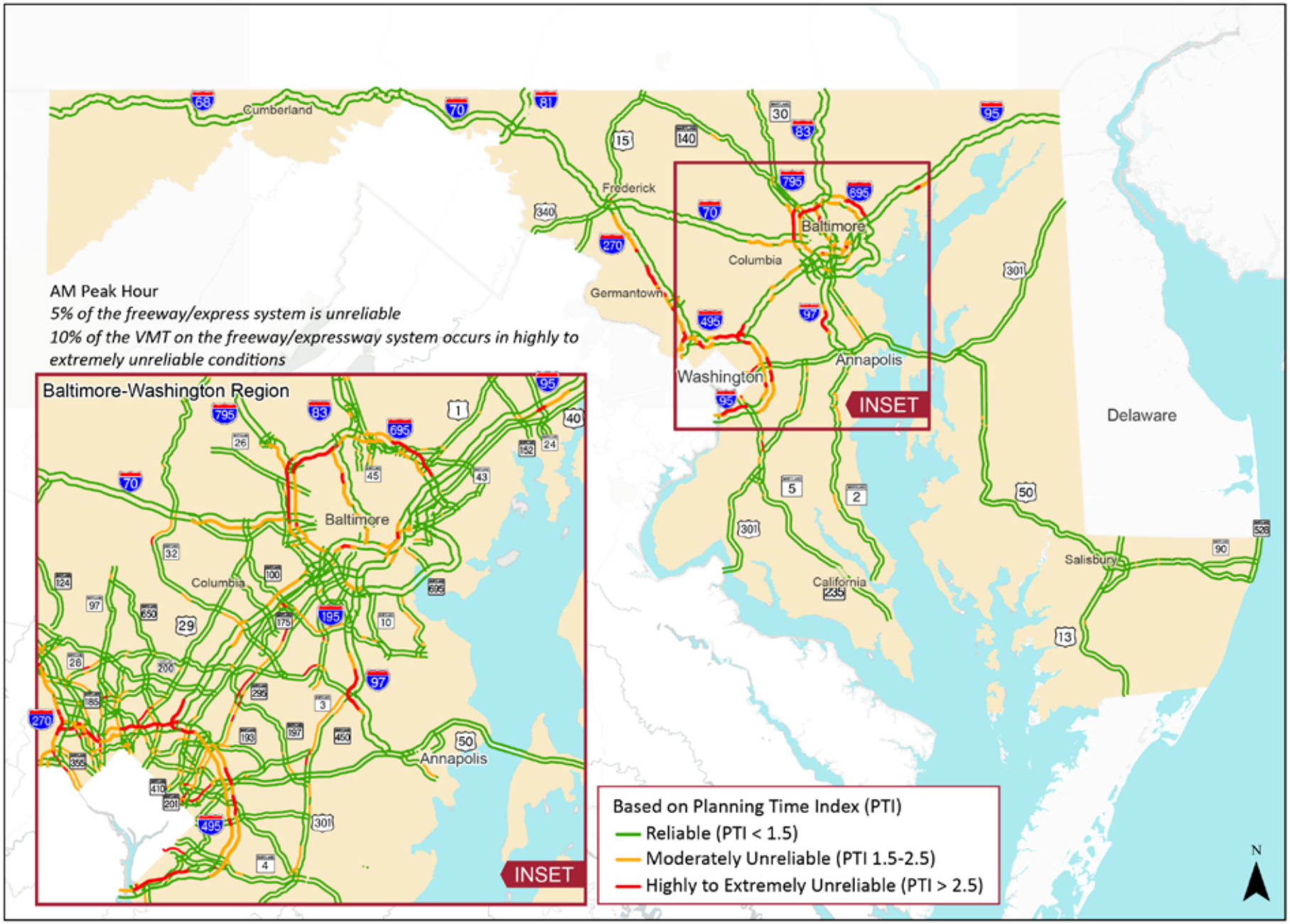
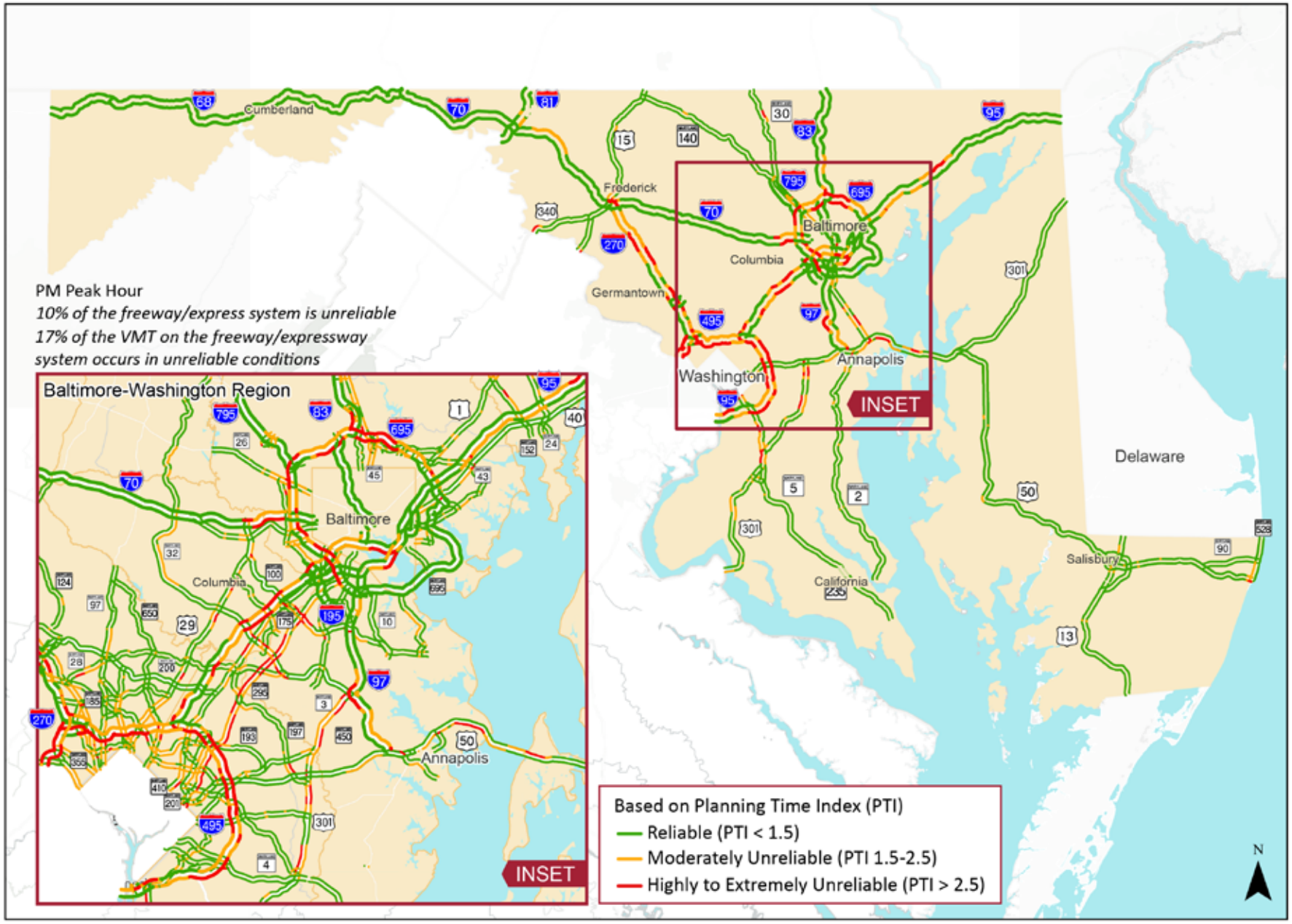


Figure 26 – Maryland Reliability Map: 2022 PM Peak Hour (5-6) PM



The lowest level of reliability is termed highly to extremely unreliable conditions. There was a substantial increase in the number of roadway miles and percent of VMT impacted by the worst conditions in the AM and PM peak hours on Maryland's freeway/expressway system from 2021 to 2022 (**Table 21)**.

Table 21

STATEWIDE FREEWAY/EXPRESSWAY SYSTEM (AVERAGE WEEKDAY AM/PM PEAK HOUR RELIABILITY SUMMARY)								
HEAVY TO EXTREMELY UNRELIABLE CONDITIONS	2020		2021		2022		CHANGE FROM 2021 TO 2022	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Number of Roadway Miles	46	77	40	133	79	161	+39	+28
Percent of Roadway Miles	3	5	3	8	5	10	+2	+2
Percent of Peak Hour VMT Impacted	6	9	5	14	10	17	+5	+3

Roadways that operate with severe congestion tend also to be the roadways that experience the highest levels of unreliability, but there are exceptions to this. 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 motorists traveling to vacation destinations.

An evaluation was performed comparing reliability (PTI) values with congestion (TTI) values for freeways/expressways. 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 I-95 to MD 43
- I-95/I-495 Local Lanes Inner Loop from MD 414 to MD 210
- MD 295 Southbound from MD 202 to Washington DC Line
- US 50 Westbound from MD 410 to MD 295

The sections that showed the largest difference between the PTI value for reliability and the TTI value for congestion in the PM peak hour on freeways/expressways include:

- US 50/US 301 Eastbound from MD 179 to Oceanic Dr
- I-495 Outer Loop from MD 187 to I-270 West Spur
- I-270 West Spur Southbound from I-270 Split to I-495
- MD 295 Southbound from MD 175 to MD 32
- I-495 Inner Loop from MD 187 to MD 185

TRUCK DATA AND TRENDS

The successful movement of freight and goods is vital to the economy of Maryland. This is accomplished through a well-connected and maintained network of highways, intermodal connections to ports, user-friendly airports, rail terminals, and first/last mile routes accessible to industries. The majority of freight is moved along the roadway system, especially SHA and MDTA roadways.

Maryland roadways are used as both an origin/destination for goods throughout the state and for long-distance trucks traveling along the entire Eastern Seaboard. This includes significant roadways such as I-95, I-81, I-70, I-68, I-83, US 50, and US 301 which are critical freight corridors supporting national freight flows.

SHA monitors the movement of trucks through the state through various data platforms. One of these is conducting 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 22 and Figure 27**). There are over 20% trucks along several roadways with more than 1,000 ADT (**Table 23 and Figure 27**).

Table 22

HIGHEST TRUCK VOLUMES (included all types of trucks)		
	LOCATION	AVERAGE DAILY TRUCK VOLUME[1]
1	I-95 North of MD 43	28,200
2	I-95 North of MD 24	22,100
3	I-95/I-495 South of MD 704	21,900
4	I-95 South of MD 24	21,000
5	I-81 North of I-70	20,900

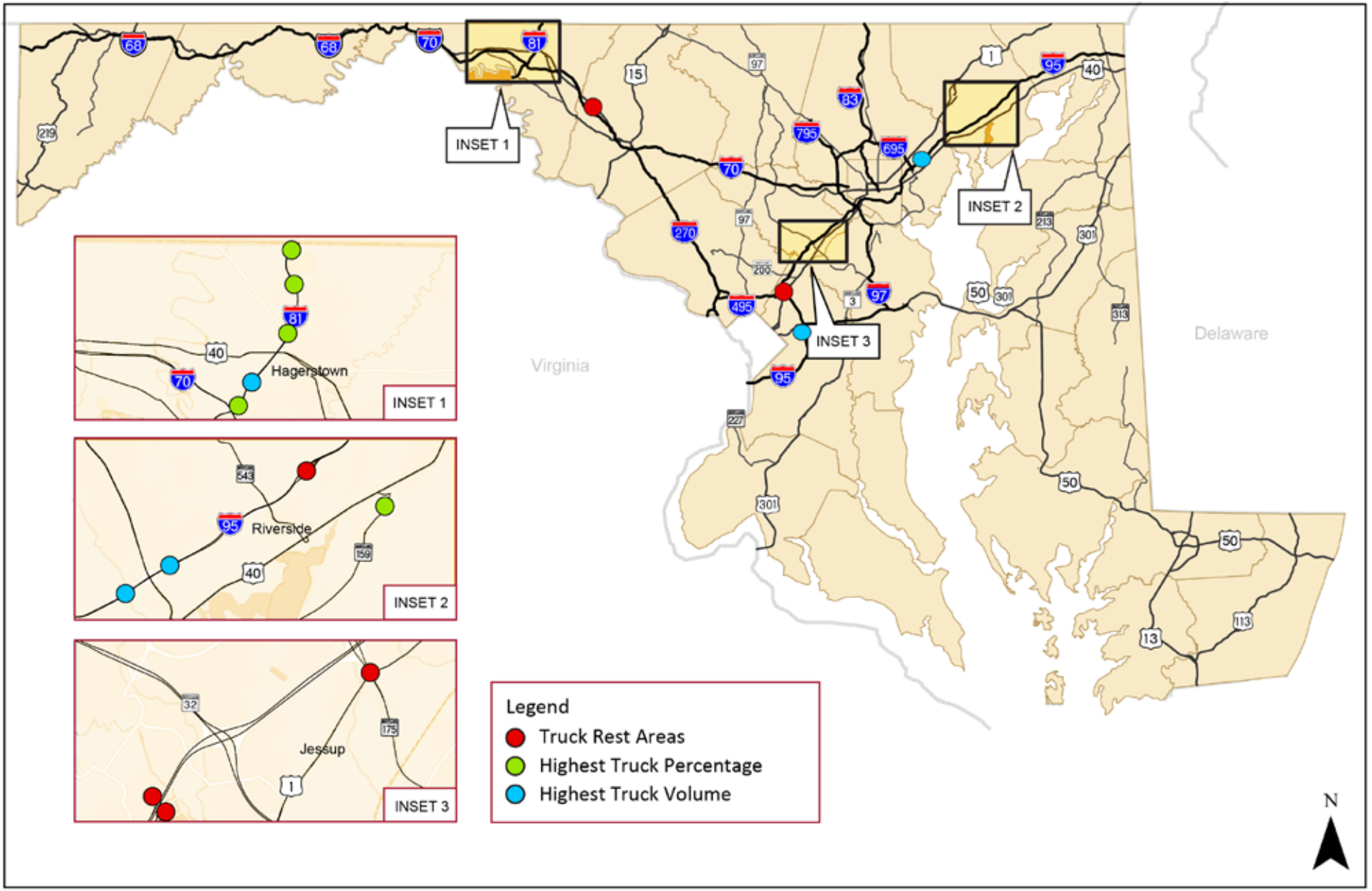
Table 23

HIGHEST TRUCK PERCENTAGE LOCATIONS (includes all types of trucks)		
	LOCATION	TRUCK %
1	I-81 South of Pennsylvania State Line	31%
2	I-81 South of Showalter Rd	30%
3	MD 159 South of US 40	28%
4	I-81 North of I-70	25%
5	I-81 South of MD 58	24%

1- Includes all types of trucks

Over 10,000 tractor-trailers use I-81 and I-95 daily in certain areas.

