Resilience 2050

Adapting to the Challenges of Tomorrow

BRTB

Resilience 2050 Table of Contents

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**The draft of Appendix E includes only a sample advertisement. A full summary of public outreach and engagement materials will be included in the final document.*

Executive Summary

Regional Long-Range Transportation Plan

Long-term planning for the transportation system is critical to ensuring that the Baltimore region grows and develops in a way that is consistent with regional goals and objectives. As conditions change, it is important to reevaluate and update long-range transportation plans. The Baltimore Regional Transportation Board (BRTB) updates a regional long-range transportation plan (LRTP) every four years, as required by federal regulations.

Resilience 2050: Adapting to the Challenges of Tomorrow is the latest LRTP for the Baltimore region. We deliberately selected the theme of resilience and adapting to the challenges of a changing tomorrow for this LRTP. The ability of our region to be resilient is necessary for the ongoing and effective performance of our transportation system, our environment, our economy and our livelihoods. It sets out to make the best use of the region's limited transportation resources to benefit all residents, visitors and businesses.

Resilience 2050 includes a mix of projects that add to or enhance our region's transportation system and may receive federal funding in the years 2028-2050. These include transit, bicycle, pedestrian, roadway and interchange projects. Many of these projects expand roadway and transit capacity, while others help our transportation system to function more efficiently or seek to preserve existing transportation infrastructure. The plan also shows anticipated revenues for these projects with estimated project costs.

Chapter 1: Federal Requirements and Policies

Chapter 1 focuses on the legal basis for development of the LRTP. This includes an overview of federal requirements for the planning process, fiscal requirements and civil rights laws.

Federal law requires every urbanized area in the U.S. with a population greater than 50,000 to have a metropolitan planning organization (MPO). An MPO is a regional policy making body consisting of representatives of local governments and related state transportation agencies. The purpose of an MPO is to ensure regional cooperation in transportation planning. The Baltimore Metropolitan Council provides technical staff to assist the BRTB and advisory committees.

Each MPO must develop an LRTP and a short-range Transportation Improvement Program (TIP) for its region. We select projects for the LRTP and TIP according to regional goals and policies in consultation with state agencies, transit providers and local jurisdictions. The anticipated costs of transportation projects and programs in *Resilience 2050* cannot exceed anticipated revenues. Other federal requirements covered in Chapter 1 include air quality analysis, congestion management, consultation with the public, Title VI and Environmental Justice.

Baltimore Regional Transportation Board Members

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County Executive, Anne Arundel County – Chair

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*Maryland Transit Administration **

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*Secretary, Maryland Department of the Environment **

