PURPOSE AND NEED

1.1 INTRODUCTION

The Maryland Transportation Authority (MDTA), in coordination with the Federal Highway Administration (FHWA), has initiated the Chesapeake Bay Crossing Study: Tier 1 National Environmental Policy Act (NEPA), referred to as the "Bay Crossing Study." As announced by Governor Larry Hogan in 2016, the Bay Crossing Study is the critical first step to begin addressing existing and future congestion at the William Preston Lane Jr. Memorial (Bay) Bridge and its approaches along US 50/US 301. The study encompasses a broad geographic area, spanning nearly 100 miles of the Bay from the northern-most portion of the Bay in Harford and Cecil counties to the southern border with Virginia between St. Mary's and Somerset counties (**Figure 1**).

1.1.1 The Tiered NEPA Process

This two-tiered NEPA study will follow formal regulatory procedures in accordance with the Council on Environmental Quality and FHWA NEPA regulations resulting in preparation of a Tier 1 Environmental Impact Statement (EIS). A tiered environmental review process is being undertaken due to the regional needs to be addressed by the proposed action, influence of the Bay Crossing from both an environmental and socio-economic perspective, and expansive size of the study's geographical area. Throughout both tiers of this analysis, previous studies assessing potential Bay crossings, such as the 2004 Transportation Needs Report, 2005 Task Force Study and 2015 Life Cycle Cost Analysis Study will be taken into consideration as appropriate.

Tier 1

The Tier 1 NEPA Study represents the MDTA's first step within a two-tiered NEPA approach and includes a high-level, qualitative review of engineering and environmental data. The EIS prepared in the Tier 1 NEPA Study will define existing and future transportation conditions and needs at the existing Bay Bridge, identify broad corridor alternatives (including a "No-Build" alternative), document the corridor alternative screening process, identify the most reasonable Corridor Alternatives Retained for Analysis (CARA), evaluate potential environmental impacts of the CARA, and present recommendations for one preferred corridor alternative to be advanced into a Tier 2 NEPA Study. Decisions resulting from the Tier 1 NEPA Study (e.g., deciding upon a preferred corridor alternative for a potential future proposed action) will address broad planning level issues consistent with a corridor-level analysis for both potential corridor alternatives and environmental impacts. The size of the corridor alternatives analyzed in Tier 1 will not necessarily be binding for a project-level Tier 2 analysis, depending on the corridor alternative selected, the proposed project engineering design, and the nature of the key resources identified within that corridor. The corridor alternative decision in Tier 1 will likely identify logical termini for a potential new crossing by establishing potential connections to the existing transportation network.

The Tier 1 NEPA Study evaluation will involve close coordination with regulatory and resource agencies, stakeholders, and the public to identify critical resources and assist in determining key mobility, environmental, and other impacts associated with potential corridor alternatives. Possible adverse environmental impacts that could occur as a result of moving forward with a preferred corridor will be identified to help inform site-specific, potential avoidance,

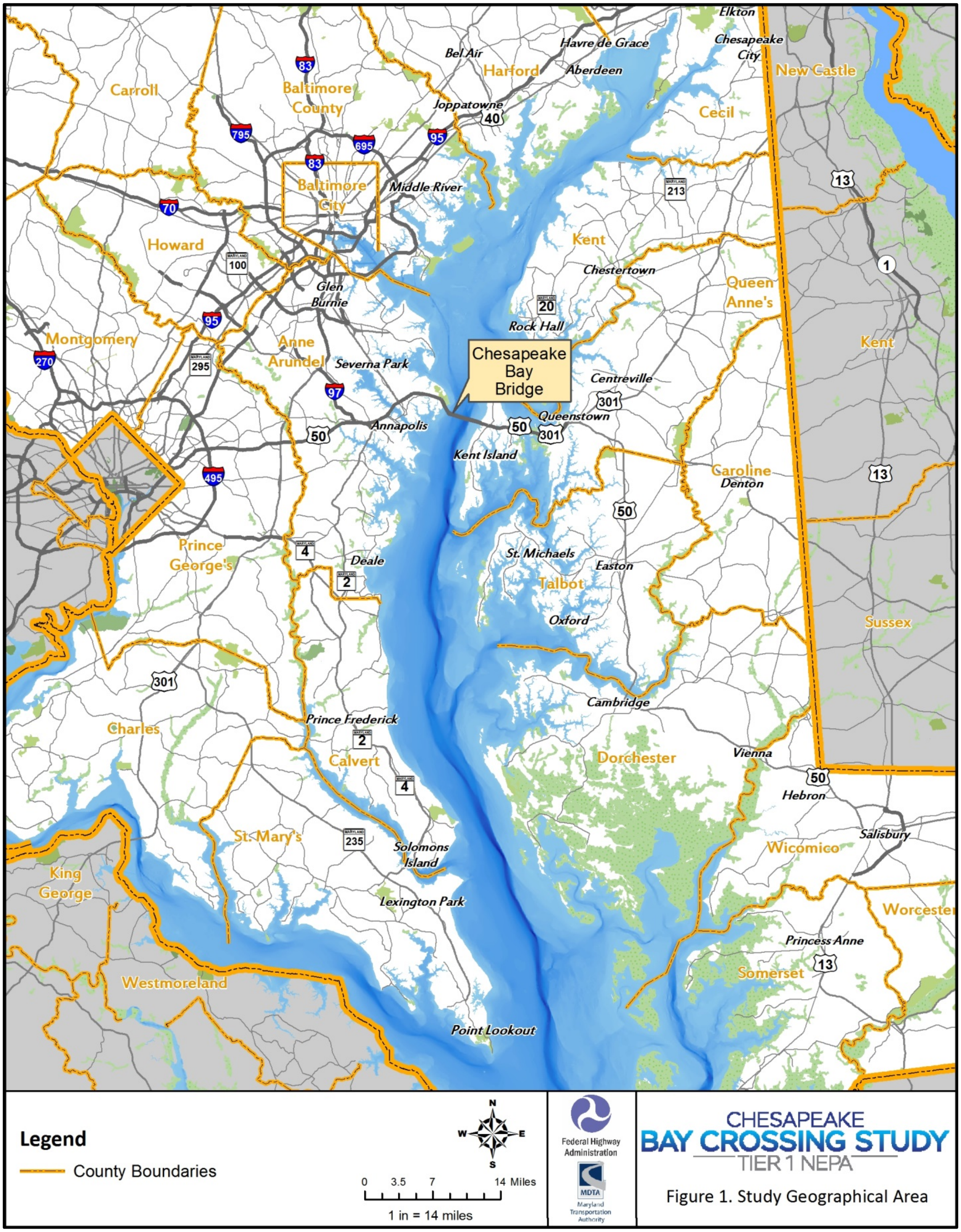


Figure 1. Study Geographical Area

minimization and mitigation opportunities. As with all NEPA analyses, the Tier 1 Study will take into account comments from cooperating and participating State and federal agencies as well as the public.

Tier 2

At the end of the Tier 1 NEPA Study, the MDTA will move forward with a Tier 2 NEPA Study when appropriate. In comparison to the more general Tier 1 analyses, a Tier 2 NEPA Study would result in decisions made on a project-level (site-specific) analysis, through evaluation of specific alignments within the preferred corridor alternative selected in the Tier 1 NEPA Study. Agency and public involvement will continue to be a large part of the Tier 2 NEPA Study, which will include detailed engineering design of alternative alignments and assessment of potential environmental impacts.

In the Tier 2 NEPA Study, avoidance and minimization measures will be considered and recommended; the potential for unavoidable adverse direct, indirect and cumulative impacts will be documented; and appropriate permitting and mitigation measures for any unavoidable impacts will be identified. Results of the analyses conducted during Tier 2 will aid in decisions to be made regarding engineering for a specific crossing and supporting transportation network, cost considerations for those technical matters, and mitigation. Final project design and construction will follow final agency decisions based on completion of Tier 2 NEPA Study documents. Examples of regulatory activities resulting from the Tier 2 NEPA Study include Section 4(f) resource avoidance (to the extent such resources are involved), Section 106 consultation and negotiation of a memorandum of agreement, if necessary, and other specific permitting decisions for applicable water, species, and other natural resources matters.

1.1.2 Importance of the Chesapeake Bay

The Chesapeake Bay is one of Maryland’s most iconic and significant environmental resources. Comprising a 64,000 square mile watershed spanning six states and the District of Columbia, the Bay holds more than 18 trillion gallons of water and is the largest estuary in the United States. The Bay maintains a functioning ecosystem that filters water and provides suitable habitat for diverse and abundant life. In an effort to support Bay restoration efforts, many State and federal agencies, including the Maryland Department of Transportation (MDOT), have committed to achieving specific pollution-reduction targets by 2025. As supporters of Bay restoration, the MDTA and FHWA recognize the importance of the Chesapeake Bay and the major role it plays in the lives of those living in the Chesapeake Bay watershed, and beyond.