Figure 27 – Truck Volumes and Rest Areas



OVERNIGHT TRUCK PARKING

Truck parking is critically important for truck drivers to get the required rest and to be compliant with safety regulations. Areas along the I-95 Corridor experience parking shortages, especially in major metropolitan areas like the Baltimore-Washington region. The lack of truck parking is one of the most significant freight challenges, but it is complex, and solutions are multi-faceted. Maryland currently has a total of approximately 600 publicly supplied spaces and over 2,300 private parking spaces. The approximately 2,900 parking spaces cannot meet the demand.

Federal surface transportation law prioritizes truck parking, and states are considered an important stakeholder and champions in developing solutions. In 2012, the 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)[1] 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

In the inaugural Jason's Law report, the Federal Highway Administration (FHWA) 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 the problems persist and that Maryland is a state with shortages of truck parking in relation to various measures of truck activity and is cited by truckers as having shortages.

In 2020, MDOT released an annual statewide Truck Parking Study, which found clusters of need throughout the state and low parking availability using a combination of INRIX and Trucker Path data. The study identified the 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 24 and Figure 27**).

Table 24

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

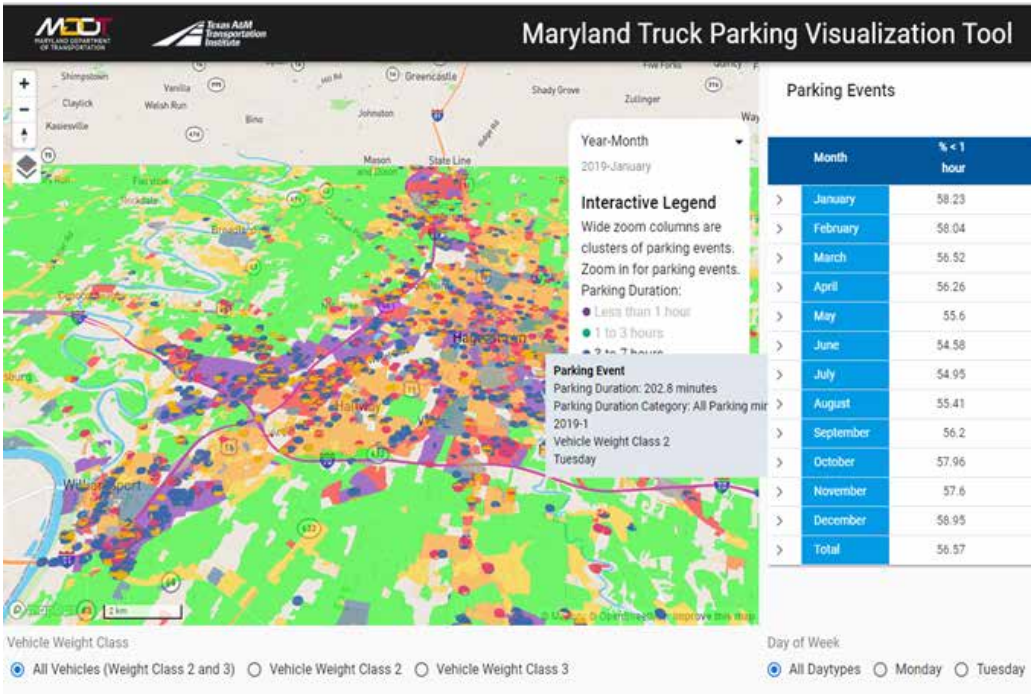
[1] – *Jasons Law was established to provide a national priority to the shortage of long term parking for commercial motor vehicles.*

Several efforts are being undertaken to address truck parking shortages. The first method is using data in smarter ways to develop performance visualization information that illustrates the problem and helps engage stakeholders to develop solutions. Furthermore, SHA is using this information to monitor parking needs to identify capacity and operational strategies. This includes advancing capacity at select locations throughout the state and evaluating existing SHA properties that could support truck parking opportunities. In addition, coordination is taking place with other MDOT agencies, local governments, and the private sector on parking opportunities. Finally, SHA is investing in a shared freight data platform and truck information systems that can assist with disseminating truck parking availability information.

The key to addressing the truck parking efforts is having the data and being able to provide it easily to the public to help them make informed decisions. SHA has developed the Truck Parking Tool, a first-of-its-kind resource that is a platform that identifies the demand and supply of parking in Maryland. This 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. Further, on state-owned lots, the tool shows a capacity ratio and a ratio of trucks having to park on ramps and shoulders, which usually is an indication the lot is full. This information helps to understand the time of day, week, and year when capacity constraints exist and provides context for identifying solutions. The use of the Truck Parking Tool is demonstrated for Washington County (**Figure 28**).

Figure 28

TRUCK PARKING VISUALIZATION TOOL - WASHINGTON COUNTY



WORST CONGESTION BOTTLENECKS

As with motorists, truck drivers experience congestion along the freeway/expressway and arterial system. An essential objective is to identify where freight operators experience the highest congestion levels. This will allow for various programs and projects in coordination with federal funding to address these freight congestion issues. SHA is accomplishing identifying these locations through the MRPT. This identifies the top bottlenecks based on delay per mile, weighed by truck volume, and normalized by roadway length (in miles). The MRPT tool uses INRIX data conflated to Maryland's Highway Performance Monitoring System (HPMS) GIS for performance analytics.

The Top 5 freight congestion locations include:

- I-495 Inner Loop at I-270 Spur
- I-95 SB at MD 24
- I-270 SB at MD 109
- I-270 NB at MD 109
- US 50/US 301 EB at Bay Bridge

MARYLAND FREIGHT CONGESTION COSTS

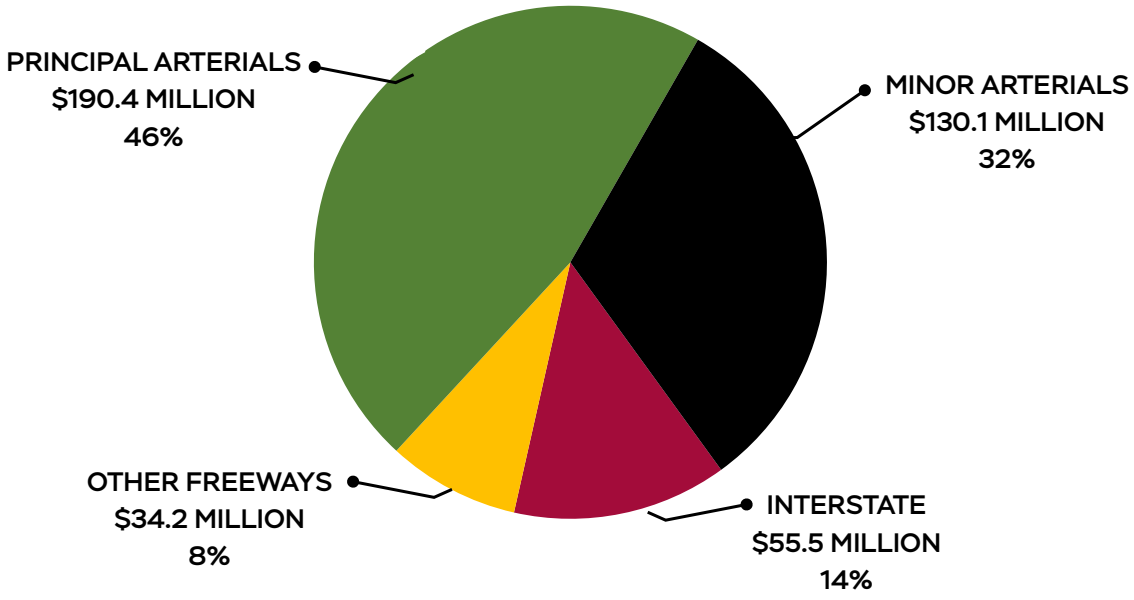
During periods of recurring and non-recurring congestion, all drivers' arrivals at their destinations get delayed. This is especially true for truck drivers trying to either pick up freight to transport or deliver goods to the endpoint. It is important for freight operators since they experience congestion costs due to truck driver delays, truck cargo delays, and additional fuel costs. 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 interstates, other freeways/expressways, and arterial roadways. The MRPT was used to determine the cost experienced by truckers moving goods in 2022. The cost experienced by freight operations increased by approximately 17% over 2021 (**Table 25 and Figure 29**).

Table 25

2022 FREIGHT CONGESTION STATEWIDE ($ MILLIONS)[1]				
FACILITY TYPE	2020	2021	2022	CHANGE FROM 2021 TO 2022
Interstate	$14	$43	$56	+13
Other Freeways/ Expressways	$16	$29	$34	+5
Arterials	$196	$278	$320	+42
TOTAL	**$226**	**$350**	**$410**	**+60**

1-Revised methodology based on the Maryland Reporting Performance Tool

Figure 29
2022 FREIGHT CONGESTION COST ON MARYLAND'S SYSTEM



Congestion costs climbed to over $410 million for truck operations along roadways in Maryland.

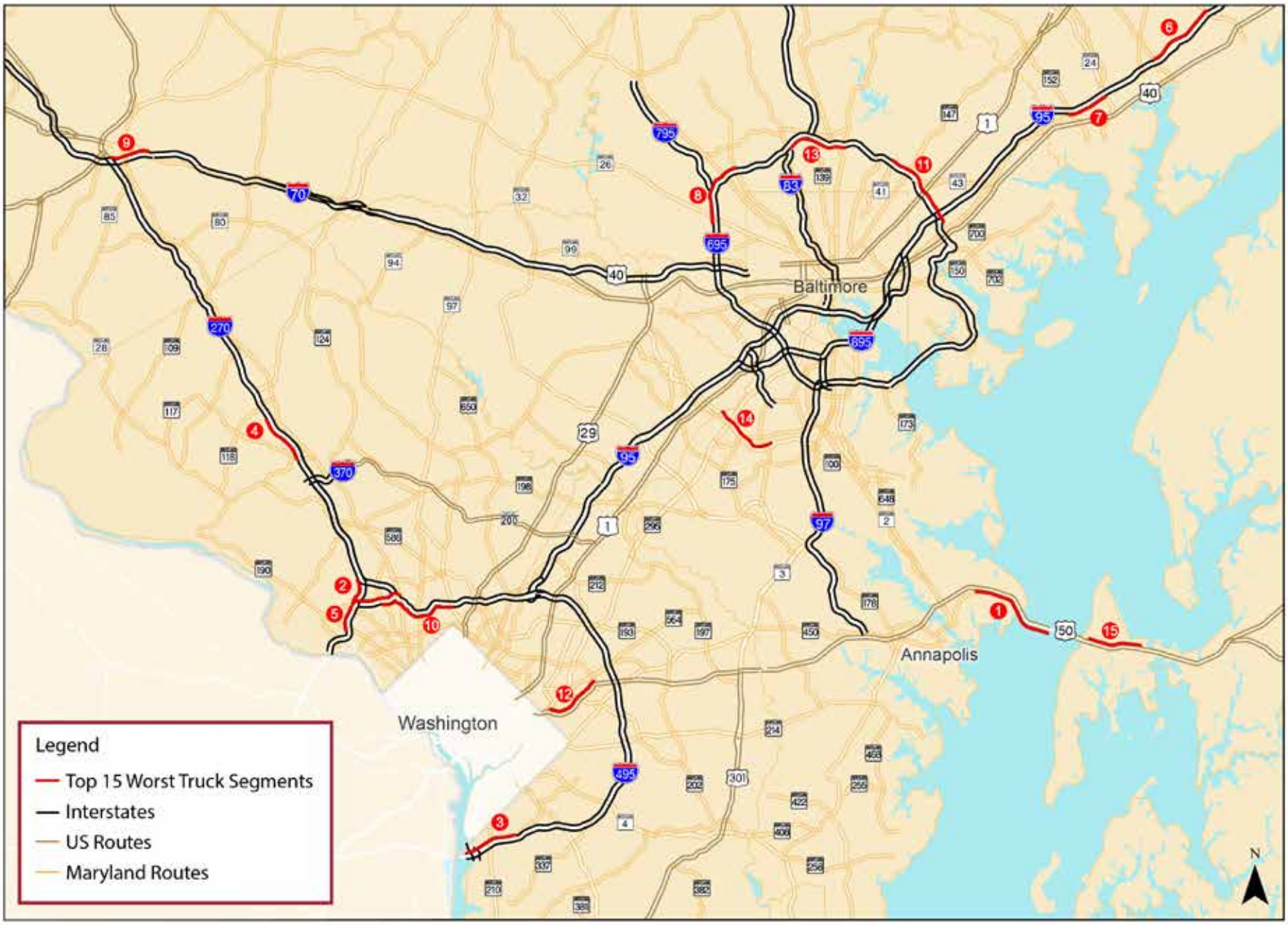
TRUCK TRAVEL TIME RELIABILITY INDEX

As seen during the pandemic, freight and goods movement play a vital role in the economy of both the United States and Maryland. When freight operations are slowed by congestion this has an impact on several aspects such as supplies not arriving on time, spoilage of goods, or additional costs companies must endure due to longer delivery times. To monitor this the Federal Highway Administration (FHWA) requires that a freight performance metric be used to evaluate truck operations. 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 the final system performance. The five time periods are the AM peak period, midday peak period, PM peak period, overnight, and weekends. Each 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 26 and Figure 30**). The higher the TTTR value, the worse the operations are in that segment.

Table 26

2022 TOP 15 WORST CORRIDIORS 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	7.5
2	I-270 West Spur Southbound	I-270 Split to I-495	Montgomery	1.7	6.0
3	I-95/I-495 Inner Loop	MD 414 to I-295	Prince George's	3.9	5.0
4	I-270 Southbound	Middlebrook Road to MD 117	Montgomery	3.1	4.4
5	I-495 Outer Loop	MD 355 to MD 190	Montgomery	3.8	4.4
6	I-95 Southbound	MD 22 to MD 543	Harford	4.1	4.3
7	I-95 Northbound	MD 152 to MD 24	Harford	3.1	4.0
8	I-695 Outer Loop	MD 129 to MD 26	Baltimore	3.5	4.0
9	I-70 Westbound	MD 144 to US 15/US 340	Frederick	3.0	3.9
10	I-495 Inner Loop	MD 187 to MD 97	Montgomery	4.9	3.7
11	I-695 Outer Loop	I-95 to MD 41	Baltimore	3.9	3.6
12	US 50 Westbound	MD 410 to MD 295	Prince George's	3.1	3.4
13	I-695 Inner Loop	I-83 South to MD 146	Baltimore	3.3	3.4
14	MD 100 Westbound	MD 170 to Coca-Cola Drive	Anne Arundel/Howard	3.2	3.3
15	US 50 Westbound	S Piney Road to MD 8	Queen Anne's	3.1	3.2

Figure 30 – Maryland's Worst Corridors for Truck Travel: 2022



MDOT SHA
MOBILITY PROJECTS

MD 210 at Livingston Rd/Kerby Hill Rd

CAPITAL **PROJECTS**

Maryland congestion costs motorists billions of dollars sitting in traffic. The congestion can also lead to crashes. There are various solutions to address roadway issues that lead to congestion. These solutions include transportation management and operations (TSMO), adaptive signals, and capital projects to improve roadways. MDOT selects these projects using 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 such as sidewalks and bike lanes. These improvement projects, which were completed in the 2022 calendar year, provide congestion relief, improve safety, and enhance multi-modal traffic operations.