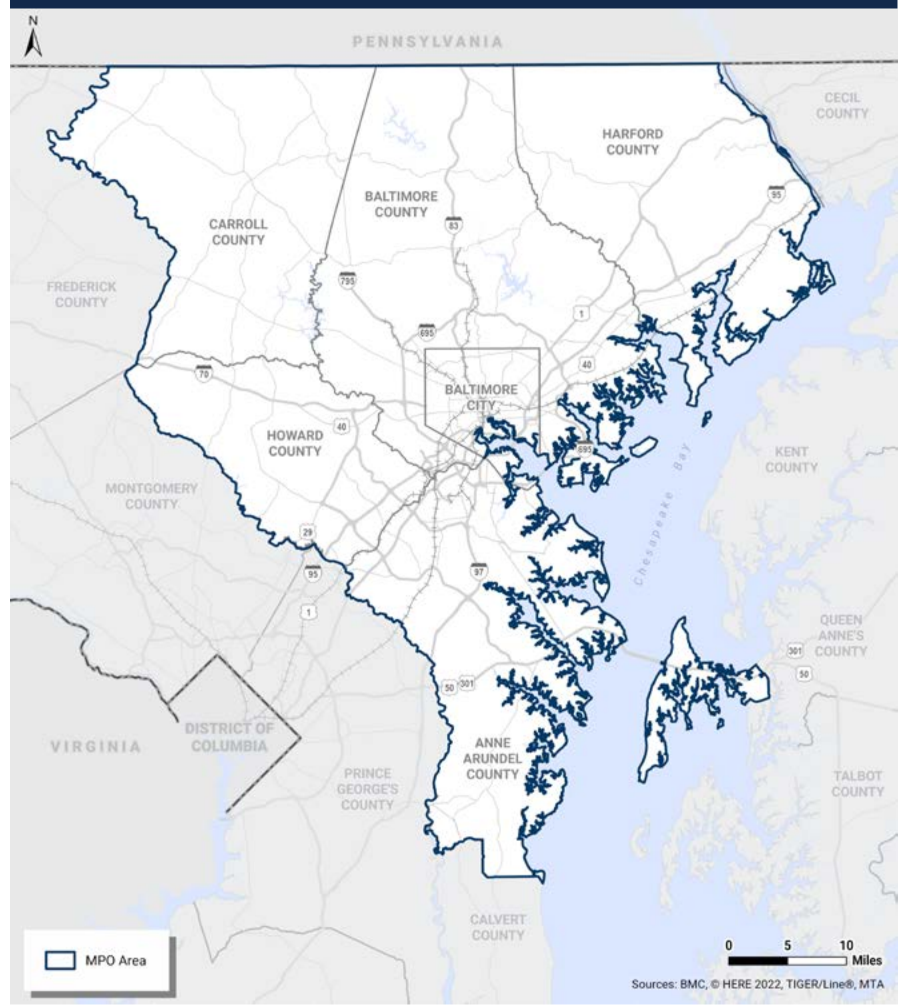
Honorable Rebecca Flora
*Secretary, Maryland Department of Planning **

Kwaku Duah, Ph.D.
Representative of Public Transportation, Annapolis Transit

** Denotes non-voting members*

Members of the BRTB are listed in the box to the left. Map 1 shows the Baltimore Metropolitan Planning Area (MPA). The Baltimore MPA consists of the city of Baltimore, the counties of Anne Arundel, Baltimore, Carroll, Harford and Howard as well as a portion of Queen Anne's County.

Map 1 - Baltimore Metropolitan Planning Area



Chapters 2 and 3: Future Factors and Trends

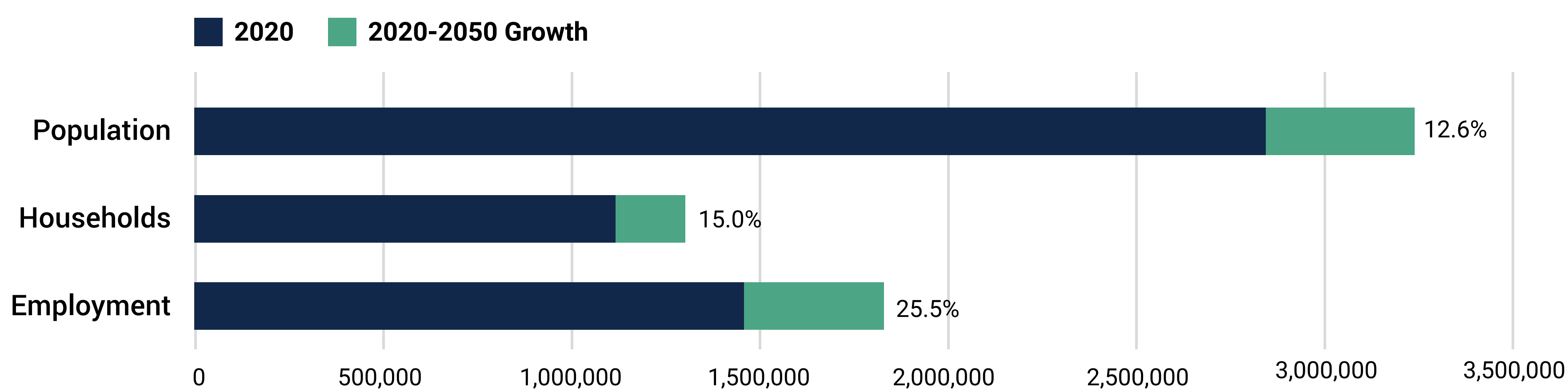
Chapters 2 and 3 provide additional context to clarify how decisions made in *Resilience 2050* might better prepare the region to respond to the uncertainties of the future.