The Bay not only supports thousands of animal and plant species, but it also provides flood protection, serves as a transportation route for cargo and cruise ships, and plays a major role in Maryland’s economy via commercial fishing activities, recreational, educational and tourism opportunities. Nationally, Maryland is the largest producer of blue crabs. Each year, 500 million pounds of seafood (namely blue crabs, clams and oysters) are harvested from the Bay, adding nearly $600 million to Maryland's economy. Recreational boating and fishing are also popular activities in Maryland. According to the Chesapeake Bay Foundation (CBF) and the 2007 *Economic Impact of Maryland Boating* report, roughly $2 billion and 32,000 jobs are generated each year in Maryland due to the recreational boating industry. Additionally, in 2014, CBF estimated that implementation of the Chesapeake Clean Water Blueprint, a plan for improving the value of the Bay’s natural services, will increase Maryland’s economy by $4.6 billion annually, from $15.8 to $20.4 billion (The Economic Benefits of Implementing the Blueprint in Maryland Fact Sheet, CBF).

Accessible through the Bay, Maryland's Port of Baltimore is recognized as an ideal location for international trade, as it is only one of two Eastern U.S. ports where the main shipping channel is dredged to a depth of 50 feet. The Port generates nearly $3 billion in annual wages and salary, and supports 13,650 direct jobs and 127,000 jobs connected to Port work (Maryland State Archives, 2017). In January 2017, the Port handled a record-setting tonnage of cargo and number of loaded containers, moving key exports such as coal, waste paper, and automobiles, and imports including automobiles, farm and construction machinery, petroleum products (Maryland State Archives, 2017). Additionally, the Port of Baltimore is home to *Cruise Maryland*, a passenger cruise terminal that offers year-round trips and welcomes a variety of cruise lines. The Port of Baltimore's cruise industry supports over 500 jobs and brings in over $90 million to Maryland's economy (Maryland State Archives, 2017).

1.1.3 Chesapeake Bay Bridge History

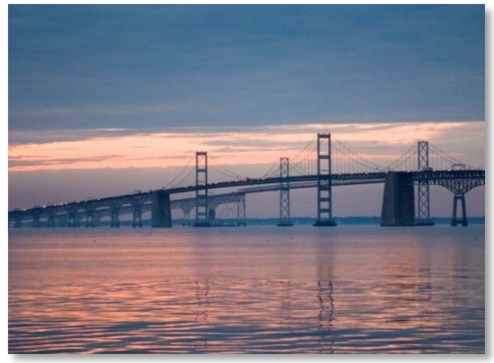
The Bay undoubtedly provides a great variety of unique activities and opportunities for visitors and Marylanders alike; however, the Bay also presents a clear transportation barrier between Maryland's Western and Eastern Shores. In 1952, the first highway connection between Maryland's Western Shore in Anne Arundel County and Eastern Shore in Queen Anne's County was built as a two-lane bridge along US 50/US 301 across the Chesapeake Bay.

In an effort to keep up with the growing travel demand, a second parallel Bay Bridge carrying three lanes of traffic opened in 1973. Today, the nearest alternative roadway routes are over 45 miles north of the Bay Bridge along US 40 or I-95 across the Susquehanna River. Using these routes, travelers must head north and around the Bay in order to head south towards some of the coastal destinations. The nearest southern alternative roadway route is in Virginia, 140 miles south of the Bay Bridge via the Chesapeake Bay Bridge-Tunnel along US 13.

The original two-lane span of the William Preston Lane, Jr. Memorial Bridge, more commonly known as the Bay Bridge, opened to travel in 1952.

As Maryland's only crossing of the Chesapeake Bay, the Bay Bridge plays a major role in the State's regional transportation system and is vital in supporting the diverse regional economy. The Western Shore is characterized by its high-tech base, exhibiting strong information technology, telecommunications, medical, aerospace and defense industries, complemented by agricultural, seafood and waterfront industries. By contrast, the Eastern Shore is best known for its farming and agricultural enterprises, seafood and waterfront industries, as well as tourism and recreational activities in coastal areas.

Throughout the years, as travel between the shores has become easier, employment centers have also become more accessible to residents of both shores. Summer vacations along the coast have also turned into household norms. However, increased use of the Bay Bridge has meant that daily commuters, regional travelers and vacationers have experienced increased congestion at the Bay Bridge, often struggling to reach their destinations with low confidence in travel times. Aging infrastructure, capacity limitations at the existing bridge, and an increasing demand for trips across the Bay will only continue to exacerbate congestion and delays currently experienced by the traveling public.



View of today's eastbound and westbound spans of the Bay Bridge.

As the area's population grows, barriers to crossing the Bay Bridge are expected to intensify, threatening to jeopardize the functionality of the existing connection between the shores. If this primary link between the Eastern Shore and the Baltimore and Washington metropolitan areas becomes seriously degraded or unavailable due to safety or performance issues, negative consequences with wide-ranging effects are foreseeable for Marylanders and visitors alike. For example, populations dependent upon a reliable Bay crossing that live on the Eastern Shore would experience disadvantages in access to employment opportunities located on the Western Shore, resulting in potential job and financial losses. Additionally, travelers that typically head east towards recreational and coastal areas may be compelled to start choosing alternate travel destinations. In summary, an inadequate connection between the shores increases the likelihood for negative impacts to communities and a reduction in the State's local and regional economies.

1.1.4 Previous Actions and Studies

The MDTA understands that time is valuable to all, and extra time required to cross the existing Bay Bridge, especially if unpredictably variable, can and does have immediate and long-term effects. Without an adequate crossing, an employee might not be able to arrive to work on time or vacationers may be discouraged from making plans at coastal locations. To address congestion at the Bay Bridge, the MDTA has used contra-flow (reversible lanes) during peak periods, eliminated the westbound toll plaza in the 1980s, implemented electronic toll collection at the toll plaza (including dedicated "electronic toll collection only" lanes), and developed extensive promotional and educational efforts aimed at encouraging travelers to take trips during off-peak periods.

Despite these efforts, congestion has continued to worsen at the Bay Bridge to a point where in 2016, the Governor announced the MDTA's initiation of this Tier 1 NEPA Study. An important distinction between the Tier 1 NEPA Study and previous efforts is that this study will result in the identification of a potential Bay crossing corridor location through qualitative, high-level analysis and extensive agency, stakeholder, and public involvement following the NEPA process which is required for federal approval. Previous studies were focused on gathering data to begin identifying potential needs at the existing Bay crossing and were not aimed at identifying specific solutions for implementation.

Photo Left: Summer weekend queues have been observed to extend up to 4 miles and even longer in the eastbound direction at the Bay Bridge. Photo Right: Contra-flow operations provide for three lanes of flow in the eastbound direction on the Bay Bridge.

This Tier 1 NEPA Study will utilize applicable information from the following previous MDTA studies and analyses as appropriate:

- **2004 Transportation Needs Report:** The MDTA initiated a study of transportation and safety needs associated with the existing Bay Bridge in 2001, which resulted in preparation of the 2004 Transportation Needs Report.

- **2006 Task Force Report:** The MDTA formed a Task Force in 2005 to examine the range of issues to help educate stakeholders about the need for additional capacity across the Bay. Subsequent studies were conducted to evaluate the potential for transit or ferry service to provide capacity and alleviate congestion (e.g., September 2007 Analysis of Transit Only Concepts to Address Traffic Capacity Across the Chesapeake Bay).

- **2015 Life Cycle Cost Analysis Study:** The Life Cycle Cost Analysis Study was conducted by the MDTA in 2015 to evaluate the travel operations and structural condition of the Bay Bridge, understand the costs and time frame associated with implementing future Bay Bridge improvements, and evaluate complementary improvements that would be needed if/when (a) new structure(s) were built including mainline US 50/301 improvements.

1.2 PURPOSE OF THE BAY CROSSING TIER 1 NEPA STUDY

The **purpose** of the "Chesapeake Bay Crossing Study: Tier 1 NEPA" is to consider corridors for providing additional capacity and access across the Chesapeake Bay in order to improve mobility, travel reliability and safety at the existing Bay Bridge. The Tier 1 NEPA Study will evaluate potential new corridor alternatives that will include an assessment of existing and potentially expanded transportation infrastructure needed to support additional capacity, improve travel times, and accommodate maintenance activities, while considering financial viability and environmental responsibility.