Capital projects provide a substantial benefit to Marylanders. They decrease congestion, reduce fuel usage, and increase safety. Each capital project was evaluated and the benefits are summarized below (**Table 26**).

Table 26

2022 CAPITAL IMPROVEMENT PROJECTS OPENING YEAR BENEFITS[1]					
COUNTY	ROUTE	LIMITS	CONGESTION & FUEL SAVINGS	SAFETY SAVINGS	ANNUAL COST SAVINGS
			$ (Thousands)		
Anne Arundel	MD 424	Duke of Kent Dr to MD 450	$1,347	$227	$1,374
Baltimore	I-83	Padonia Rd	$6,136	$618	$6,754
Baltimore	MD 30	Gilead Rd	$6	$2	$8
Baltimore	MD 147	Joppa Rd	$458	$11	$469
Charles	US 301	Nice/Middleton Bridge	$824	$3,183	$4,007
Frederick	I-270	MD 85	$4,614	$3,106	$7,720
Howard	MD 32	Linden Church Rd to I-70	$2,563,010	$117,540	$2,680,550
Montgomery	MD 190	Braeburn Pkwy	$2,290	$1,320	$3,610
Prince George's	MD 210	Livingston Rd/Kerby Hill Rd	$51	$14	$65
Worcester	MD 376	US 113 to Flower St	$21,785	$5,062	$26,847
Total			$2,603,632	$130,886	$2,734,518

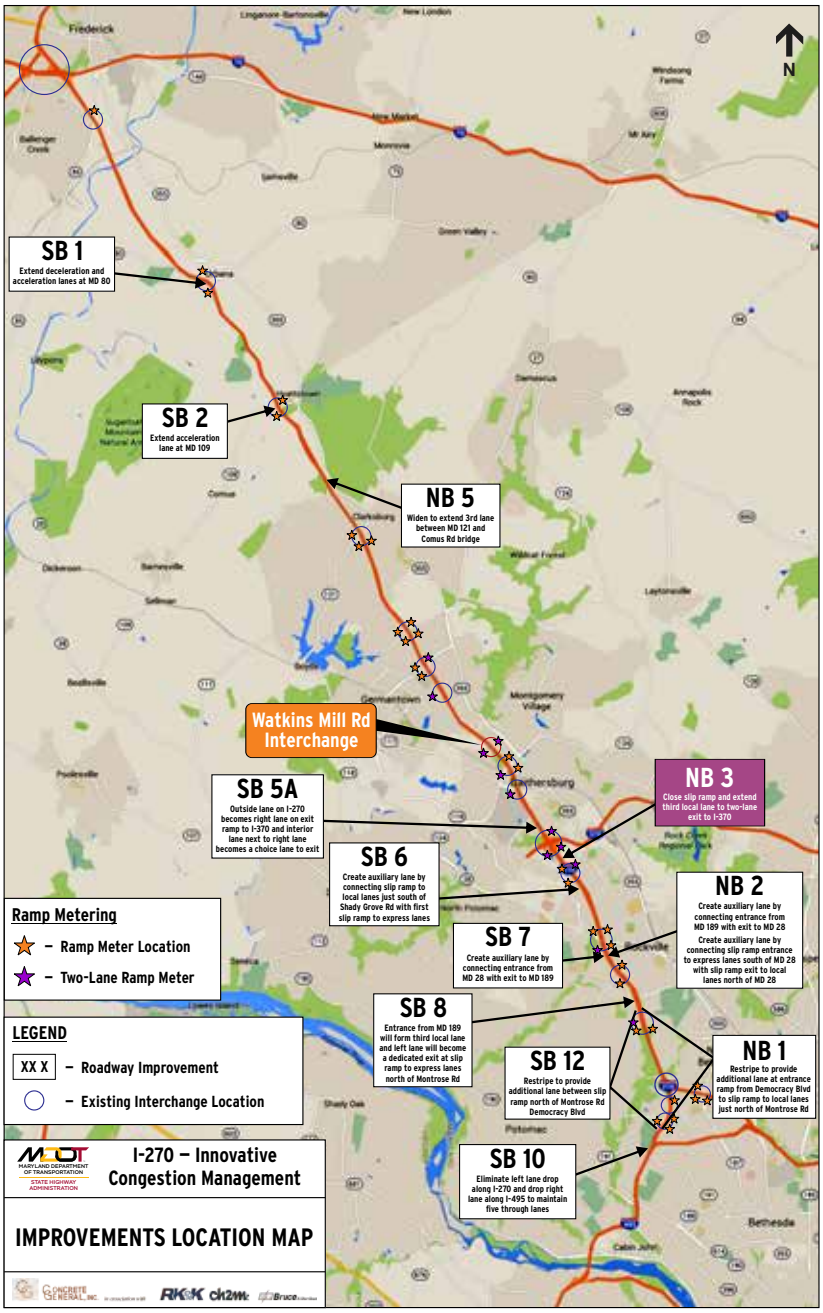
1 - For more details see Mobility Report Supplement.

Capital Improvement projects provided more than $2.7 billion in annual user cost savings during the opening year, which equates to more than $250 million per project, on average.

I-270 INNOVATIVE **CONGESTION MANAGEMENT (ICM)**

The I-270 Innovative Congestion Management improvement project was one of the highest-profile projects in Maryland. I-270 is a critical 30-mile interstate from I-70 in Frederick City to I-495 in Montgomery County, carrying more than 200,000 vehicles per day in some segments. I-270 has been plagued by recurring and non-recurring congestion and delays for many years. To address these issues, MDOT implemented various improvements. These include ramp metering and discrete geometric improvements to improve safety, and reliability, and provide for adaptability to future improvements along the I-270 corridor. These improvement projects afford savings of up to 30 minutes of travel time along I-270 southbound in the AM weekday peak period. The location of each geometric improvement and ramp metering deployment ranges from MD 80 in Frederick County to I-495 in Montgomery County (**Figure 31**).

Figure 31
I-270 CORRIDOR IMPROVEMENTS



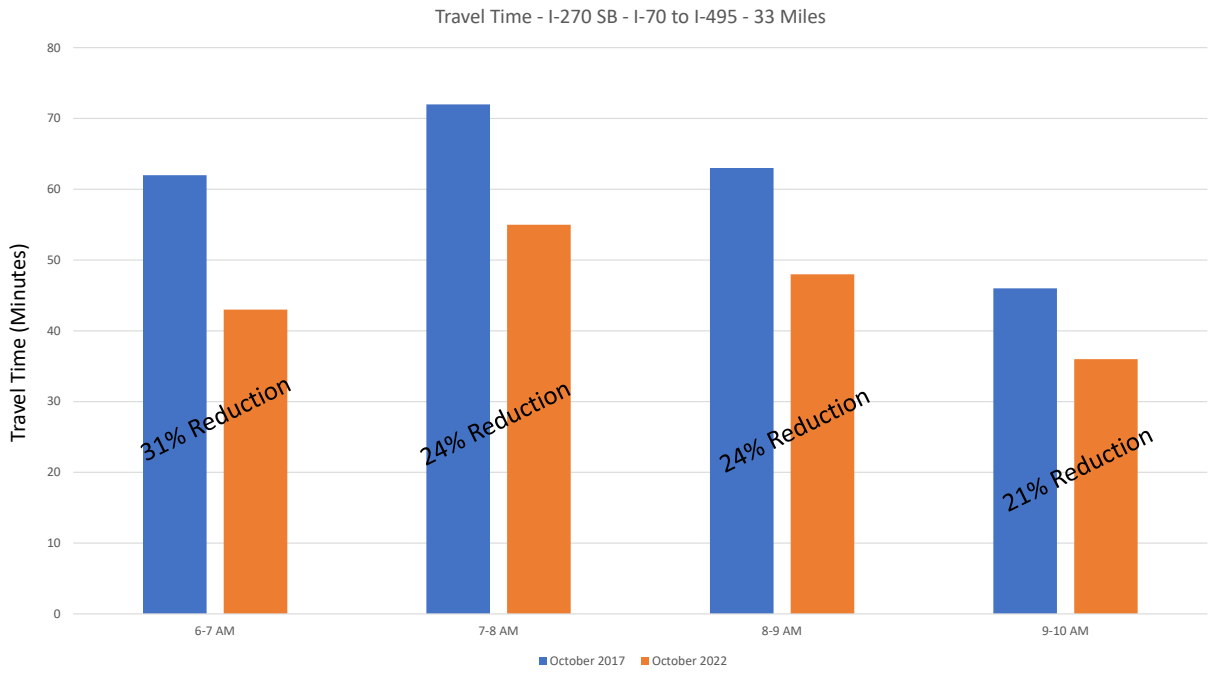
The I-270 ICM project constructed southbound geometric improvements with ramp metering and went live in September 2021. This is the first application of ramp metering in Maryland. So far, it has proven successful with no significant issues.

A regional integrated transportation information system (RITIS) congestion scan comparison based on INRIX data was conducted for the four time periods in September. These include 2017—before any ICM geometric improvements, 2019—ICM geometric improvements before ramp metering, 2021—ICM geometric improvements before ramp metering, and 2021—ICM geometric improvements with ramp metering. For the I-270 mainline southbound from MD 80 to I-495, the results showed that ICM geometric roadway improvements saved up to 31 minutes of travel time and ramp metering saved up to 13% in travel time.

A traffic comparison was conducted immediately before ramp metering took effect. It found that during similar days for the remainder of September 2021, travel time savings were as high as 10 minutes due to ramp metering. Furthermore, comparisons of October 2017, 2019, and 2021 (the first full month that ramp metering was in place) showed up to 17% in travel time savings along the mainline. The local lanes (I-270 local southbound from MD 124 to Y Split), showed up to 13 minutes of travel time savings with ICM improvements and ramp metering in place. Additional RITIS analysis using 2017 and 2022 data shows up to a 43% reduction in travel time (**Figure 32 and Figure 33**).

Figure 32

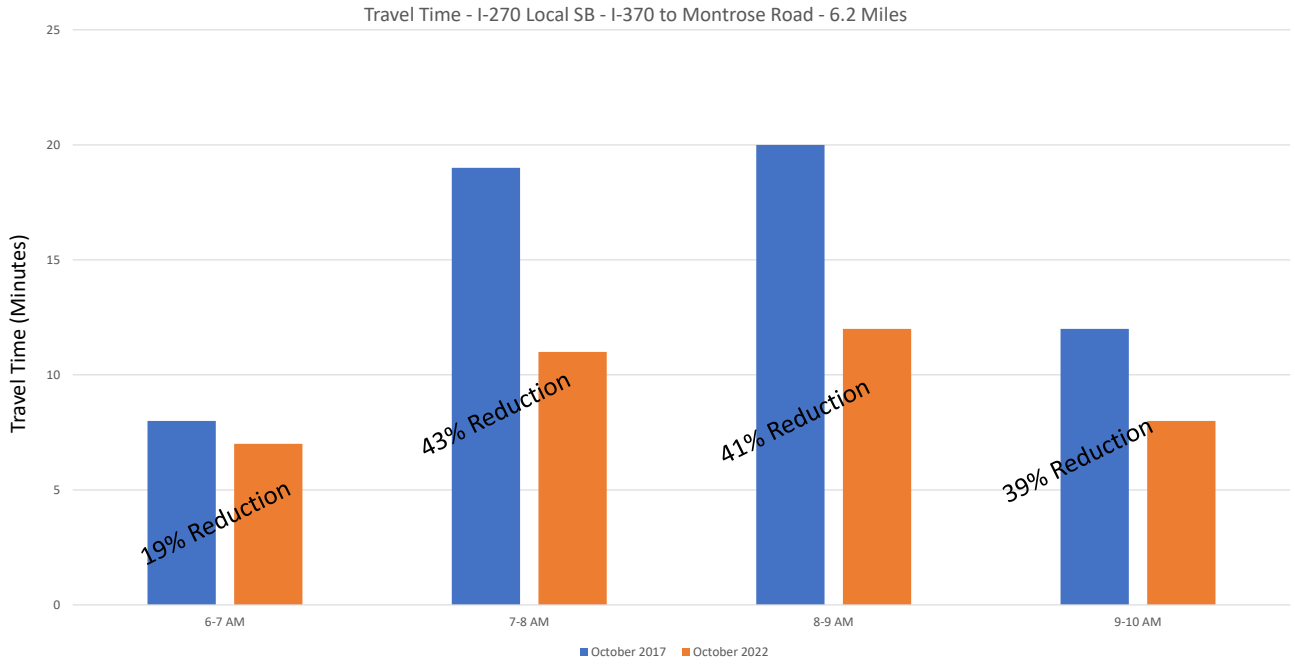
RITIS CONGESTION SCAN DATA 2017 AND 2022 – I-270 SOUTHBOUND FROM I-70 TO I-495



INRIX Data is the average of Tu, We, and Th data in October, excluding data points with accident impact (3 in 2017, 5 in 2022)

Figure 33

RITIS CONGESTION SCAN DATA 2017 AND 2022 – I-270 SOUTHBOUND FROM I-370 TO MONTROSE ROAD



INRIX Data is the average of Tu, We, and Th data in October, excluding data points with accident impact (3 in 2017, 5 in 2022)

I-270 Ramp Metering

PEDESTRIAN **PROJECTS**

A comprehensive multi-modal network allows people to have choices in their trip making. From an environmental and health standpoint, one of the most positive methods to incorporate multi-modal elements is providing a network of sidewalks and trails to promote walking. The MDOT SHA constructs various improvements often as a part of a dedicated pedestrian project or a comprehensive roadway improve ment 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. A major issue for pedestrians is the interaction with vehicles from a safety perspective. These vulnerable users accounted for approximately 130 fatalities in 2022. To improve safety, Maryland constructed new sidewalks in 13 counties (**Table 27**) in 2022. The location of the new sidewalks is shown in the Maryland Mobility Report Supplement.