1.3 NEEDS

The following three primary **needs** were identified for the Tier 1 NEPA Study and will be the basis for evaluating corridor alternatives: adequate capacity; dependable and reliable travel times; and flexibility to support maintenance and incident management in a safe manner. Recognizing the importance of the resource being crossed and the magnitude of possible solutions, other elements that will be considered include the financial viability and environmental responsibility of any solutions proposed to address the study needs.

At present, the MDTA is responsible for the four-mile long, dual-span Bay Bridge and its approach roadways, in addition to its responsibilities relating to constructing, managing, operating and improving Maryland's other toll facilities. US 50/US 301 is classified as an urban freeway/expressway with three lanes in each direction at both approaches to the Bay Bridge. On the western approach for eastbound travelers in Anne Arundel County, there is an eleven-lane wide toll plaza, where all lanes are electronic toll collection (ETC) enabled (three of the lanes were designated as ETC only in 2018). There are no tolls for westbound travelers.

1.3.1 Adequate Capacity

The Bay Bridge typically carries three lanes of westbound traffic except during periods of heavy eastbound travel when one westbound lane is reversed to provide a third eastbound lane. This reverse travel flow condition is called contra-flow operation. The eastbound travel lane widths are 12 feet five inches and the westbound travel lanes are 12 feet wide. There are less than two feet of offset on the outside of the travel lanes in each direction.

The existing two spans of the Bay Bridge carry increasing volumes of travelers that frequently approach or exceed its capacity for longer durations. These increasing travel volumes, containing a high percentage of trucks during weekdays, correlate with increases in regional population and employment, and result in greater congestion. Queue lengths of up to four miles eastbound during summer weekend evenings have been observed recently. While the computed capacity of the Bay Bridge in either the eastbound or westbound direction is up to approximately 4,900 vehicles per hour (vph), it has been observed that queues begin forming at demand levels at or less than 3,900 vph. The reported capacity of the eastbound toll plaza is 9,900 vph. Therefore, the bridge itself is the constraining factor to travel flow.

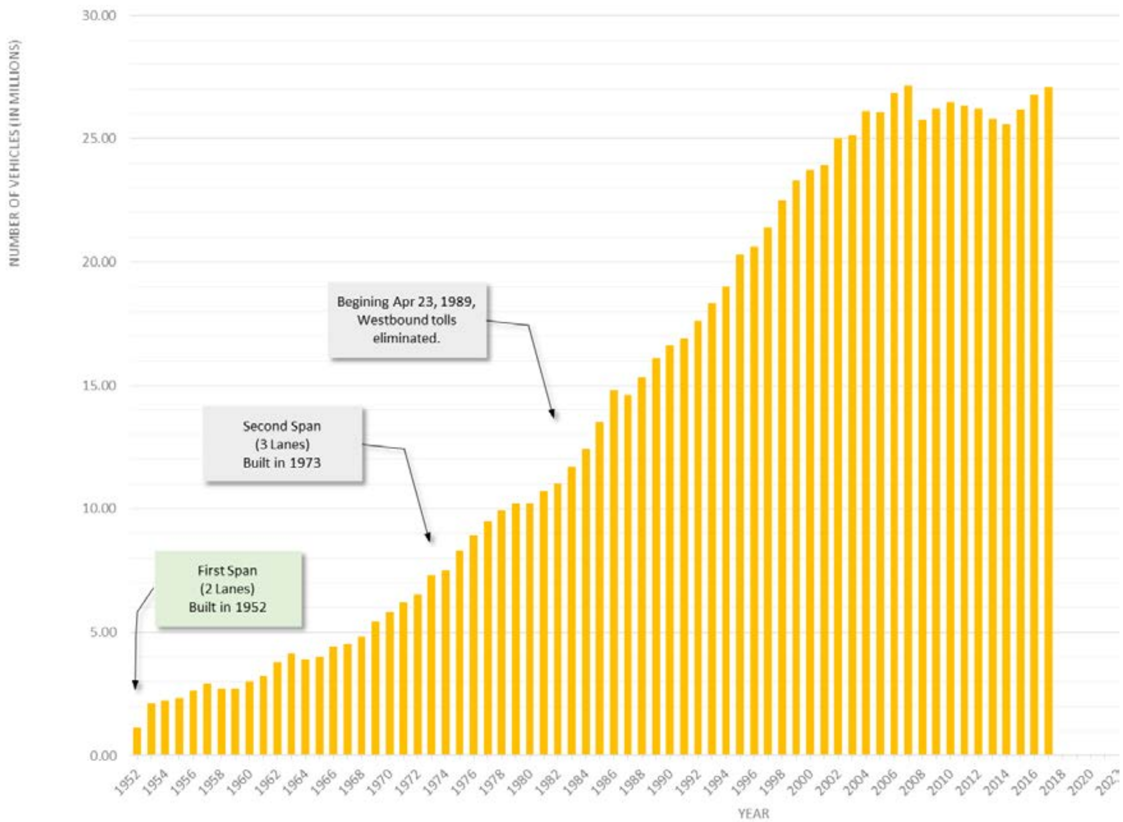
To illustrate the historical increase of travel volumes at the Bay Bridge, **Table 1** and **Graph 1** present the annual number of vehicle trips across the Bay Bridge. After 57 years of consistent growth between 1953 and 2007, the annual number of vehicles crossing the bridge fluctuated between 2008 and 2014, coinciding with the national economic recession. A minimum of two percent annual growth in the number of vehicles crossing the bridge was reported in 2015 and 2016, with the greatest number of reported crossings occurring in 2016, which is over two and half times the number of crossings in 1980.

Table 1. Annual Number of Vehicle Trips across the Bay Bridge[1]

Year	Number of Vehicles	Annual Growth (%)
1953[2]	2,100,000	-
1974[3]	7,500,000	+6.2
1980[4]	10,323,300	+5.5
1985	13,686,400	+5.8
1990	16,078,600	+3.3
1995	20,410,800	+4.9
2000	23,867,600	+3.2
2005	26,066,100	+1.8
2006	26,855,600	+2.9
2007	27,140,600	+1.1
2008	25,740,950	-5.2
2009	26,184,950	+1.7
2010	26,449,700	+1.0
2011	26,344,950	-0.4
2012	26,193,150	-0.6
2013	25,788,700	-1.5
2014	25,544,900	-0.9
2015	26,173,400	+2.5
2016	26,696,100	+2.0

[1] *Number of vehicles obtained by doubling the annual vehicle counts in the EB direction*
[2] *1953 is the year after the first Bay Bridge span opened to traffic.*
[3] *1974 is the year after the second Bay Bridge span opened to traffic.*
[4] *Five year increments are shown between 1980 to 2005 due to steady annual growth during this period of time (see Graph 1 below). Annual growth shown reflects the annual growth between each of these entries, not the 5-year growth.*

Graph 1. Annual Chesapeake Bay Bridge Volume



As a comparison to the growth in trips across the Bay Bridge, **Table 2** presents the historic population growth in Maryland:

Table 2. Population in the State of Maryland

Year	Population (in millions)	Difference
1952 (original span of Bay Bridge opens)	2.5	-
1973 (second span of Bay Bridge opens)	4.1	1.6 times
1980	4.2	1.0 times
2016	6.0	1.4 times

Source: US Census Bureau

The growth in the State population between 1980 and 2016 was less than the growth in the number of crossings during the same period of time (1.4 times versus 2.5 times). Moreover, the growth in the State population since the second span was opened is approaching the population growth in the State that occurred between the opening of the original and second spans (1.4 times versus 1.6 times).

Increasing travel demand at the crossing has resulted in growing congestion and vehicle queues at the Bay Bridge. These congested conditions at the bridge, which can last up to four hours during an average weekday evening and up to 11 hours through a summer weekend afternoon and evening, are expected to worsen by the planning horizon year of 2040 due to anticipated regional growth in population and employment from the Baltimore Metropolitan Council (BMC) land use model Round 8b and Metropolitan Washington Council of Governments (MWCOG) land use model Round 9.0 as shown in **Figure 2**.

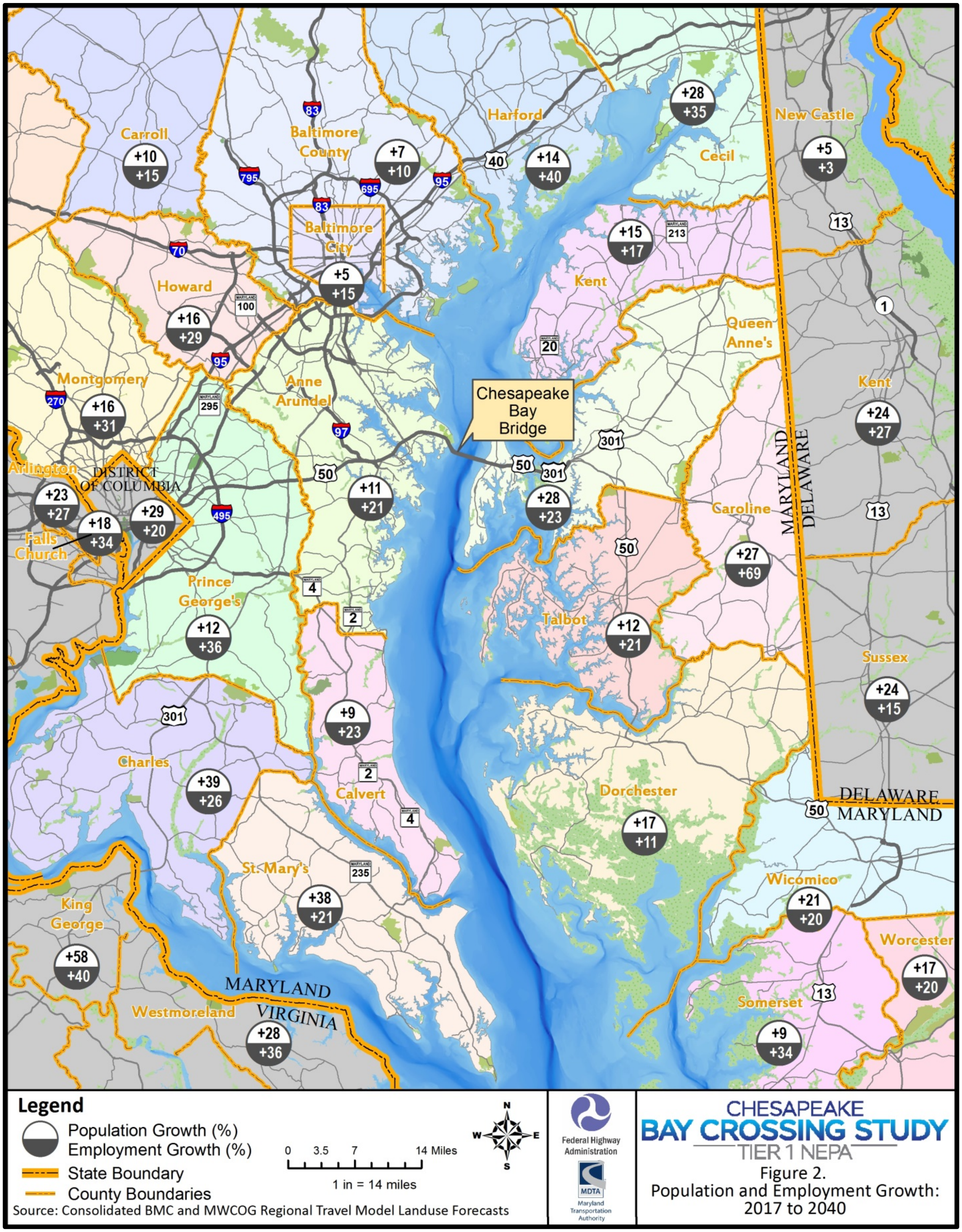


Figure 2.
Population and Employment Growth:
2017 to 2040

This anticipated growth will increase demand for trips across the Bay during the average weekday, as well as during summer months and weekends, as tourists and recreationists make their way east to points such as Ocean City and the Delaware beaches.

The ability of the Bay Bridge to support this growing volume of vehicle demand is further impacted by the amount of trucks in the vehicle mix. Trucks occupy a larger amount of space and do not accelerate as quickly as smaller vehicles at toll booths and along climbing grades. The current weekday percentage of trucks crossing the Bay Bridge is shown in **Table 3**. Bridge capacity is further negatively impacted because the weekday average percentage of trucks on the Bridge far exceeds the Maryland Statewide average of five percent for other similar type roadways (i.e., urban freeway expressways) and carries a substantial percentage of trucks as compared to other major waterway crossings in the State as shown in **Table 4**.

Table 3. Percentage of Trucks within Weekday Vehicle Mix on the Bay Bridge

Year	Truck Percentage (%)
2013	15.5
2014	15.5
2015	13.5
2016	13.5

Source: Maryland Department of Transportation State Highway Administration (MDOT SHA) Truck Volume Maps

Table 4 provides a comparison of percentage of trucks within weekday the vehicle mix at other Maryland waterway crossings.

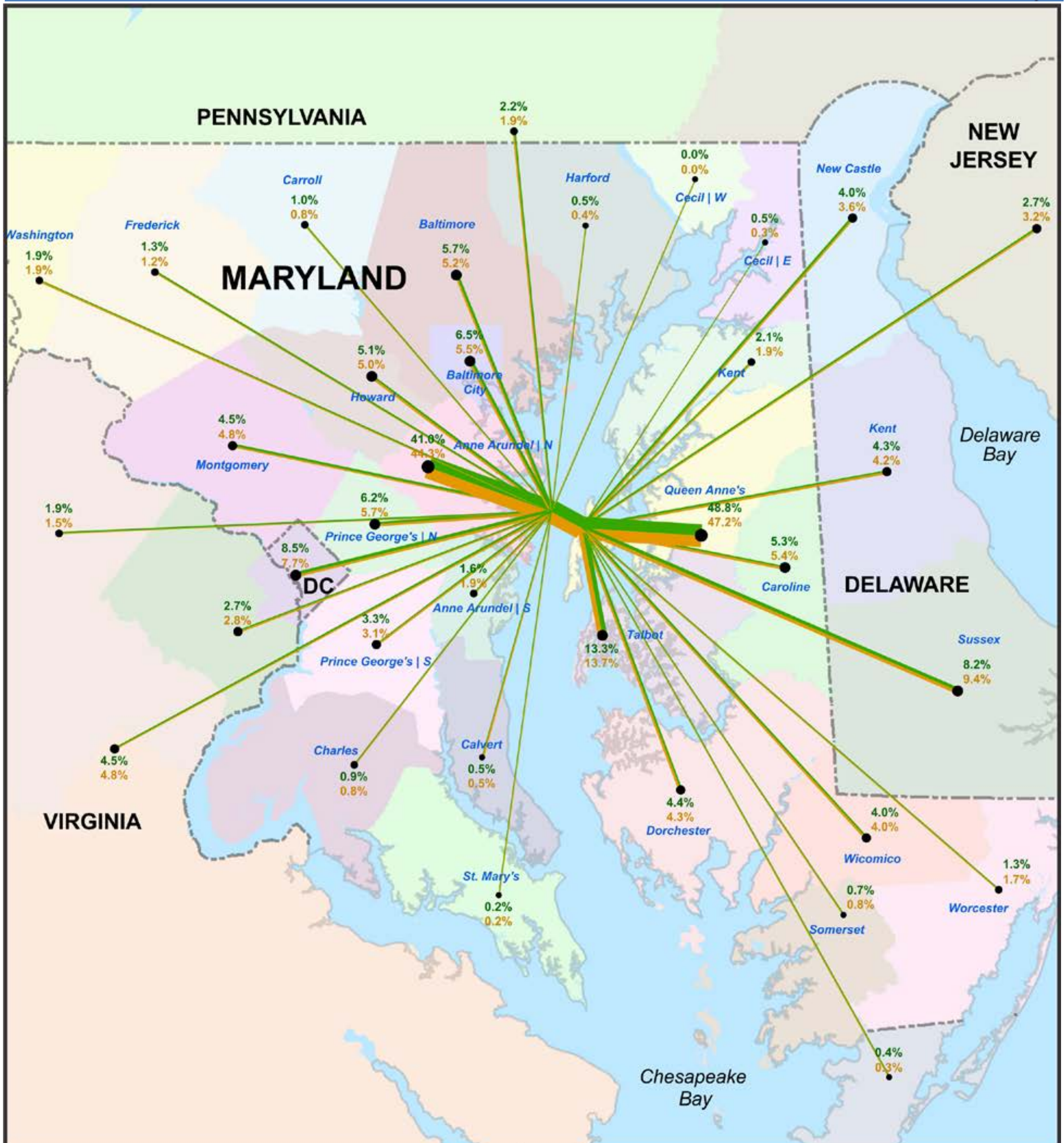
Table 4. 2016 Reported Weekday Percentage of Trucks at Maryland waterway crossings

Facility	Route No.	Road Classification	AADT	Truck Percentage
Harbor Tunnel	I-895	Urban Interstate	72,000	5.3 %
Hatem Bridge	US 40	Urban Other Principal Arterial	28,000	6.6%
Nice Bridge	US 301	Rural Other Principal Arterial	19,000	10.9%
Bay Bridge	**US 50**	**Urban Freeway Expressway**	**73,000**	**13.5%**
Ft. McHenry Tunnel	I-95	Urban Interstate	107,000	14.4%
Key Bridge	I-695	Urban Interstate	98,000	14.5%
Tydings Bridge	I-95	Rural Interstate	85,000	20.1%