Table 27

2022 NEW SIDEWALK LOCATIONS		
COUNTY	ROUTE	LIMITS
Anne Arundel	MD 170	Faith Rd to MD 174
Anne Arundel	MD 174	at Oak Station Rd
Anne Arundel	MD 174	MD 170 to Severn Elementary School
Anne Arundel	MD 175	MD 713 to Royal Farms
Anne Arundel	MD 175	at Odenton Auto Spa Express
Anne Arundel	MD 436	at Giddings Ave
Anne Arundel	Hammonds Ln	at MD 648
Baltimore	MD 137	Royal Farms to Hereford Shopping Center
Baltimore	MD 140	at Pleasant Ridge Dr
Baltimore	MD 151	at Amazon DCA1 Offsite Lot
Baltimore	MD 151	at Finishing Mill Rd
Baltimore	US 1	at State Highway Administration
Baltimore	Innovation St	at MD 43
Carroll	MD 30 BUS	at Tevis Home Store
Carroll	MD 140	at Malcolm Dr
Carroll	Washington Rd	at Gist Rd/Margaret Ave
Cecil	MD 272	Northeast Plaza to US 40
Cecil	MD 272	US 40 to Northeast Library Sidewalk
Cecil	MD 279	at MD 277
Cecil	US 40	at Commerce Center Dr
Cecil	US 40	at Maudin Ave
Charles	MD 5	at Tower Self Storage
Charles	MD 228	at Jenifer School Ln
Charles	US 301	at Smallwood Dr
Dorchester	MD 343	Canvasback Way to Foxtail Dr

Dorchester	MD 343	Red Bill Ln/West Side Bypass to Foxtail Ln
Frederick	MD 17	at US 40
Frederick	MD 85	Westview Promenade to Darcars Toyota
Frederick	MD 85	at Crestwood Blvd
Frederick	MD 355	Urbana Pike/Worthington Dr to Thornapple Dr/Campus Dr
Harford	US 1 BUS	at Bell Gate Centre
Howard	MD 99	at Wetherburn Rd/Maplewood Dr
Howard	MD 103	at Hunters Hollow Rd
Howard	MD 103	at Bethel Baptist Church
Howard	US 1	at Paddock Pointe Townhomes
Howard	US 1	at Ridgelys Run Rd
Montgomery	MD 97	Hollow Crest Dr to Owens Rd
Montgomery	MD 121	Broadway Ave to W. Old Baltimore Rd
Montgomery	MD 355	at Newcut Rd
Montgomery	MD 355	W. Old Baltimore Ave to Milestone Manor Ln
Montgomery	MD 355	Woodport Rd to Running Brook Rd
Montgomery	US 29	at Tech Rd
Montgomery	Stewart Ln	at US 29
Montgomery	Tech Rd	at Tech Rd Park & Ride
Prince George's	MD 210 Service Rd	Kerby Hill Service Rd to MD 210
Prince George's	MD 210 Service Rd	Kerby Hill Rd to Southbound MD 210
Prince George's	MD 210 Service Rd	Wilson Bridge Dr to Kerby Hill Rd
Prince George's	MD 223	Sherwood Dr to Dower House Rd
Prince George's	Kerby Hill Rd Service Rd	Kerby Hill Rd Service Rd to MD 210
Prince George's	Kerby Hill Rd Spur	at MD 210 SB Ramp
Prince George's	Indian Head Hwy Service Rd	at MD 210 Service Rd
Prince George's	Livingston Rd	MD 210 to Murry Hill Dr
Prince George's	Naylor Rd	at L&V Crab Cafe
Prince George's	US 1	at Academy Ln
Wicomico	MD 346	at Beaver Run School
Worcester	MD 376	at Dollar General/Flower St

MDOT SHA constructed almost seven miles of new sidewalks and reconstructed more than five miles of sidewalks. To date, 71% of sidewalks are ADA-compliant along Maryland Routes.

BICYCLE **PROJECTS**

There are many benefits to providing a robust multimodal transportation system. Fewer vehicles on the road improves air quality and provides transportation equity and health benefits for the citizens of Maryland by encouraging an active lifestyle. One of the many methods SHA uses to promote multimodal transit is by providing facilities as part of roadway projects and through separately funded initiatives.

Capital for these projects is received through a wide variety of sources—ranging from money set aside for bicycle facilities to funding as part of resurfacing, maintenance, safety, and capacity improvement projects.

The SHA has established a complete street policy to support these initiatives. The policy strives to improve bicycle safety and accessibility. The projects include upgrades to 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 the bicycle projects. A sample of some of those bicycle facility upgrades and the type of improvement are included in the table (**Table 28**).

Table 28

2022 SELECTED BIKE FACILITY UPGRADE LOCATIONS

COUNTY	ROUTE	LIMITS	IMPROVEMENT
Frederick	MD 85	Pegasus Ct to Spectrum Dr	1.0 miles of bike lanes
Howard	MD 103	New Cut Rd to Wheatfield Way	0.3 miles of pocketed bike lanes
Howard	MD 108	Linden Linthicum Ln to Centennial Ln	4.3 miles of bike lanes
Montgomery	MD 187	Nicholson Ln to South of I-495	2.3 miles of buffered bike lanes
Prince George's	MD 193	Cherrywood Ln to Kenilworth Ave	0.7 miles of bike lane
Prince George's	MD 214	MD 202 to Jennings Mill Rd	4.8 miles of bike lanes
Worcester	MD 707B	MD 452 to MD 589	1.4 miles of bicycle signage

There was a 15-mile increase in directional miles for marked bicycle facilities in 2022.

FREIGHT **PROJECTS**

There are two categories of freight projects that elevate mobility and safety to the highest level. 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 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. The system provides auto issuance of applications for loads meeting pre-determined thresholds whose routes pass analysis. Data analysis is performed on various parameters including route, dimensions, weight, starting and ending point to show various patterns in movement of cargo in and through Maryland.

The improved automated hauling permit system now auto-issues approximately 88% 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, 96% of all permits are issued within two hours or less and 99% are issued within two days or less. Megaload permits (up to one million pounds) require coordination between multiple agencies and take longer to process.

Presently, the SHA Motor Carrier Division is working on several enhancements including:

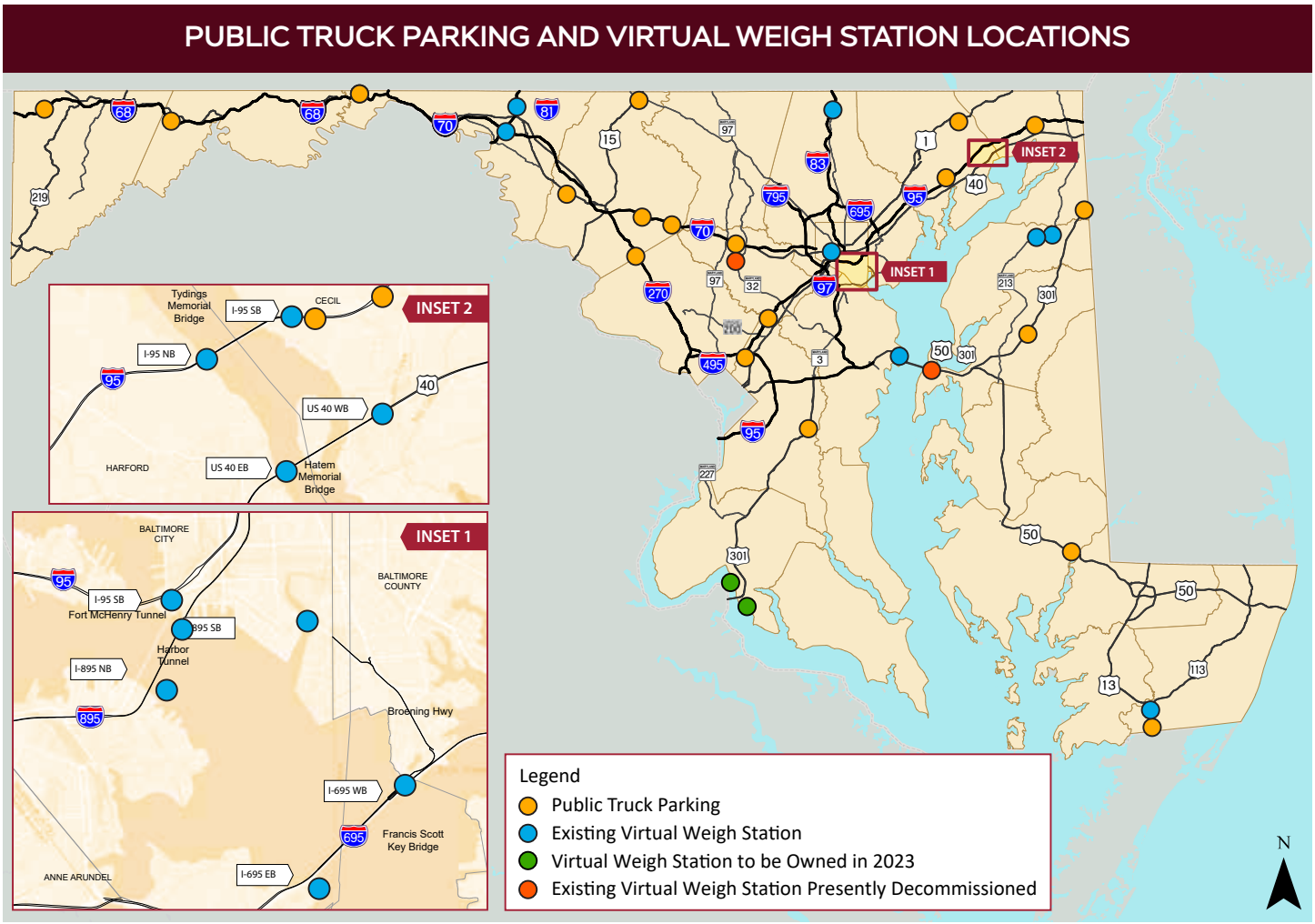
- **County Roads** - adding County Road bridge data and restrictions, to automate the process of county approvals.
- **Drivewyze** - adding messaging through Drivewyze
- **Enhanced Driving Directions** - enhanced driving directions such as turn-by-turn directions and bridge restrictions. An app will also be available for speaking directions.
- **Escort Queue** - providing transparency across agencies regarding escorting.
- **Permit Harmonization** - harmonizing permit labels and locating updated data.
- **Port Night Order Queue** - enhance customer experience when scheduling access to the Port of Baltimore at night. They are currently required to call with a limited window. This queue will be available 24-7, and Port personnel will have access to approve electronically.
- **Route Authorization** - routes will be added as a requirement to blanket permits to enhance the ability to capture freight numerical data for actual trucks traveling on roads versus general statewide information.
- **Work Zone Data** - incorporating work zone information to Maryland One

US 50/301 Virtual Weigh Station

The Motor Carrier Division is also responsible for constructing and maintaining Virtual Weigh Stations (VWS). These 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. Two of these sites were commissioned last year at MD 213 northbound and southbound in Galena, Cecil County. An additional two new sites have been constructed at US 301 Thomas "Mac" Middleton Bridge and will be transferred over in 2023. The MD 32 site in Howard County and the US 50 westbound site at the Bay Bridge are currently decommissioned at this time (**Figure 34**).

In 2022, Maryland became the first state to be OIML F5 certified to perform high-speed enforcement. This is a major accomplishment. Maryland will accomplish this through KI digital traffic weigh-in-motion and tire anomaly sensors. In addition, an evaluation is underway to construct the first high-speed direct enforcement VWS site along I-83 near Middletown Road with USDOT and using license plate recognition technology. This will involve creating a new class of WIM standard (WIM Class E) and will be the basis for the test site on I-83.

Figure 34



One major safety concern in urban areas such as Baltimore and Washington is finding enough places for truck drivers to park for rest. Truck parking at rest areas and welcome centers provide safe, off-road locations (**Figure 34**) 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.

To address the issues with truck parking, SHA is moving forward with a two-pronged approach. The first is through expansion and the second is through driver information. Expansion is not limited to state-owned locations but working with local governments and private entities throughout the State to find ways to increase truck parking. Driver information is provided through SHA's Truck Parking Visualization Tool which includes state-owned lots, capacity of each lot, a capacity ratio, and a ratio of trucks parking on shoulders identifying the lot is full. In addition, SHA is working to establish freight traveler and truck parking information systems that can alert drivers to available parking and determine how to push existing data available to the freight community.

OVERNIGHT TRUCK PARKING EXPANSION

I-70 South Mountain Welcome Center Frederick County – 25 added spaces under design

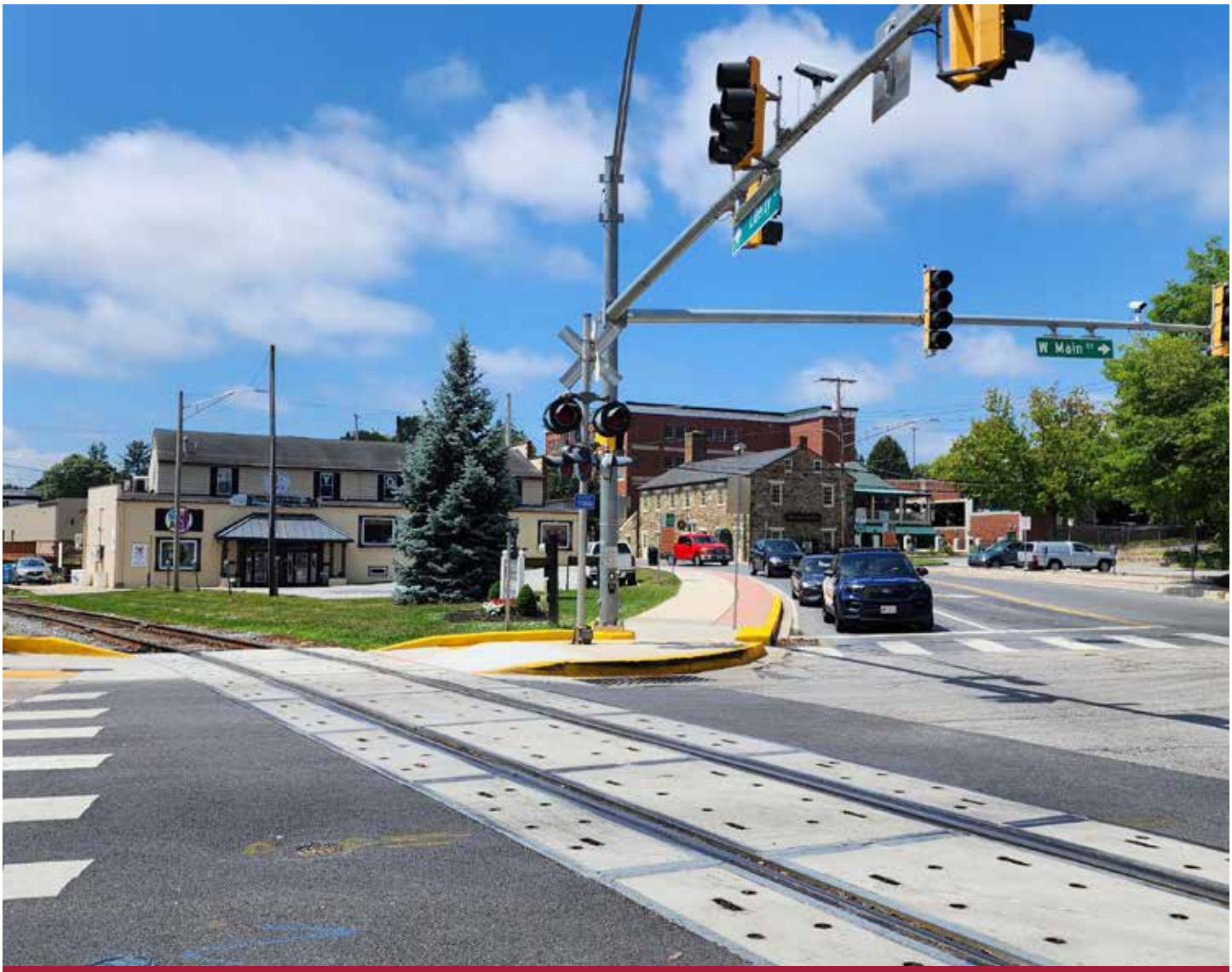
I-70 Welcome Center

RAILROAD GRADE **CROSSING PROJECTS**

Motorists and trains interact at locations where at-grade crossings exist. These locations can present a safety issue for all transportation users. Each year SHA provides safety improvements for locations with at-grade railroad crossings to either eliminate hazards or improve traffic control devices. These improvements include but are not limited to installing new flashing light signals (with or without gates), updating the components at existing active warning devices, and improving crossing surfaces. In 2022, SHA completed the construction of two projects to improve at-grade crossings:

- MD 27/Main Street– City of Westminster, Carroll County
- MD 75 – Union Bridge, Carroll County

In addition to improvements in 2022, MDOT officially reestablished the Maryland Operation Lifesaver Program, focusing on rail safety education. Additional information can be found at www.oli.org.