Source: Maryland Department of Transportation State Highway Administration (MDOT SHA) Truck Volume Maps

Travel Demand Origins and Destinations

The capacity provided by the Bay Bridge supports travel demand for both local trips (e.g., work related and discretionary trips) with origins and destinations (O-D) relatively close to the shores, and regional trips (e.g., commerce, recreation, regional travel) with O-Ds throughout and beyond Maryland. Current travel patterns are observed from origin-destination surveys of trips crossing the Bay Bridge conducted between June and August 2016 and 2017, and October and May 2016 and 2017, as reflected in **Figures 3 and 4**, and the table included in **Appendix A.**



Source: Street Light Data Inc. October 2015 through May 2016 and October 2016 through May 2017

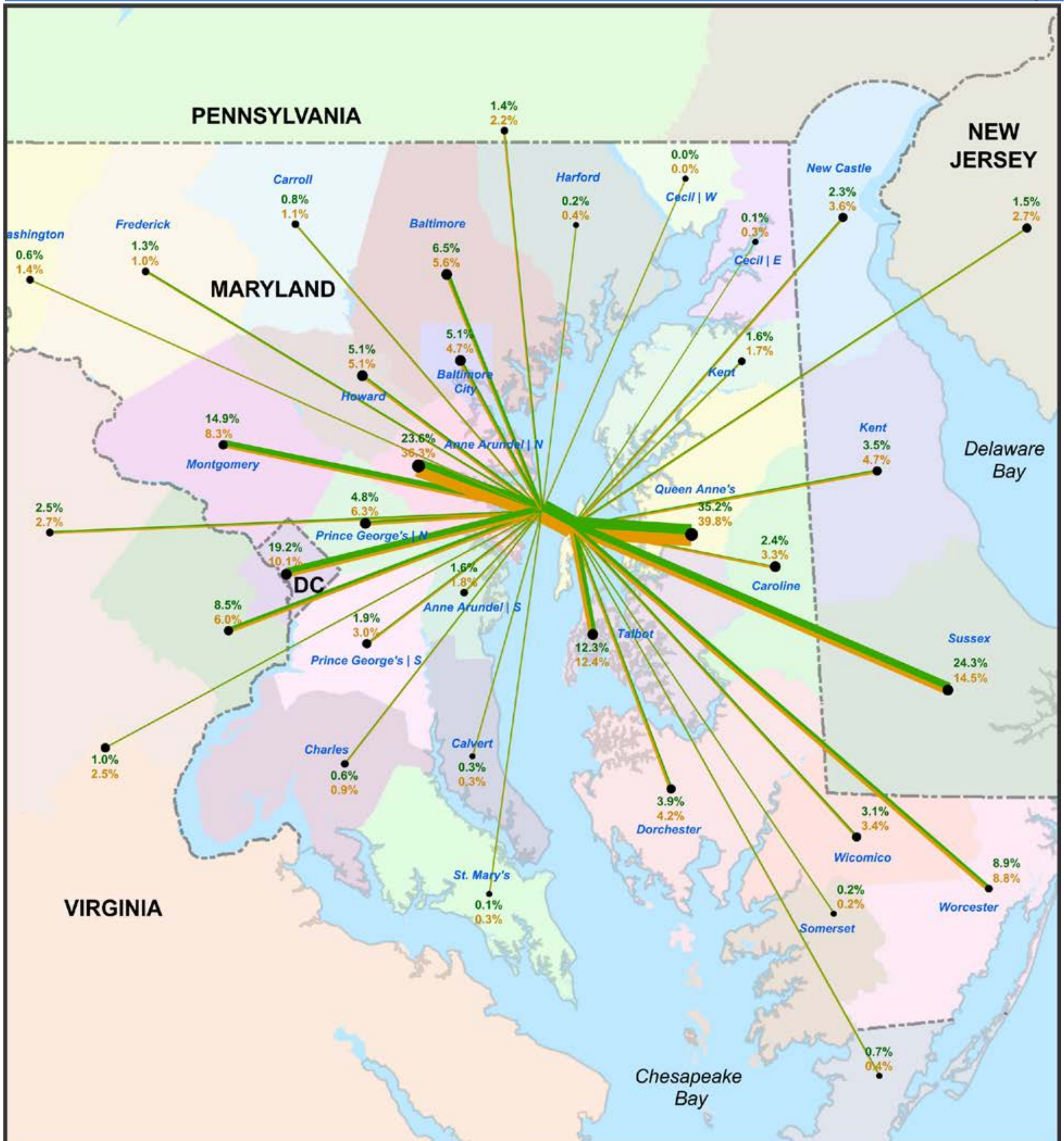
0.0% - WB Trip Origins/Destinations
0.0% - EB Trip Origins/Destinations
Westbound Travel
Eastbound Travel

Federal Highway Administration

MDTA Maryland Transportation Authority

CHESAPEAKE
BAY CROSSING STUDY
TIER 1 NEPA

Figure 3
Non-Summer
Average Weekday Travel
Across Bay Bridge



Source: Street Light Data Inc. October 2015 through May 2016 and October 2016 through May 2017

0.0% - WB Trip Origins/Destinations
0.0% - EB Trip Origins/Destinations
Westbound Travel
Eastbound Travel

Federal Highway Administration

MDTA Maryland Transportation Authority

CHESAPEAKE BAY CROSSING STUDY TIER 1 NEPA

Figure 4
Summer Sunday Average Travel Across the Bay Bridge

During a non-summer weekday, 60 to 67 percent of the trips crossing the Bay Bridge are between points near either the western or eastern ends of the existing bridge, as shown in **Table 5**, which are typical destinations of local or commuter trips. During summer weekends, as reflected by travel on a summer Sunday, there is a higher percentage of trip destinations beyond the western and eastern ends of the bridge (42 to 50 percent) as compared to weekday trips (32 to 39 percent), which are more characteristic of regional or recreational trips. As the region's population and employment levels grow, the demand for all trip types will increase, requiring more travel capacity across the Bay.

Table 5. Origins and Destinations (Dest.) of Trips across the Bay Bridge

	Non-Summer Weekday (Tuesday through Thursday)				Summer Sunday			
	EB Trip Origins	EB Trip Dest.	WB Trip Origins	WB Trip Dest.	EB Trip Origins	EB Trip Dest.	WB Trip Origins	WB Trip Dest.
Near western end of the bridge[1]	62.7%			60.6%	57.5%			51.1%
Near eastern end of the bridge[2]		66.3%	67.4%			55.5%	49.9%	
Beyond vicinity of bridge	37.3%	33.7%	32.6%	39.4%	42.5%	44.5%	50.1%	48.9%

Note: EB = eastbound, WB = westbound
[1]Anne Arundel and Prince George's counties, MD; Washington, D.C.; Arlington and Alexandria VA
[2] Caroline, Queen Anne's and Talbot counties, MD

Travel Demand Volume

Table 6 presents the average daily travel volume at the Bay Bridge in 2017 and projected in the planning horizon year 2040 using the Maryland Statewide Travel Model.

Table 6. Daily Trips across the Bay Bridge (vehicles per day)

	2017	**2040 No-Build**	**Percent Change (%)**
Average Weekday	68,598	84,276	22.9
Summer Weekend Day	118,579	135,280	14.1

Source: May and August 2017 counts and Maryland Statewide Travel Demand Model

As shown in **Table 6**, the Bay Bridge is expected to carry nearly 14 to 23 percent more daily travel volume in 2040 as compared to current daily travel demand in 2017.

Results from an analysis of the Peak Hour vehicle volumes for average weekdays and summer weekend days are summarized in **Table 7**. The Sunday afternoon volumes during the summer are very consistent between 12 PM and 10 PM. The shift in the peak hour reflected for 2017 and 2040 is a result of this steady flow condition. The results in **Table 7** show a projected increase of between nearly 11 and over 19 percent of current peak hour traffic volumes by 2040.

Table 7. Directional Peak Hour Volumes across the Bay Bridge (vehicles per hour)

	Average Weekday		Summer Weekend Day	
	Eastbound (5-6 PM)	Westbound (7-8 AM)	Eastbound - Friday (4-5 PM)	Westbound - Sunday (12-1 PM in 2017 4-5 PM in 2040)
2017	3,395	3,448	4,299	4,170
2040 No-Build	4,055	4,009	5,133	4,658
Percent Change (%)	19.4	16.3	19.4	11.7

Source: May and August 2017 counts and Maryland Statewide Travel Demand Model

The need for additional capacity is demonstrated by both the daily and peak hour projected travel volumes, which indicate a continuation of the historic trend of increases in travel demand at the Bay Bridge.

1.3.2 Dependable and Reliable Travel Times

Mobility across and around the Bay will continue to be reduced by the anticipated increase in population and employment in communities on both sides of the Chesapeake Bay (**Figure 2**), a nearly 20 percent increase in commuter travel, and increased tourism and recreational travel (**Tables 6 and 7**). Marylanders and visitors need dependable Chesapeake Bay crossing options with reliable operating speeds and travel times. Reliable crossing options support access to employment and recreation areas, as well as facilitate emergency services and evacuation events.

One method to describe how dependable travel flow is operating is "level of service" (LOS). The Highway Capacity Manual (HCM) 6th Edition (Transportation Research Board, 2016) defines LOS as, "A quantitative stratification of a performance measure or measures that represent quality of service, measured on an A-F scale, with LOS A representing the best operating conditions from the traveler's perspective and LOS F the worst." Usually a LOS D is regarded as the lowest acceptable operating condition in rural areas and LOS E is regarded as the lowest acceptable operating condition in urban areas.

A summary of the 2017 and projected 2040 no-build directional hourly LOS for both average weekday and summer weekend day conditions across the Bay Bridge using the Highway Capacity Software (HCS) is presented in **Table 8**.

Table 8. Hourly Levels of Service across the Bay Bridge

Time	2017				2040 No-Build			
	Average Weekday		Summer Weekend		Average Weekday		Summer Weekend	
	EB	WB	EB	WB**	EB	WB	EB	WB**
12-1AM	A	A	A	A	A	A	A	A
1-2AM	A	A	A	A	A	A	A	A
2-3AM	A	A	A	A	A	A	A	A
3-4AM	A	A	A	A	A	A	A	A
4-5AM	A	B	A	A	A	B	A	A
5-6AM	A	C	B	A	B	D	B	A
6-7AM	C	D	C	A	C	E	D	A
7-8AM	C	D	D	A	D	F	D*	A
8-9AM	C	D	C*	B	D	D	D*	B
9-10AM	C	C	D*	C	D	D	E*	C
10-11AM	D	B	E*	D	C*	D	F*	D
11AM-12PM	D	B	E*	D	C*	D	F*	D
12-1PM	D	B	E*	E	C*	D	F*	F
1-2PM	D	B	E*	E	D*	D	F*	E
2-3PM	D*	C	E*	D	E*	D	F*	E
3-4PM	E*	C	E*	E	F*	D	F*	E
4-5PM	E*	C	F*	E	F*	D	F*	F
5-6PM	E*	C	E*	E	F*	D	F*	F
6-7PM	D*	C	E*	E	E*	C	F*	E
7-8PM	C*	B	E*	E	D*	B	F*	F
8-9PM	C	A	D*	E	D	A	E*	F
9-10PM	C	A	C*	E	C	A	D*	F
10-11PM	B	A	D	D	B	A	D	D
11PM-12AM	A	A	B	B	B	A	C	B

*Assuming contra-flow operation on the westbound bridge
**Assuming 3 lanes in the Westbound Peak-Flow Direction, this never overlaps the Eastbound Peak-Flow
Note: Highlighted values exceed LOS D.

During an average weekday in 2017, the hourly travel demand in one direction approaches the capacity of the Bay Bridge for three hours in the afternoon. Similarly, during summer weekends in 2017, the hourly travel demand approached or exceeded the bridge capacity in at least one direction for 10 hours. Under 2040 No-Build conditions, hourly travel demand is predicted to exceed the capacity of the Bay Bridge in at least one direction for five hours on an average weekday (as compared to three hours in 2017) and 12 hours on a summer weekend day (as compared to 10 hours in 2017).

A measure of the transportation network reliability is its' ability to provide travelers with dependable travel times. Transportation facilities with variable travel times, particularly during peak hours of travel, are considered unreliable due to recurring congestion.

The formation of consistent vehicle queues helps to identify the points of recurring congestion. Due to projected increases in travel demand volumes at the Bay Bridge, the current summer weekend vehicle queues of up to four miles eastbound are projected to increase to nearly 13 miles in 2040. Similarly, in the westbound direction, the current two and a half mile queues are predicted to grow to over 10 miles during the summer weekend evenings in 2040. During average weekdays, current evening eastbound queues of up to one mile are expected to increase to five miles in 2040, while westbound morning queues over one mile long are expected to form by 2040.

Events along a transportation facility such as vehicle breakdowns, crashes, weather, and maintenance activities reduce usable capacity and affect the reliability of the facility. These non-recurring events add to the variability of trip times provided by the transportation system, making trip planning difficult.

The annual "State Highway Mobility Report" accounts for non-recurring events in trip reliability using the measurement of the Planning Time Index (PTI). The PTI represents the 95th percentile travel time for a section of the transportation network and is considered the total time travelers should allow for trips to assure on-time arrival at destinations. If free-flow conditions allow a five minute trip, a traveler should allow 15 minutes when the PTI is 3.0. The lower the PTI, the more reliable the trip planning time. Statewide PTI are categorized as follows:

PTI less than 1.5 – Reliable
PTI between 1.5 and 2.5 – Moderately Unreliable
PTI above 2.5 – Highly to Extremely Unreliable

The PTI for a trip along US 50/US 301 between the MD 2 interchange in Anne Arundel County and the US 50/US 301 split in Queen Anne's County for each travel direction was calculated for 2017 during average weekdays and Fridays and Sundays during the summer. **Tables 9 and 10** present the PTI findings.

The highest PTI for an eastbound trip in 2017 occurs on a summer Friday between 6 PM and 7 PM with a measurement 5.80. The highest PTI for a 2017 westbound trip occurs on a summer Sunday between 3 PM and 4 PM with a measurement of 3.37.

The dependability and reliability of trip travel times across the Chesapeake Bay support the need for additional capacity given the following conditions at the existing crossing:

- expected growth in vehicle queue length and duration by 2040
- predicted increase in the number of hours of unsatisfactory Level of Service by 2040
- current unreliability of the Bay Bridge as measured by the Planning Time Index.

Table 9. Planning Time Index for Eastbound Trips on US 50/US 301 between MD 2 and the US 50/US 301 Split

Time of Day	2017 Average Weekday (Sep. 2016 to May 2017)	2017 Summer Friday (Jun 2017 to Aug 2017)	2017 Summer Sunday (Jun 2017 to Aug 2017)
12A – 1A	1.13	1.12	1.10
1A – 2A	1.14	1.12	1.11
2A – 3A	1.13	1.09	1.14
3A - 4A	1.12	1.07	1.11
4A – 5A	1.08	1.06	1.09
5A – 6A	1.06	1.04	1.12
6A – 7A	1.04	1.01	1.16
7A – 8A	1.04	1.02	1.07
8A – 9A	1.04	1.02	1.04
9A – 10A	1.05	1.04	1.09
10A – 11A	1.05	1.08	1.46
11A – 12P	1.07	1.32	2.34
12P – 1P	1.06	1.27	3.57
1P – 2P	1.05	1.57	3.84
2P – 3P	1.21	2.47	3.52
3P – 4P	1.42	4.42	3.15
4P – 5P	1.74	5.25	3.58
5P – 6P	1.96	5.08	2.76
6P – 7P	1.66	5.80	1.89
7P – 8P	1.17	5.39	1.27
8P – 9P	1.14	5.63	1.09
9P – 10P	1.14	3.71	1.12
10P – 11P	1.13	2.03	1.13
11P – 12A	1.13	1.24	1.20

Source: RITIS Data (September 01, 2016 to May 31, 2017 for average weekday values and June 01, 2017 to August 31, 2017 for summer values)

Note: Highlighted values exceed the threshold for moderately unreliable conditions

Table 10. Planning Time Index for Westbound Trips on US 50/US 301 between the US 50/US 301 Split and MD 2

Time of Day	2017 Average Weekday (Sep. 2016 to May 2017)	2017 Summer Friday (Jun 2017 to Aug 2017)	2017 Summer Sunday (Jun 2017 to Aug 2017)
12A – 1A	1.08	1.13	1.20
1A – 2A	1.07	1.10	1.11
2A – 3A	1.07	1.11	1.11
3A - 4A	1.06	1.07	1.09
4A – 5A	1.03	1.07	1.07
5A – 6A	1.00	0.99	1.11
6A – 7A	1.00	0.98	1.14
7A – 8A	1.08	1.01	1.05
8A – 9A	1.14	1.04	1.05
9A – 10A	1.05	1.04	1.05
10A – 11A	1.04	1.22	1.06
11A – 12P	1.06	1.41	1.28
12P – 1P	1.06	1.74	1.63
1P – 2P	1.06	1.56	1.91
2P – 3P	1.06	1.51	2.65
3P – 4P	1.05	1.60	3.37
4P – 5P	1.06	1.32	3.36
5P – 6P	1.07	1.26	3.28
6P – 7P	1.08	1.28	3.23
7P – 8P	1.08	1.13	3.32
8P – 9P	1.10	1.10	2.93
9P – 10P	1.13	1.09	3.44
10P – 11P	1.08	1.08	2.45
11P – 12A	1.08	1.09	1.57