MD 75 Union Bridge

DEVELOPER **PROJECTS**

New developments or redevelopments are one of the major channels to assist in the growth of Maryland's economy. These developments include a variety of uses including residential units, commercial centers, office buildings, industrial sites, and warehouses. These developments generate more traffic to and around the site.

Developers are often required to mitigate the additional volume to ensure that other roadway users are not negatively impacted. In 2022, these wide-ranging improvements included intersection modifications, enhancements for pedestrian, bicycle, and transit, interchange improvements, and access improvements such as acceleration and deceleration lanes **(Table 29)**. Through a joint permitting process, 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 29

2022 SELECTED DEVELOPER IMPROVEMENT PROJECTS

COUNTY	ROUTE	LIMITS	IMPROVEMENT
Anne Arundel	MD 170	Minnetonka Road	Right turn lane addition
Anne Arundel	MD 3	Evergreen Road	Left turn lane addition
Cecil	US 40	MD 279	2nd left turn lane addition
Harford	MD 543	I-95 Southbound Ramp	2nd left turn lane addition
Frederick	I-70	Meadow Road	New exit ramp and widening MD 144 FA
Frederick	MD 355	Stone Barn Drive	Thru, left, and right turn lane addition
Montgomery	MD 119	MD 28 to Sam Eig Highway	Northbound lane addition

MD 543 at I-95

MDOT PROGRAMS TO IMPROVE
MOBILITY 2022 RESULTS

I-270 at MD 124 Park-and-Ride Lot

COORDINATED HIGHWAYS **ACTION RESPONSE TEAM (CHART)**

A major effort put forth by all transportation agencies is how to make use of the roadway network to its fullest potential. Often this is at its most visible when incidents or other events occur such as vehicle breakdowns, work zones, or poor weather that impacts travel. These non-recurring congestion events affect the mobility, safety, and reliability of the roadway system particularly given the fact that waiting for an incident to clear directly influences motorist mobility and reliability. This in turn can cause secondary incidents that can affect safety, for instance when an original incident causes drivers to slow or stop suddenly, resulting in another crash.

SHA aims to improve safety and mitigate non-recurring and recurring congestion. This goal is often accomplished through projects, which are vital to improving mobility. However, SHA has also established programs to help improve traffic flow and reduce congestion. These programs incorporate methods such as reducing demand on a specific roadway and making better use of existing pavement to deal with mobility issues.

One such program is the Coordinated Highways Action Response Team (CHART), which 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 utilizing TSMO solutions. The CHART program finds primary incidents quickly, allowing emergency personnel to be alerted and minimizing the time motorists spend in congestion, therefore saving them time and money. The improved response time reduces the potential for secondary collisions and thereby, lowers the cost impact of these incidents. The typical approach of CHART incident management is shown below.

CHART INCIDENT MANAGEMENT PROCESS

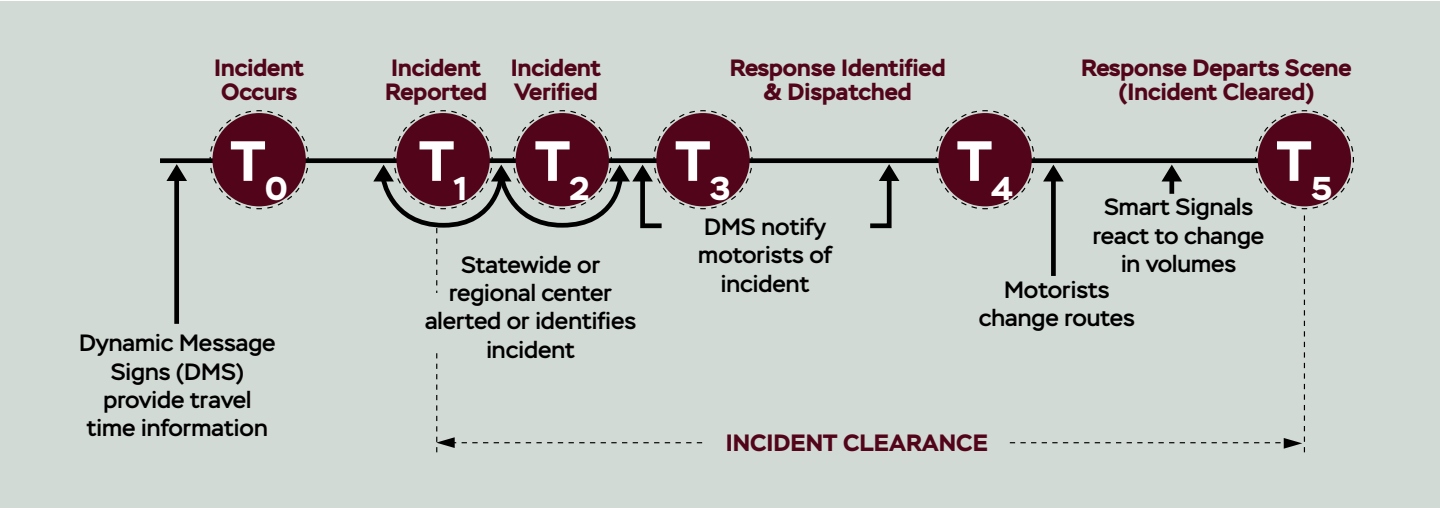


CHART is involved in the following core functions to address non-recurring congestion:

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

The resources dedicated to traffic management include:

- 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

The key to the ability for CHART to respond is based on a distinct set of data that is collected to evaluate how the roadway system is operating. This data is collected from a variety of ITS equipment, strategically placed throughout the state. Travel time information is made available based on the analysis of INRIX probe speed data, and 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.

CHART can access:

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

Data 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.

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:

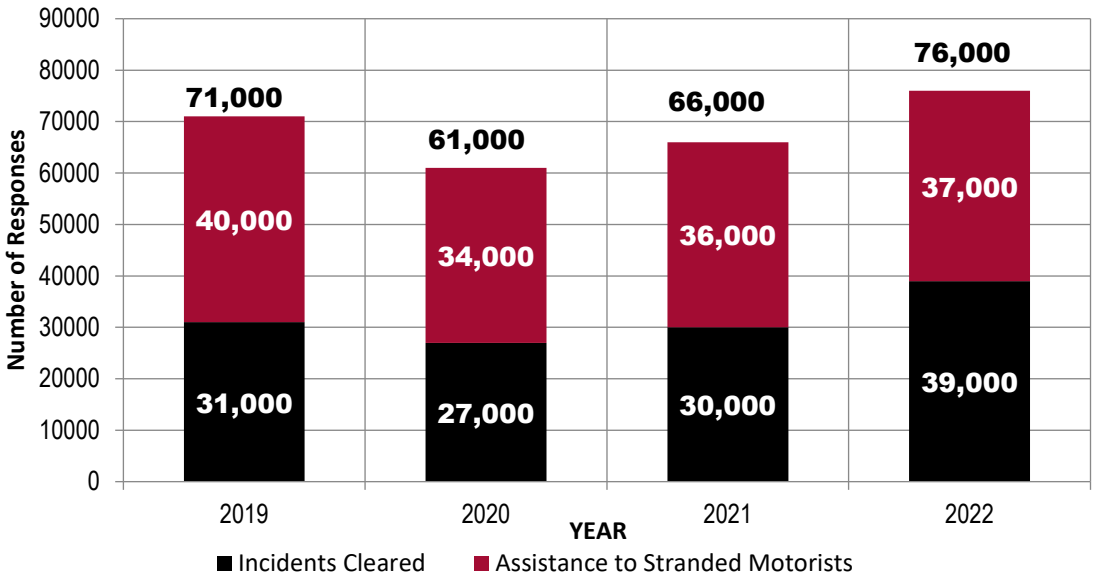
- Baltimore and the National Capital Region (Full-time 24/7 Patrols)
- Annapolis and Frederick
- Eastern Shore (Summer)

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

I-695 Outer Loop near MD 144

ERTs made approximately 76,000 service calls to address motorists' and emergency response agency needs along state roads. These calls included responding to approximately 39,000 incidents along Maryland roadways and more than 37,000 service calls for aid to motorists **(Figure 35)**. This aid included changing flat tires, supplying hotshots, and delivering fuel. This total represents the highest number of responses ever recorded.

Figure 35
EMERGENCY RESPONSE TECHNICIAN RESPONSES



The high volumes of traffic on many roadways mean that the longer an incident is on the roadway, the greater the delay to other motorists. 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. In the past year, CHART has reduced the duration of incidents thereby increasing the number of hours of delay that were saved **(Figures 36 and 37)**.

Figure 36
CHART REDUCTION IN DELAY

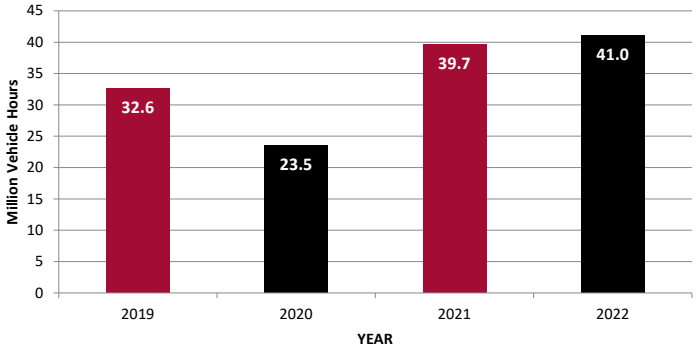
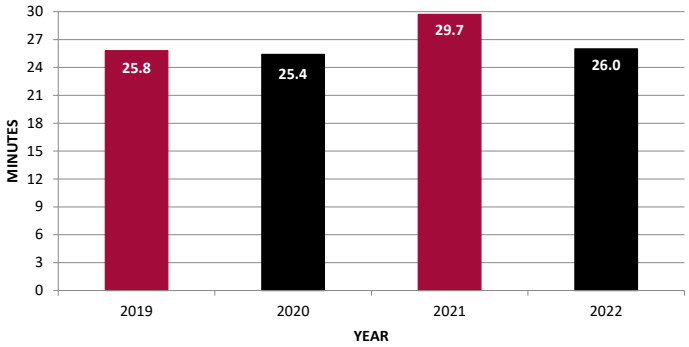


Figure 37
AVERAGE INCIDENT DURATION



The time saved through reductions in delay translates into savings in annual user costs for Maryland travelers, amounting to $2.03 billion in 2022 **(Figure 38)**. Annual user cost savings include a reduction in delay and savings in fuel and emissions.

Figure 38
CHART ANNUAL USER COST SAVINGS

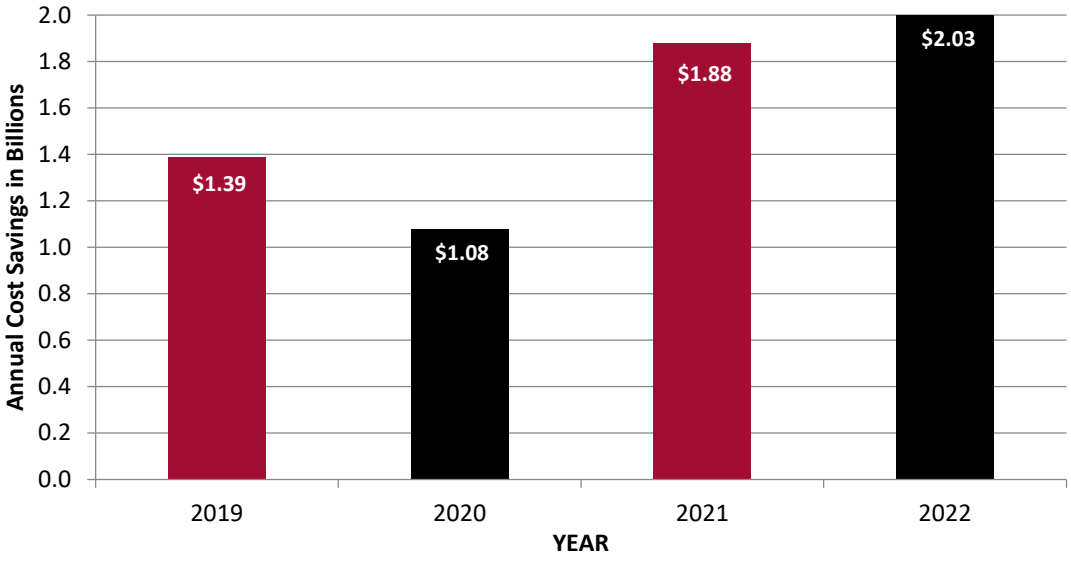


CHART services delivered a record annual benefit of $2.03 billion and ERTs responded to almost 76,000 service calls, an all-time high.

SIGNAL **OPERATIONS**

Traffic signals are a key element to ensure that motorists move safely and efficiently along many arterial, collector, and local roadways. If signals are poorly timed, motorists may take risks such as running the red indication which can lead to crashes. Also, motorists become frustrated if they feel they get stopped at every signal. To reduce delay and increase mobility, traffic signal timing improvements are 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 into a signal system that allows motorists to progress along an entire corridor more efficiently. Statewide, SHA owns 2,830 signals, with Montgomery County maintaining approximately 575 of those signals *(Note: SHA also maintains locally owned signals in certain counties)*.