Source: RITIS Data (September 01, 2016 to May 31, 2017 for average weekday values and June 01, 2017 to August 31, 2017 for summer values)

Note: Highlighted values exceed the threshold for moderately unreliable conditions

1.3.3 Flexibility to Support Maintenance and Incident Management in a Safe Manner

As reported in the 2015 Bay Bridge Life Cycle Cost Analysis, the need for maintenance and rehabilitation activities will increase as the Bay Bridge ages. These activities, along with the incident management (i.e., crash response, debris removal) on the Bay Bridge, increase congestion, causing travelers to wait out the resulting delays due to the lack of nearby alternative detour routes. These conditions also put maintenance workers and incident responders at risk when performing their duties next to moving traffic. Additional capacity across the Bay is needed to maintain flexible options for safe travel during maintenance and for management of incidents on the Bay Bridge.

Structural analysis concludes that the existing Bay Bridge structures are currently in satisfactory condition and can provide functionality for the next several decades with scheduled rehabilitation and maintenance (i.e., painting, deck rehabilitation, suspension span rehabilitation, traffic control device and electrical repairs). Beyond the Tier 1 Study horizon year of 2040, major superstructure and substructure rehabilitation/replacement work involving short- and long-term lane closures would be required to maintain fair condition of the bridges. Such rehabilitation work will cause a substantial impact to capacity and travel operations across the Bay. During maintenance work, as well as during incident management on the Bay Bridge, flexibility in crossing the Chesapeake Bay is needed to support any required lane closures or width/use restrictions (i.e., narrowed lane widths, vehicle width/weight prohibitions). Those restrictions, in turn, exacerbate congestion and negatively affect safety conditions.

Whenever possible, the MDTA attempts to schedule maintenance activities during periods when they will have the least impact on travel operations. Many maintenance activities on the Bay Bridge occur during overnight hours when volumes are lowest. Lane closures (or bridge closures) are signed on the impacted roadways well in advance, in accordance with statewide standards for lane/roadway closures. In addition, when possible, the MDTA notifies the public of upcoming maintenance activities through public announcements using various sources (i.e., traditional and social media, postings at toll booths)

During an incident, the MDTA uses state-of-the-art incident management techniques to detect, verify, respond to, and clear the incident. The primary goal is to save lives and address any injuries, while protecting the public and employees from any further injury. Once those issues have been addressed, clearing the incident to restore full capacity of the crossing is undertaken. The MDTA and the MDTA Police are active members of the Coordinated Highways Action Response Teams (CHART) program, which also includes the Maryland Department of Transportation State Highway Administration and the Maryland State Police. This program provides advanced notification to travelers of the incident and the related progress made in clearing the incident. The CHART Program also coordinates evacuations with Maryland and local government agencies, as well as agencies in other states for the use of the Bay Bridge during major weather events. Increased crossing capacity would provide resiliency in the network to better handle evacuations and major incidents requiring travel.

A total of 224 crashes were reported for US 50 from Oceanic Drive to MD 8 (Romancoke Road) between January 1, 2014 to December 31, 2016. The resulting 49.3 crashes per 100 million vehicle miles traveled (MVMT) is significantly higher than Maryland Statewide rate for urban freeway expressways (39.0 crashes per 100 MVMT). There was one fatal crash reported in 2016, while 62 of the crashes involved injuries. The 161 property damage crashes occurred at a rate of 35.4 crashes per 100 MVMT, which is significantly higher than the Maryland Statewide rate for urban freeway expressways (25.2 crashes per 100 MVMT). Property damage crashes typically result from lower speed incidents, which correlate to congested conditions. **Table 11** lists the most frequent probable causes of crashes as listed on police reports, and **Table 12** lists the types of crashes most frequently reported for this segment of US 50.

Table 11. Most Frequent Reported Probable Causes of Crashes along US 50 from Oceanic Drive to MD 8 (Romancoke Road) (January 1, 2014 – December 31, 2016)

Reported Probable Cause of Crash	Number of Crashes	Percent (%) of Crashes
Other or Unknown	65	29
Failure to give Full Attention*	47	21
Too Fast for Conditions*	35	16
Followed too Closely*	33	15

*These causes relate closely with congested conditions.

Rear-end, sideswipe and opposite direction type crashes occurred at a rate significantly higher than the Maryland Statewide rate for urban freeways/expressways. Rear-end type crashes, are typically experienced during congested conditions. The rate of truck related crashes was 9.2 crashes per 100 MVMT, which is significantly higher than the Maryland Statewide rate for urban freeway expressways (4.5 crashes per 100 MVMT). This finding correlates to the high percentage of trucks in the weekday vehicle mix across the Bay Bridge.

Table 12. Most Frequent Type of Reported Crash along US 50 from Oceanic Drive to MD 8 (Romancoke Road) (January 1, 2014 – December 31, 2016)

Reported Type of Crash	Number of Crashes	Percent (%) of Crashes
Rear-End	139	62
Sideswipe	53	24
Other	15	7
Guardrail/Barrier	10	4
Opposite Direction	4	0.9

Figure 5 presents the location and direction of the reported crashes along the segment of US 50/US 301 between Oceanic Drive and MD 8 from 2014 through 2016. Of the 224 reported crashes in this segment, 112 or half occurred on the Bay Bridge itself. Almost two times more crashes were reported in the eastbound direction than in the westbound direction of travel (146 versus 78). The portion of this segment of US 50/US 301 west of the center of the Bay Bridge saw the majority of the total reported crashes (151 out of 224, or 67.4 percent). Most of the crashes occurring west of the center of the Bay Bridge were in the eastbound direction (125 out of 146, or 85.6 percent). This result may be related to the two lane eastbound span versus the three lane westbound span and the toll plaza on the eastbound approach to the bridge. It is noted that 162 or 72.3 percent of the reported crashes occurred between 11 AM and 8 PM, with the peak of 27 crashes being reported in the 3 PM timeframe. Approximately 41 percent of the crashes occurred in the months of June, July and August and 55 percent were reported on Friday, Saturday and Sunday. Twenty seven percent of the crashes were reported on a Friday, Saturday or Sunday in June, July and August.

As shown from recent crash history in the vicinity of the Bay Bridge, and the Life Cycle Analysis of the Bay Bridge structures, additional capacity is needed across the Chesapeake Bay to provide travelers alternate routes to avoid crash-related delays. There is also an expected increase in frequency of maintenance activities along the Bay Bridge, which will require additional short- and long- term lane closures on the bridge in the future supporting the need for additional capacity across the Bay.

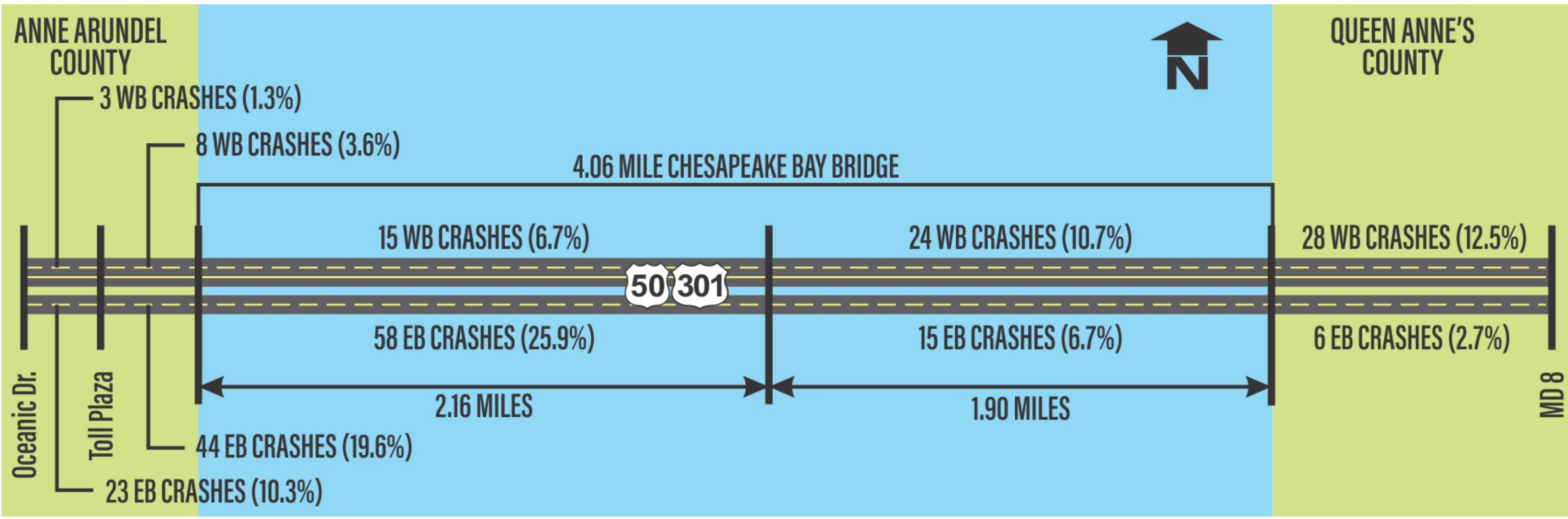


FIGURE 5: CRASH EXPERIENCE IN VICINITY OF THE BAY BRIDGE
(2014 THROUGH 2016)