The SHA system consists of:

- 2,339 SHA Maintained Traffic Signals of which 1,591 are coordinated
- 268 Signal systems

To improve signal timing and operations, SHA reviews select corridors each year. In 2022, the signal timings for 79 signals in 15 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 integrating INRIX Signal Analytics to address operational issues.

The overall Improvements for the fifteen systems:

- Reduced over 650,000 hours of delay
- Reduced delay by approximately 13%
- Saved an estimated 255,000 gallons of fuel
- Saved users $30.2 million annually

MD 272 at Rogers Rd

In 2022, the highest annual delay savings occurred along three systems in Prince George's County **(Table 30)**.

Table 30

2022 NETWORK DELAY SAVINGS FOR MDOT SHA SIGNAL SYSTEMS UPGRADES				
ROUTE	LIMITS	COUNTY	NO. OF SIGNALS	DELAY SAVINGS (VEH-HRS)
MD 337	Old Branch Ave to Allentown Mall	Prince George's	3	380,000
MD 450	MD 450 –MD 193 to Racetrack Rd, MD 197 – MD 450 to Tulip Grove Rd	Prince George's	17	77,000
MD 202	I-95/I-495 NB Ramp to White House Rd	Prince George's	10	75,000
MD 32	MD 144 to MD 99	Howard	4	40,000
MD 2	Virginia Ave to MD 214	Anne Arundel	7	30,000
MD 210	Palmer Rd to Old Fort Rd (South)	Prince George's	5	15,000
MD 24	Red Pump Rd to MD 23	Harford	4	12,000
MD 450	King George Dr to Perry Circle	Anne Arundel	2	12,000
MD 272	Rogers Rd to Northeast Plaza	Cecil	2	8,000
MD 201	Cherrywood Ln to I-95/I-495 SB Ramp	Prince George's	6	8,000
MD 45	MD 45 – Shawan Rd to Wight Ave; Shawan Rd-MD 45 to McCormick Rd	Baltimore	6	4,000
US 40	66th St to Batavia Farm Rd	Baltimore	4	2,000
MD 8	Thompson Creek Rd to MD 18	Queen Anne's	4	< 1,000
MD 450	Chinquapin Round Rd to Admiral Dr	Anne Arundel	2	-10,000
Coca Cola Drive	MD 103 to MD 100 WB Ramp	Anne Arundel	3	N/A
	TOTAL		**79**	**653,000**

N/A – Delay savings predicted for 2023

The highest overall largest delay reductions by percentage were:

- MD 337 Prince George's County – (59%)
- MD 450 Prince George's County – (40%)
- MD 32 Howard County – (17%)
- MD 450 Anne Arundel County – (10%)

TRANSIT **SIGNAL PRIORITY**

To maximize transit ridership, it is of paramount importance that buses maintain schedules so passengers know they will be getting to their destination on time. One way to assist in accomplishing this along congested corridors is to provide a travel time advantage. Transit signal priority (TSP) at signalized intersections allows for buses to gain this 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 TSP systems are operating:

Ride On extRa service (Montgomery County):

- MD 355 – Lakeforest Mall to Medical Center METRO Station – 30 signals
- Buses operating on the corridor made over 427,000 TSP requests at signalized intersections.

Ride On FLASH service (Montgomery County):

- US 29 – Burtonsville to Silver Spring METRO – 15 signals
- There were over 1,487,000 TSP requests at signalized intersections along the corridor

US 29 Ride On FLASH Bus

SMART/ADAPTIVE **SIGNAL SYSTEMS**

Traffic patterns along a corridor vary from minute to minute and hour to hour. Signal timings on most corridors are programmed to provide the best progression of traffic while ensuring that side-street delays are reasonable. The timing allocated for movements along a corridor is typically dictated by traffic data collected in the past but can be improved with real-time data and SMART/adaptive systems technology.

SMART signals use computer software that responds to real-time traffic conditions, effectively deploying delay optimization algorithms to keep traffic moving. These systems maximize the green time for the major roadway while considering the operation of the minor street. The SMART signals are connected at multiple intersections along a major roadway corridor to 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. This technology has been implemented on some of SHA's most congested corridors.

Adaptive signal systems have been implemented in 20 congested corridors throughout the State to reduce delays. These included one new system with six signals, which became operational in 2022 **(Table 31)**. A comparison was made of the delay savings these adaptive signal corridors provided by using PTI values **(Table 32)**. This was based on 2022 versus 2019 data since COVID-19 impacted data from 2020 and 2021, so a valid correlation could not be made.

Table 31

2022 ADAPTIVE SIGNAL IMPLEMENTATION CORRIDORS

ROUTE	LIMITS	COUNTY	NO. OF SIGNALS
MD 45	MD 45: Timonium Rd to Fairgrounds Entrance/ Timonium Rd: MD 45 to I-83 Ramp	Baltimore	6

MD 26 adaptive signal system at Lord Baltimore Dr

Table 32

2022 ADAPTIVE SIGNAL IMPLEMENTATION CORRIDORS BENEFITS			
ROUTE	LIMITS	COUNTY	% IMPROVEMENT FROM BEFORE SYSTEM IMPLEMENTATION TO 2022[1]
MD 2/MD 178/ MD 450	MD 2: Forest Dr to MD 450; MD 178/MD 450: MD 2 to Bestgate Rd	Anne Arundel	Up to 5%
MD 2	Hammond Lane to 11th St	Anne Arundel	Up to 31%
MD 2	Annapolis Harbor Dr to Tarragon Ln	Anne Arundel	Up to 7%
MD 3	MD 450 to St Stephens Church Rd	Anne Arundel	Up to 5%
MD 7	MD 588 to Rossville Blvd	Baltimore	N/A
MD 26	Kelox Rd to Offut Rd	Baltimore	Up to 3%
MD 139	Kenilworth Ave to I-695 Ramp	Baltimore	N/A
US 40	Nuwood Dr to Coleridge Rd	Baltimore	Up to 17%
US 40	Golden Ring Rd to Rossville Rd	Baltimore	N/A
MD 140/MD 31	MD 140: Market St to MD 31 & WMC Dr to MD 832/ MD 31: Main St to Uniontown Rd	Carroll	Up to 10%
US 301/ MD 228/MD 5	US 301: Chadds Ford Rd to Smallwood Dr; MD 228/MD 5 Business: Western Pkwy to Post Office Rd	Charles	No improvement
MD 22	Technology Dr to US 40	Harford	Up to 14%
MD 24	Singer Rd to Boulton Rd	Harford	Up to 30%
US 1	Montgomery Rd to MD 175	Howard	Up to 23%
US 40	Chatham Rd to Normandy Center	Howard	Up to 3%
MD 198	Sweitzer Rd to Old Gunpowder Rd	Prince George's	Up to 15%
MD 202	I-95/I-495 Ramps to Arena Dr	Prince George's	Up to 11%
US 301	Governor Bridge Rd to Pointer Ridge Rd	Prince George's	Up to 27%
US 13 Bus	Winner Blvd to Centre Rd	Wicomico	Up to 15%

1 - Represents greatest improvement for AM or PM in-peak or off-peak direction
N/A – Data is available only in longer segments so analysis could not be performed

Two adaptive systems are no longer operational. These are both in Anne Arundel County along MD 2. This involved 11 signals from the MD 10 ramp to Arnold Rd and 10 signals from the MVA Entrance to MD 270 along with the signals that were part of that system along MD 710 from MD 2 to Chesapeake Center Dr.

PARK AND RIDE **LOTS**

The goal of making the most efficient use of any roadway to improve mobility can be enhanced by reducing the number of single-person trips. A method to connect motorists and provide access to multi-modal options is through a network of park-and-ride lots. The park-and-ride sites at certain locations can be used for trucks to park overnight so they are not causing a safety hazard on the road. These lots are constructed by state and county agencies. SHA and MDTA maintain the largest number of locations, with 112 park-and-ride lots in 21 counties including shared lots with MTA. There are additional park-and-ride locations operated by MTA and other transit and local agencies. There are over 14,000 spaces at SHA and MDTA lots which 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.

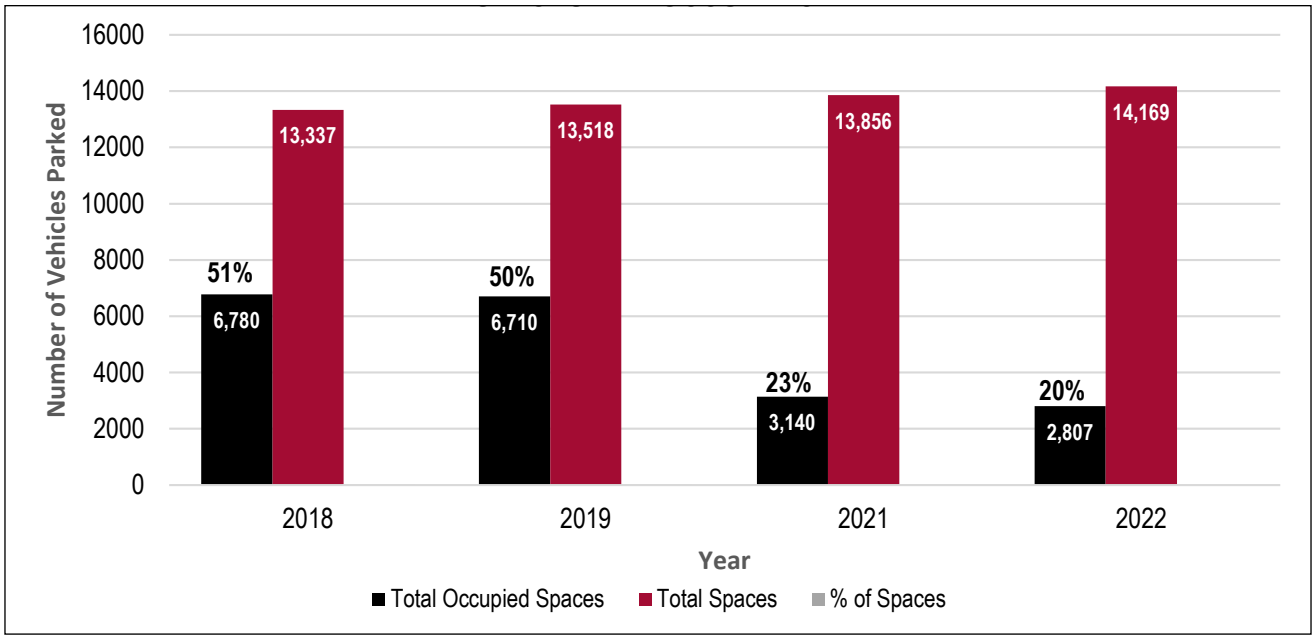
The SHA conducts a survey of all facilities to assess the number of people parking in the lots. The usage of the park and ride lots is substantially below the levels before COVID-19. During the 2022 survey, there were 2,800 vehicles parked in the lots, compared to 6,700 vehicles during the 2019 survey. This is a decrease of 3,900 motorists or 58% since 2019 **(Figure 39)**.

The highest volume locations where motorists were parking, and the average number of vehicles parked at those lots are:

- I-95 at I-495 (170)
- I-270 at MD 117 (134)
- I-270 at MD 124(125)
- MD 210 at MD 373 (118)
- MD 32 at Broken Land Parkway East and West Lots (114)
- MD 665 at Riva Rd (112)

Figure 39

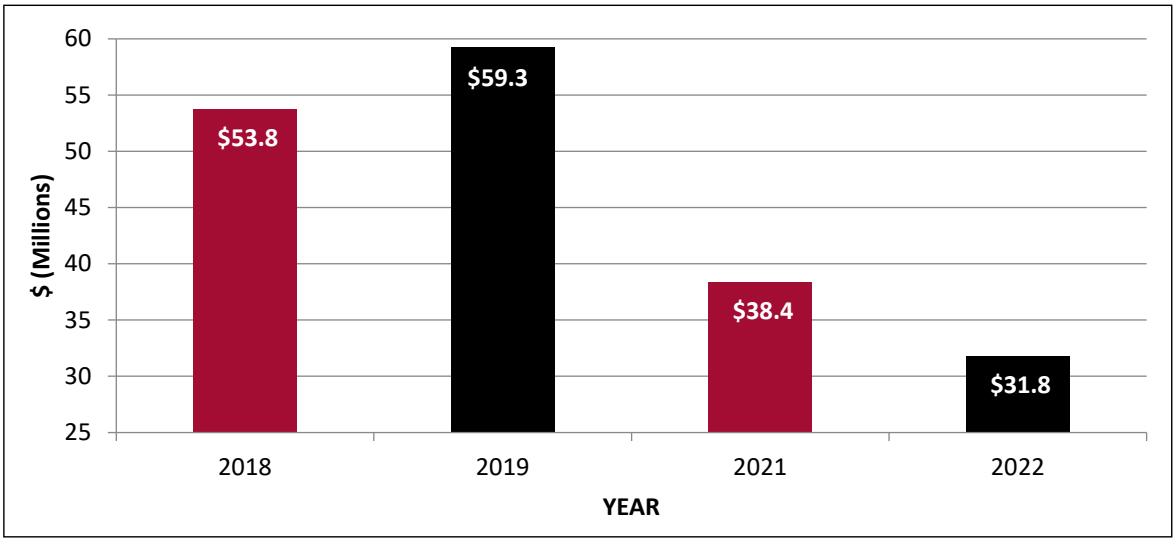
SHA/MDTA PARK AND RIDE LOT SPACES AND OCCUPANCY



Note: Data was not available for the year 2020

The availability of these park-and-ride lots reduced the amount of VMT driven on Maryland roadways and resulted in approximately $32 million in annual cost savings in 2022 **(Figure 40)**. This benefit decreased from 2021 due to a lower number of motorists parking at the lots which has continued to occur since the start of COVID-19.

Figure 40
SHA/MDTA PARK AND RIDE LOT SAVINGS TO MOTORISTS (MILLIONS)



Note: Data was not available for the year 2020

One new lot was constructed and the expansion of two lots occurred over the past years. The new lot was added at the MD 5/MD 373/Spine Road interchange. Reconstruction of park and ride lots to add spaces occurred at US 15 and Mount Zion Road and the Broken Land Parkway west lot.

The MDOT MTA and the Washington Metropolitan Area Transit Authority (WMATA) operate lots to support their transit operations. The MTA has supply connections to light rail, MARC, Baltimore METRO, and bus service, while the WMATA lots provide service to the Washington Metrobus and Metrorail systems.

SHA and MDTA Park and Ride lot usage dropped over 50% from 2019. Approximately 400 additional parking spaces are available to motorists via park-and-ride lots constructed since the beginning of 2021.

HIGH OCCUPANCY VEHICLES **(HOV) LANES**

Among the strategies implemented in Maryland to improve upon the number of persons traveling at one time (person throughput) along a freeway are high occupancy vehicle (HOV) lanes. These lanes are used to encourage carpooling and increase the person throughput that uses a roadway without expanding the number of lanes. These lanes provide 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. There are two corridors in the Washington DC region where HOV lanes are present. The HOV lanes are located in Montgomery and Prince George's Counties.

The location, direction, and operational hours are 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]

Only vehicles with two or more occupants, transit vehicles, motorcycles, or plug-in electric vehicles may use these lanes. Previous studies showed the I-270 HOV lanes can provide from a few minutes to approximately 10 minutes in travel time savings versus the general-purpose lanes. The travel times were not reported in 2022 due to the I-270 ICM project. Future reports will include this information once traffic conditions have normalized.

US 50 HOV Lanes

REVERSIBLE **LANES**

A method to make use of existing facilities more effectively is by dynamically managing the facility using technology. This method is termed active travel demand management (ATDM). One of the methods to accomplish this is by using 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. This allows 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 33)**.

Table 33

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

Three of the four reversible lane facilities operate in the standard and AM and PM peak commuting periods. These are MD 177, US 29, and MD 97. The final location is probably the most familiar to people traveling to and from the Eastern Shore of Maryland. This location is at the Bay Bridge. The lanes on this structure are reversed using overhead lane signing in the PM peak period and during the summer on Saturday mornings and Friday evenings. This strategy allows for the two eastbound and three westbound lanes to be converted to three eastbound and two westbound lanes. MDTA has recently automated the implementation of the reversible lanes to minimize personnel needed and to improve safety. Hourly volumes on the reversible lanes range from approximately 200 vehicles to over 1,400 vehicles per lane **(Table 34)**.

Table 34

2022 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**	**PM**
US 50/301	N/A	2,840[1]	N/A	2	N/A	1,425[1]	N/A	1
MD 177	825	1,185	1	1	220	220	1	1
US 29	1,090	1,135	2	2	600	600	2	2
MD 97	2,420	2,440	3	3	440	455	1	1

1 - Volumes represent Saturday peak hour

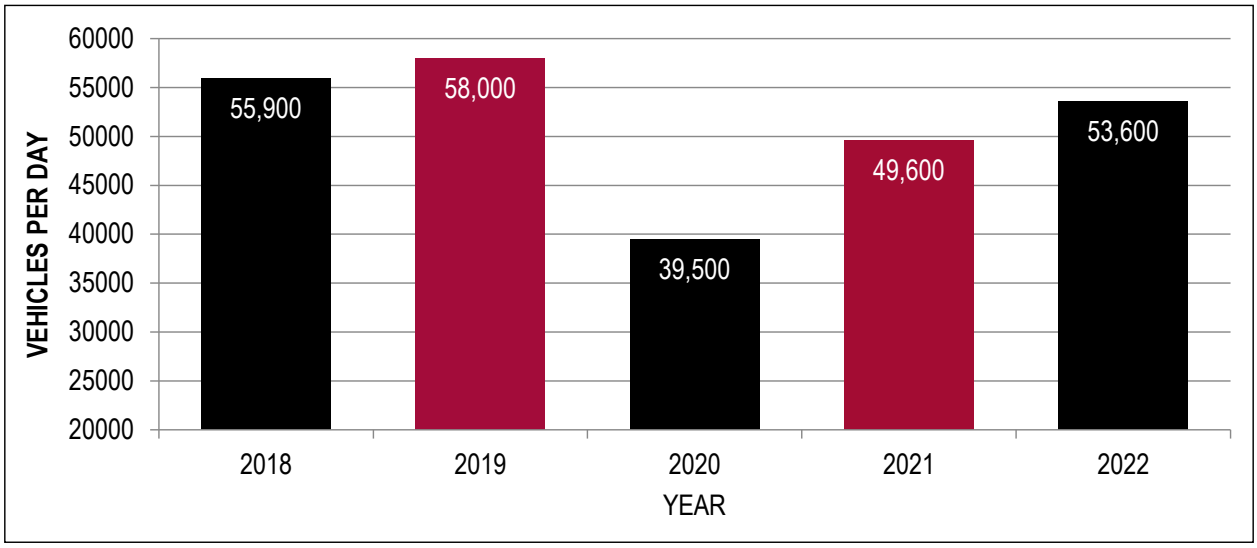
MANAGED LANE FACILITIES AND **EXPRESS TOLL LANES**

The Maryland Transportation Authority (MDTA) is responsible for all toll facilities including the Chesapeake Bay Bridge (US 50/301), Nice/ Middleton Bridge (US 301), Hatem Bridge (US 40), Key Bridge and approaches (MD 695), MD 200, I-895 Harbor Tunnel Thruway including the Harbor Tunnel, and I-95 from the southern limits of the Baltimore City Line to the Delaware Line including the Fort McHenry Tunnel and Tydings Bridge. Along MD 200 and I-95 on the north side of Baltimore City, the MDTA incorporated two additional approaches to improve mobility. Both projects have been in operation since 2014 and incorporate tolls to improve traffic flow but do so in two different methods.

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 the time of day with tolls being slightly higher in the AM and PM peak periods. 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 49,600 vehicles per day in 2021 to 53,600 vehicles per day an 8% increase in 2022 between I-370 and I-95 **(Figure 41)**.

Figure 41

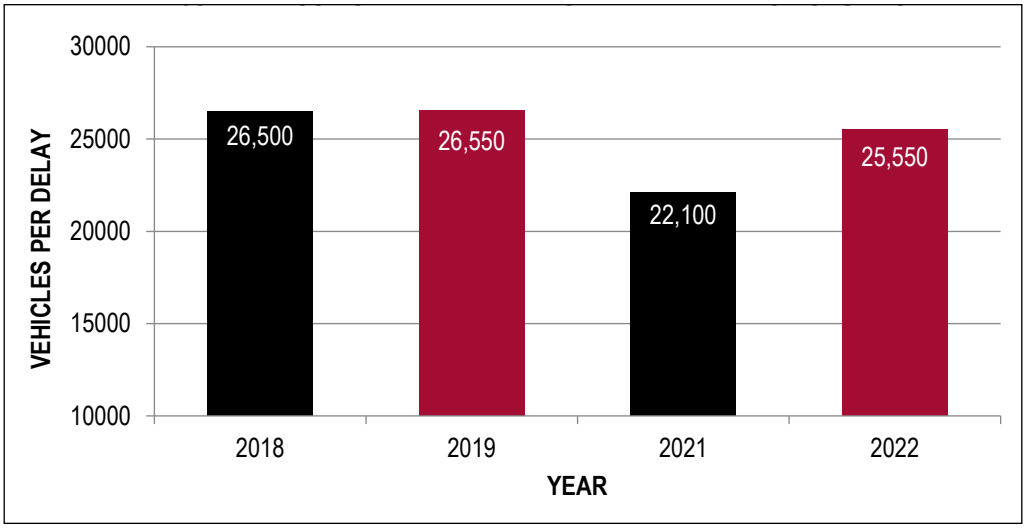
MD 200 AVERAGE DAILY TRAFFIC VOLUMES BETWEEN I-370 AND I-95 FOR FIVE SEGMENTS



The second project, which is implemented along I-95 from south of I-895 in Baltimore City to north of MD 43 in Baltimore County, is accomplished using barrier-separated lanes that operate at acceptable speeds without experiencing delays. Motorists have a choice to use either the four free general-purpose lanes or pay an E-ZPass® toll, based on when they travel in the free flow express toll lanes (ETLs). Tolls vary by the time of day with higher tolls in the more congested periods. Transit vehicles may always use the express toll lanes for free. This improves transit time reliability to better meet schedules for routes in the corridor.

Volumes in the ETLs continue to increase to pre-COVID levels with over 25,500 motorists per day using the facility **(Figure 42)**. This was greater than a 15% increase over 2021 volumes. 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 42
I-95 EXPRESS TOLL LANE AVERAGE DAILY TRAFFIC VOLUMES



Note: Data was not available for 2020

I-95 at MD 43 ETL

Traffic volumes increased by over 8% on MD 200. In the hours with the highest level of ridership, 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. In order to address this, the Investment in Jobs Act prioritizes transportation equity such as improved safety for pedestrians and bicyclists. SHA has been working toward this goal with their "Context Driven: Access and Mobility for All Users" guide. This guide provides the framework to improve pedestrian and bicycle safety, and to provide a balanced and sustainable multi-modal transportation system. By implementing principles from this guide, safety, accessibility, and mobility will improve for multi-modal users through innovative treatments and strategic investments framed by complete streets and practical design principles. Additionally, the SHA incorporates bicycle and pedestrian facilities into roadway projects and provides grants to plan, design, and construct bicycle and pedestrian amenities on non-state-owned facilities.

PROGRAMS

Maryland offers a wide variety of federal and state funded programs to assist in planning, designing, and constructing projects throughout the state. These programs allow communities and other potential applicants to improve pedestrian and bicycle access and provide safer facilities. The SHA, MTA, and Maryland Department of Natural Resources have coordinated with many federal agencies to establish programs that increase pedestrian and bicycle facilities. These range from enforcement campaigns to increase the safe use of existing facilities, student/pedestrian/bicycle safety education, and engineering solutions such as constructing sidewalks, trails, cycle tracks, curb ramps, and signing and pavement marking upgrades. These initiatives provide funding for the following programs: (2023-2028 $ in millions[1]) (Example Project - County):

- Retrofit Bicycle Program ($70.5) (MD 413 Trail Marion Station to Westover– Somerset)
- Retrofit Sidewalk Program ($127.5) (MD 514 MD 20 to Sutton Way - Kent)
- ADA Program ($52.8) (MD 223 South of Victoria Dr to north of Sherwood Dr – Prince George's)
- Recreational Trails Program ($23.2) (Patuxent Branch Trail Surface Upgrade– Howard)
- Kim Lamphier Bikeways Network Program ($16.0) (BWI Trail Spur Extension to Nursery Rd – Anne Arundel)
- Transportation Alternatives Program ($109.7) (Three Notch Trail Phase VII – St Mary's)
- Primary / Secondary Program ($1.4) (MD 185 at Jones Bridge Rd – Montgomery)
- Neighborhood Conservation Program ($29.9) (MD 222 South of High St to Mill St -Cecil)
- Maryland Highway Safety Office Bicycle Programs ($0.5)
- 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 2023-2028 amounts to over $430 million.

1 - Consolidated Transportation Program 2023-2028

BICYCLE AND PEDESTRIAN MASTER PLAN

Maryland SHA recognized that providing a more equitable transportation system must start with a plan. To meet this need, the SHA developed the "2040 Maryland Bicycle and Pedestrian Master Plan 2019 Update". This update outlines the vision to develop active transportation and offer a blueprint for solutions to the current challenges regarding bicycle/pedestrian facilities and safety. The "2040 Maryland Bicycle and Pedestrian Plan 2019 Update" documents the review of existing conditions, the development of strategies and objectives, and the key initiatives to encourage bicycle and pedestrian use. The plan's major goals include:

- Improving safety
- Providing connected networks
- Developing data-driven tools for analyzing and planning
- Forming partnerships
- Encouraging economic development

A safe system is crucial to encourage and expand pedestrian and bicycle usage. The "2040 Maryland Pedestrian and Bicycle Master Plan 2019 Update" aligns with the goals of the "Towards Zero Deaths" campaign to enhance safety. In 2022, there were approximately 130 pedestrians and 11 bicyclists involved in fatal crashes in Maryland. This number increased by six pedestrians and five bicyclists from 2021. To reduce the number of fatalities and injuries, the plan identifies the following strategies:

- Installing bicycle improvements such as marked bike lanes
- Performing pedestrian road safety audits
- Performing educational outreach with programs
- Evaluating innovative treatments such as green pavement, cycle tracks, and bicycle signal heads.
- Promoting connected vehicle technology use and emergency response personnel technology to prevent and reduce collision severity
- Implementing legislation and training

In 2022, the following initiatives were ongoing to promote biking and pedestrian use and improve safety:

- Releasing the Statewide Bicycle Level of Stress (LTS) analysis.
- Developing a Statewide Pedestrian Safety Action Plan
- Employing 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 developed a web portal including a statewide progress project map.
- Promoting pedestrian and bicycle campaigns such as Look Alive MD, Be Street SMART, Be The SHARE THE ROAD Driver, and Be Street Wise.
- Reducing speed limits and lane widths on several corridors.
- Introducing continental crosswalk treatments at various intersections.
- Installing geometric improvements including hardened centerlines, pedestrian median refuge islands, curb extensions, and reducing radiuses for turning vehicles to reduce speeds.
- Installing safety improvements including accessible pedestrian signals, Rapid Rectangular Flashing Beacons (RRFB), countdown signals, lead pedestrian intervals, ADA improvements, lighting enhancements, and signing such as No Turn on Red and pavement marking upgrades.
- Encouraging persons to participate in Bike to Work Week in May.
- Developing a month-long list of events to promote WALKTOBER.