1.4 FINANCIAL VIABILITY

The MDTA recognizes that additional capacity across the Chesapeake Bay, as well as improvements to existing facilities must be financially viable. In order to assess potential additional crossing corridor alternatives, it is necessary to consider the means to pay for the development, operation and maintenance of the facilities. As an independent State agency, the MDTA does not receive funding from tax dollars, the General Fund or the Transportation Trust Fund. The MDTA will explore potential funding strategies for any potential Bay Crossing improvements, which must be deemed financially viable (i.e., ability to pay for the development, operation and maintenance of such facilities).

Since the resulting financial metrics from a Tier 1 NEPA study are not typically "investment grade," the level of financial viability analysis conducted for a study of corridor alternatives cannot be as detailed as that undertaken during a Tier 2 study. This Tier 1 NEPA Study will not define the specific construction actions evaluated in a Tier 2 study, yet it is anticipated that some level of cost estimating will occur for each corridor alternative based on, among other factors:

- future navigational channel planning
- the potential amount of new or upgraded approach transportation network facilities that may be required
- the range of structure lengths required to cross the Bay (if appropriate)
- the type of structure crossing the Bay (if appropriate)
- the theoretical capacity of the Bay Crossing
- an order of magnitude of impacts
- the anticipated operating and maintenance costs associated with the crossing improvements (i.e., amount of infrastructure required)

1.5 ENVIRONMENTAL RESPONSIBILITY

The MDTA recognizes that the Chesapeake Bay is a critical environmental resource in Maryland. Any Bay Crossing improvements must take into account the sensitivity of the Bay, including existing environmental conditions, and the potential for adverse impacts to the Bay and the important natural, recreational, socio-economic and cultural resources it supports. As touched on previously, the tiered NEPA study will analyze the full range of engineering and environmental issues (generally in Tier 1 and in more detail in Tier 2), which include but are not limited to:

- natural resources (e.g., floodplain, wetlands, water quality, flora, fauna, prime farmland);
- cultural resources (e.g., archeology, historic properties);
- socio-economics (e.g., land use compatibility, environmental justice, economics);
- air quality;
- noise;
- hazardous materials; and
- indirect and cumulative effects.

Consistent with State priorities, all counties neighboring the Bay have planning documents with goals that address resource protection, growth and development. Preservation of natural resources, including forests, steep slopes, wetlands, floodplains, watersheds, and waterways is a high priority as evident in programs (e.g., Chesapeake Bay Critical Area, Heritage Areas, Open Space, Priority Preservation Areas) that limit and control development. Maryland State legislation and local land use planning processes guide development patterns throughout each county by structuring projects around designated growth areas where planned growth is suitable, while preserving the low-density development and rural areas, and limiting sprawl development.

On both shores, the more rural and agriculturally dominated counties tend to focus development in more limited, specific areas in order to maintain the agricultural and cultural character unique to each place. Additionally, residential and business development is typically limited to urban growth areas, with countryside preservation areas surrounding towns and villages. With increased populations and improved access to these rural areas of the State, development pressures have increased. The existing Bay Bridge plays an important role supporting the diverse regional economic environment.

The MDTA will take into account the Bay and the communities dependent upon it during the study to identify the effects of any potential corridor alternative on natural environmental, cultural and community resources. MDTA will also take into account potential beneficial and adverse effects to regional economic activities, such as the recreational and tourism industries. Potential corridor alternatives will be evaluated for their ability to support planned economic development. Local land uses, existing and planned development patterns, and economics will be critical elements of the corridor evaluation.

1.6 SUMMARY

Congestion currently experienced at the Bay Bridge during weekdays and summer weekends is due to increasing travel demands and the inadequate capacity of the existing bridge and its approach roadways. Adding to the congestion problem is a need for increased rehabilitation and maintenance efforts in future years, which will require lane closures and result in further back-ups and delays. The region needs a dependable Bay crossing that provides reliable operating speeds and travel times; facilitates emergency services and evacuation events; allows access to employment and recreation areas; and offers flexible options for safe travel during rehabilitation, maintenance and incident management on the existing bridge. Therefore, in an effort to improve mobility, travel reliability and safety at the existing Bay Bridge, the purpose of the Bay Crossing Tier 1 NEPA Study is to consider corridors for providing additional capacity and access across the Bay in order to improve mobility, travel reliability and safety at the existing Bay Bridge.

Evaluation of any potential new corridor alternative will include an assessment of the transportation infrastructure needed, while also taking into account financial viability and environmental responsibility, accounting for potential adverse effects to the Bay and the important natural, recreational, socio-economic and cultural resources it supports.

APPENDIX A

Existing Bay Bridge Trip Origin-Destination Data

Western Shore

Location	Non-Summer Weekday Eastbound Trips	Non-Summer Weekday Westbound Trips	Summer Sunday Eastbound Trips	Summer Sunday Westbound Trips
Anne Arundel County, MD | N	44.3%	41.0%	36.3%	23.6%
Anne Arundel County, MD | S	1.9%	1.6%	1.8%	1.6%
Baltimore City, MD	5.5%	6.5%	4.7%	5.1%
Baltimore County, MD	5.2%	5.7%	5.6%	6.5%
Calvert, St. Mary's and Charles counties, MD	1.5%	1.6%	1.5%	1.0%
Carroll County, MD	0.8%	1.0%	1.1%	0.8%
Cecil County, MD | W	0.0%	0.0%	0.0%	0.0%
Central PA and Beyond	1.9%	2.2%	2.2%	1.4%
Fairfax County, VA	2.8%	2.7%	6.0%	8.5%
Frederick County, MD	1.2%	1.3%	1.0%	1.3%
Harford County, MD	0.4%	0.5%	0.4%	0.2%
Howard County, MD	5.0%	5.1%	5.1%	5.1%
Montgomery County, MD	4.8%	4.5%	8.3%	14.9%
Prince George's County, MD | N	5.7%	6.2%	6.3%	4.8%
Prince George's County, MD | S	3.1%	3.3%	3.0%	1.9%
Southern VA and Beyond	4.8%	4.5%	2.5%	1.0%
Washington, DC, Arlington, VA and Alexandria, VA	7.7%	8.5%	10.1%	19.2%
Western MD and Beyond	1.9%	1.9%	1.4%	0.6%
Western VA and Beyond	1.5%	1.9%	2.7%	2.5%

Eastern Shore

Location	Non-Summer Weekday Eastbound Trips	Non-Summer Weekday Westbound Trips	Summer Sunday Eastbound Trips	Summer Sunday Westbound Trips
Caroline County, MD	5.4%	5.3%	3.3%	2.4%
Cecil County, MD | E	0.3%	0.5%	0.3%	0.1%
Dorchester County, MD	4.3%	4.4%	4.2%	3.9%
Eastern PA, NJ and Beyond	3.2%	2.7%	2.7%	1.5%
Kent County, DE	4.2%	4.3%	4.7%	3.5%
Kent County, MD	1.9%	2.1%	1.7%	1.6%
New Castle County, DE	3.6%	4.0%	3.6%	2.3%
Queen Anne's County, MD	47.2%	48.8%	39.8%	35.2%
Somerset County, MD	0.8%	0.7%	0.2%	0.2%
Southeast VA and Beyond	0.3%	0.4%	0.4%	0.7%
Sussex County, DE	9.4%	8.2%	14.5%	24.3%
Talbot County, MD	13.7%	13.3%	12.4%	12.3%
Wicomico County, MD	4.0%	4.0%	3.4%	3.1%
Worcester County, MD	1.7%	1.3%	8.8%	8.9%