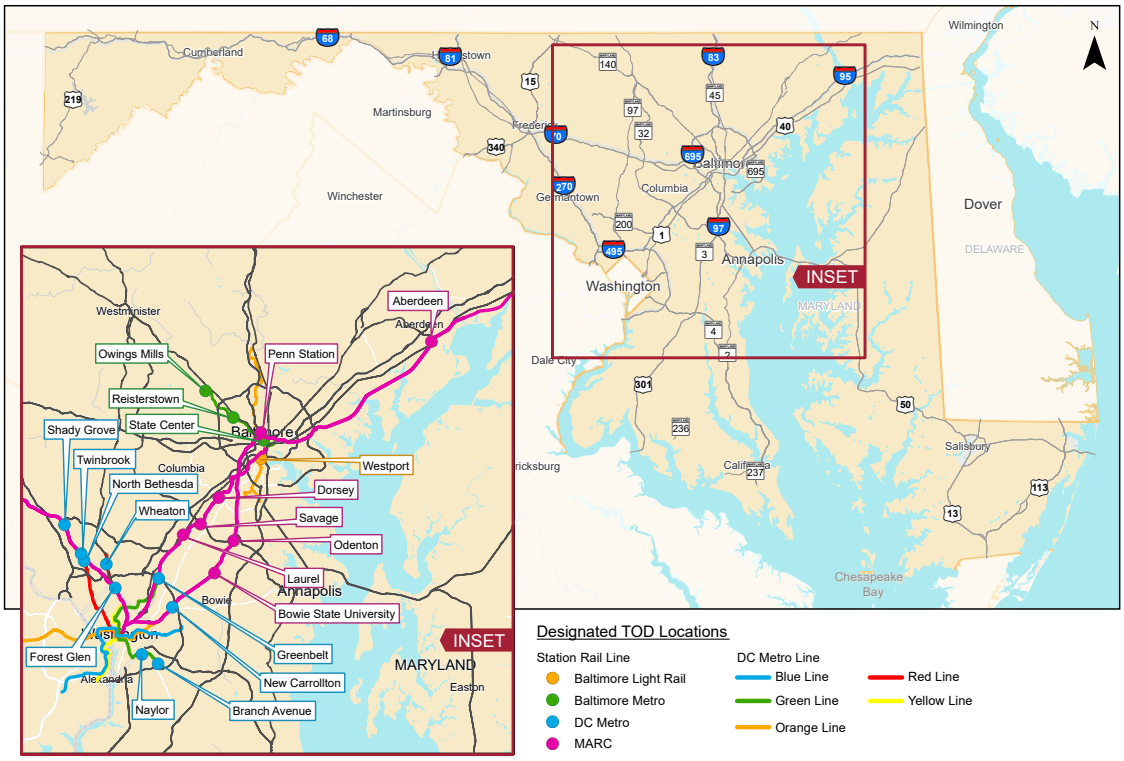
TRANSIT-ORIENTED **DEVELOPMENT (TOD)**

Maryland has been a leader in Smart Growth for the last 25 years, since former Governor Parris Glendening's efforts. This legislation heavily encourages development at or near transit stations to take advantage of multi-modal facilities. These locations are commonly referred to as Transit-Oriented Development (TOD), and they provide the perfect connection—where people can live, play, and work in a way that encourages easy multi-modal access to the station. The expansion of transit-oriented communities continues to be of major importance. This has been accomplished through incentives to encourage both public and private investment. 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 20 TOD sites along the major fixed rail transit lines of the Baltimore/Washington, D.C. region **(Figure 43)**. Baltimore Penn Station and Forest Glen were recently added as part of the statewide TOD locations..

LOCATIONS (TRANSIT SERVICE PROVIDED)

- Aberdeen (MARC)
- Owings Mills (Baltimore METRO)
- Reisterstown (Baltimore METRO)
- State Center (Baltimore METRO)
- Penn Station (MARC and Baltimore Light Rail)
- Westport (Baltimore Light Rail)
- Savage (MARC)
- Odenton (MARC)
- Bowie State University (MARC)
- Laurel (MARC)
- Dorsey (MARC)
- Shady Grove (Washington METRO)
- Twinbrook (Washington METRO)
- North Bethesda (Washington METRO)
- Wheaton (Washington METRO)
- Forest Glen (Washington METRO)
- Greenbelt (Washington METRO)
- New Carrolton (Washington METRO)
- Branch Avenue (Washington METRO)
- Naylor Road (Washington METRO)

Figure 43
TRANSIT ORIENTED DEVELOPMENT LOCATIONS



There are various levels of development at each of the 20 sites. Certain locations are much more active in ongoing construction, while others are waiting for the right market conditions or proposals for the site. The most active sites include a combination of retail, residential, and offices **(Table 35)**.

Table 35

ACTIVE DEVELOPMENT AT TODs		
TOD LOCATION	MULTI-MODAL CONNECTION	DEVELOPMENT STATUS
Metro Centre at Owings Mills	MTA-METRO	227 Unit residential building opened in 2022. Additional proposed development includes residential, office, retail, and parking facilities.
Reisterstown Plaza Metro Station	MTA METRO	Planning for Mixed-use development with garage
Penn Station	MARC	1.6 million sf of mixed-use development New station platform for high-speed rail
Annapolis Junction/Savage	MARC	Planning for: Twin tower apartment building, 150 key hotels, restaurants, and a separate parking garage.
Bowie State	MARC	Prince George's County has selected a development partner for the site
New Carrollton	WMATA-METRO	291-unit multi-family residential building is under construction 282 new apartments recently opened WMATA's 275,000 sf office building is under construction including a 1,900-space garage.
North Bethesda (Formerly White Flint)	WMATA-METRO	Montgomery County and WMATA have entered a MOU to develop 25 million square feet of mixed-use including 1,000 housing units, retail, and office anchored by the University of Maryland Institute of Health Computing
Forest Glen	WMATA METRO	Proposal for 1,125 apartments and garage

TOD sites are in six counties and Baltimore City.

FREIGHT

Freight is a major customer of Maryland's transportation network, supporting regional businesses and jobs. Trucks carry the highest tonnage and value throughout Maryland. Therefore, Maryland must provide an efficient roadway network to be competitive in the global marketplace. Transportation projects that improve freight mobility and safety are critical to the State's economy. Using data from actual trucks and technology resources, SHA assesses freight performance and system needs to identify the most appropriate improvement projects.

Federal action to improve freight movement over the past decade requires states to plan for freight and focus on critical freight infrastructure. Maryland served as a model for federal requirements as one of the first states to develop a state freight plan and focus on truck parking. The "Moving Ahead for Progress in the 21st Century" (MAP-21) established a freight network and set requirements to measure freight performance.

The network was further refined by the "Fixing America's Surface Transportation (FAST) Act" in 2015. In 2021, the passage of the Infrastructure Investment and Jobs Act (IIJA) increased the mileage for two of the categories in the national highway freight network. The categories and mileage include:

- The primary highway freight system (PHFS) – Approximately 400 miles of interstates selected by FHWA as a primary freight network for the entire United States.

- Other interstates not on the PHFS – Approximately 145 miles of non-PHFS Interstates are part of the NHFN even though they are not considered primary for freight.
- Critical urban freight corridors (CUFC) – 150 miles of metropolitan planning organization (MPO) designated urban roadways. (Up from 75 miles)
- Critical rural freight corridors (CRFC) – 300 miles of state-designated roadways. (Up from 150 miles)

States and metropolitan planning organizations (MPO) are responsible for the CUFC and CRFC designation, while the federal government determines PHFS and the remaining Interstates. The CUFC was developed through a joint effort by 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 SHA-developed criteria. Corridors were selected based on the highest truck volumes and proximity to major freight facilities.

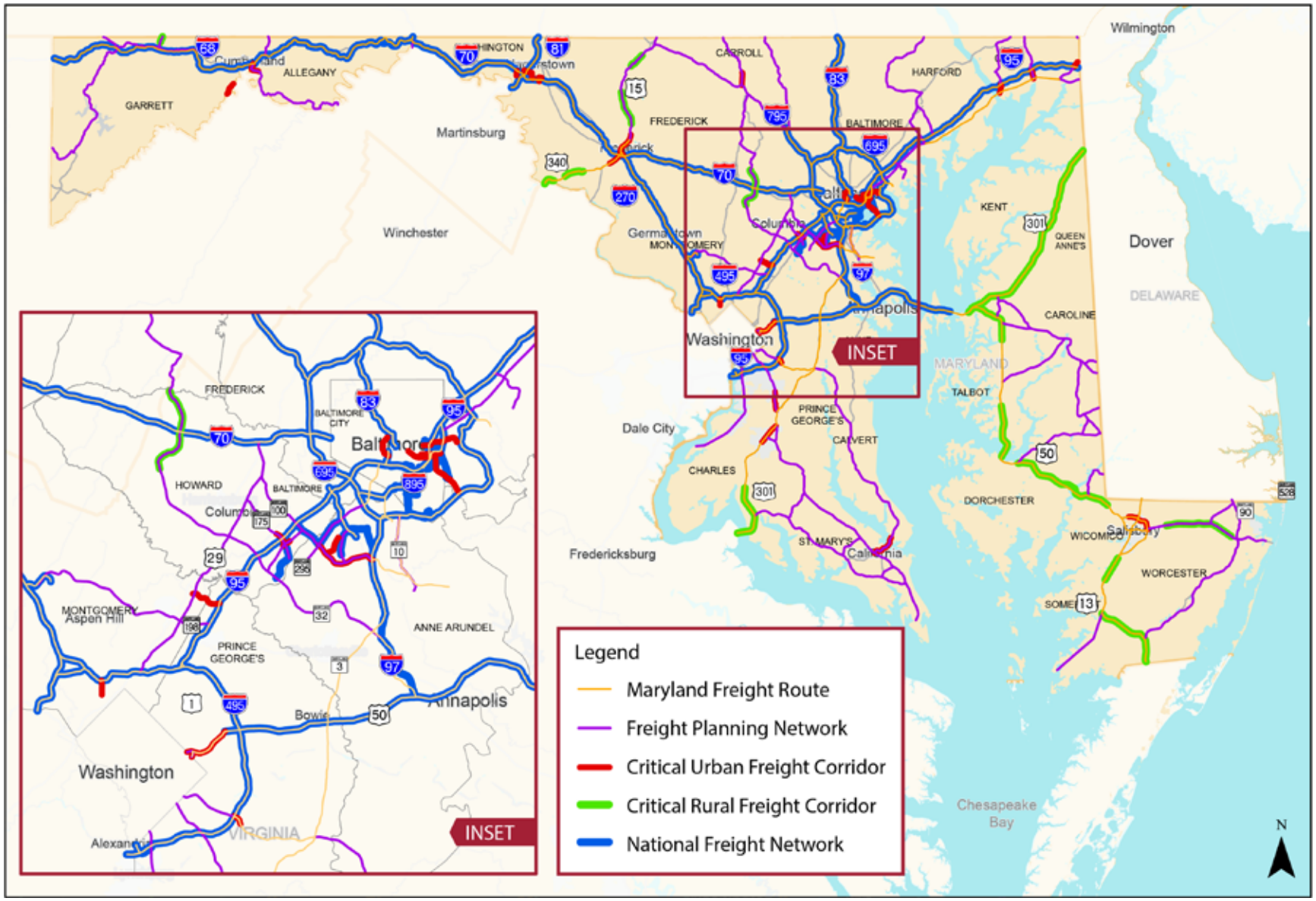
The additional miles of CUFC and CRFC should be finalized in 2023. This will be accomplished using the Maryland Roadway Performance Tool (MRPT) to identify the segments that best align with the federal CUFC and CRFC criteria, including truck volumes and proximity to freight facilities. SHA is working through the process with the MPOs. These efforts are essential to identify where Maryland can spend NHFP funding from the Federal Highway Administration.

I-95 near MD 152

The existing Maryland's Highway Freight Networks, which consist of the PHFS, Interstates, CUFCs and CRFCs, along with the freight planning network encompass roadways in all regions of the state **(Figure 44)**.

Figure 44

Freight Network



SHA projects improving freight performance include:

- Highway improvements
- Maintenance of the network
- Capacity expansion
- Operational projects (IT and TSMO that support safe and efficient movement through information systems)
- Freight planning development
- Freight performance measurement and visualization to support planning and operations
- Safety improvements in coordination with law enforcement
- Investigation of emerging technologies like automated trucking and connected vehicles

FHWA provides freight formula funds that can support capital projects on the defined NHFN. MDOT has completed the following projects to support freight on the NHFN using federal funds:

- Statewide truck stop technology enhancements
- Statewide virtual weigh station database
- Statewide static scale replacements and electronics
- Roadway Improvements such as the I-95/I-495 bridge over MD 4 and the I-68 Cumberland Viaduct
- Freight Automated Vehicle (AV) implementation plan

MDOT uses the freight formula program and other resources to support various projects and planning efforts. Projects completed or underway in 2022 include:

- Developing data and analytical visualization tools
- Establishing a freight automated vehicle implementation plan
- Developing a freight EV charging pilot
- Assessing Maryland roadways for automation opportunities for freight
- 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.
- Developing state freight plan update

Ongoing planning efforts include:

- Implementing the Maryland Statewide Truck Parking Study, which evaluates existing parking demand, the 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.
- Creating a 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

TRANSPORTATION SYSTEMS **MANAGEMENT & OPERATIONS (TSMO)**

Maryland SHA uses various methods to reduce congestion and improve safety. One of the newest methods is through a program to better manage the existing system. This assessment is called **Transportation Systems Management and Operations (TSMO)**.

TSMO involves maximizing the full-service potential of the facility to minimize roadway widening projects and make the best use of existing funding. 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

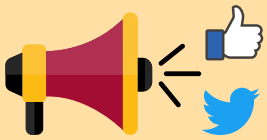
DATA ANALYSIS & PERFORMANCE MANAGEMENT

GOAL 2

SYSTEMS & TECHNOLOGY

GOAL 4

CUSTOMER EXPERIENCE & ENGAGEMENT



There are several areas that TSMO strategies are used to manage the multimodal transportation network, thereby achieving the program's goals. These include:

Homeland Security Preparedness

Transit Priority/Integration

Connected and Automated Vehicle Technology

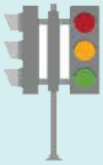
Work Zone Management

Emergency Response

Road Weather Management

Traffic Incident Management

Traffic Signal Coordination



Maintenance Fleet Management

Electronic Payment/ Toll Collection

Freeway/Arterial Management

Freight Management

Technology is the basis for effectively accomplishing TSMO projects. This involves meeting customers' needs for real-time travel information and reacting quickly to trends and travel-pattern changes. The data technologies that support TSMO are:

Real Time Applications

Archived Data Applications

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

MDOT Common Operating Picture

The goals of TSMO involve not just taking into account one corridor, but also ones which consider the entire system. For example, if an incident occurs on I-95, what can be accomplished to improve traffic operations on the parallel US 1 and US 29 corridors. SHA established and identified the following priorities to enhance the entire 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

To accomplish these goals, steps are undertaken each year. The 2022 accomplishments for SHA include:

Equipped SHA fleets with on board technology to notify their presence over Waze and other third-party vendors.

Installed CCTV, dynamic message signs and dedicated short range communication roadside units(DSRC/CV2X) along US 1 Innovative Technology corridor.

Developed traffic management decision support tool for FITM plan deployment.

Designed arterial-friendly ramp metering control system

Initiated development of incident timing plans for six signal systems in TSMO System 1 (I-70/US 29/US 40/ MD 144/MD 99).

Began signal upgrades and deploying ATMS along US 50 from the Bay Bridge to Ocean City.

Completed study on integrating fixed and mobile weather information

Used third party CV data to support signal performance monitoring

MOBILITY **ON DEMAND**

There are numerous additional options for transportation choices, especially in urban areas. These mobility-on-demand services improve transportation equity by giving people alternatives unrestricted to motor vehicles. Many of these provide positives for the environment such as bicycles, electric bikes, and scooters. Other mobility on demand services include ride-share service.

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 and scooters in Montgomery and Prince George's Counties
- Zipcar – Ride sharing vehicles throughout the Baltimore-Washington area
- Lime – Scooters, Bikes, and Mopeds in Baltimore City, Prince George's County, and Montgomery County
- Bird – Scooters in Salisbury, Aberdeen, Annapolis, 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
- Superpedestrian LINK – Electronic Scooters in Baltimore City

Capital Bikeshare US 29

Uber/Lyft Vehicle

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