How many people will call the Baltimore region home over the next 20+ years? Where will they live, work and play? How can we plan now for a transportation system that accommodates the future growth of the Baltimore region? Chapter 2 sets the stage for *Resilience 2050* by discussing planning for regional growth. It details how BRTB members work together to forecast future population, households and employment in the Baltimore region, and how these forecasts support the development of *Resilience 2050*. Figure 1 summarizes these forecasts.

Chapter 2 concludes with a discussion of the demographic trends likely to shape the future of the Baltimore region. Population growth due to natural increase (births minus deaths) is projected to decline throughout the planning period and the population is anticipated to age, mirroring national trends. The changing size and age composition of the population and shrinking size of the labor force will influence future travel patterns. For example, how can transportation adapt if the growing share of Baltimore region seniors choose to age in place? Work-from-home emerged as another trend during the COVID-19 pandemic and carries uncertain implications for travel, land use and home location choice.

Chapter 3 focuses on various factors and trends – some known, some anticipated and some unknown – that will affect the regional transportation network in the future for several transportation-related topics. These topics include:

Figure 1- Forecast Population, Household, and Employment Growth for the Baltimore Region (2020-2050)



- Environmental issues and challenges including greenhouse gas emissions, adapting to and mitigating measures for climate change and the health of the Chesapeake Bay,
- Creating connected, safe and equitable active transportation and transit networks that meet the daily needs of all users,
- Highway safety concerns including distracted and impaired driving, non-motorist safety and speeding,
- Supporting freight movement throughout the region and adapting freight delivery to accommodate changing technologies and consumer habits and
- Emerging and existing technologies including Mobility on Demand, micromobility, electric vehicles and connected and automated vehicles, ensuring that the implementation of these technologies supports regional goals and strategies.

We explored these and other issues related to the LRTP in a series of white papers released over the past year.

Chapter 4: Regional Goals and Strategies

We adopted nine broad regional goals, with supporting implementation strategies. Together, these goals and strategies will help us guide transportation investments over the 2028-2050 period.

The information below shows these goals. Chapter 4 provides more details on these goals, as well as the strategies adopted to help the region implement projects in support of these goals.

Goals That Address the Basic Functions of Transportation

- **Improve Accessibility:** Identify and support multimodal options and systems that promote equity, are resilient and sustainable and enable all individuals to reach their destinations safely and seamlessly.
- **Increase Mobility:** Help people and freight to move reliably, equitably, efficiently and seamlessly.

Goals That Address the Conditions or Effects of Transportation

- **Improve System Safety:** Reduce the number of crashes, injuries and fatalities experienced by all users of the transportation system toward meeting Zero Deaths Maryland.
- **Improve and Maintain the Existing Infrastructure:** Improve the conditions of existing transportation facilities; systematically maintain and replace transportation assets as needed.
- **Implement Environmentally Responsible Transportation Solutions:** Pass on to future generations the healthiest natural and human environment possible.
- **Improve System Security:** Provide a secure traveling environment for everyone; improve the region's ability to respond to natural and human-caused disasters.
- **Promote Prosperity and Economic Opportunity:** Support the vitality of communities and businesses, opportunities for workers and the movement of goods and services within and through the region.

Goals That Address the Transportation Decision-Making Process

- **Foster Participation and Cooperation Among All Stakeholders:** Enable all interested and affected parties to participate and cooperate to find workable solutions.
- **Promote Informed Decision Making:** Ensure that adopted transportation policies and performance measures guide the regional decision making process.

Chapter 5: Performance-Based Approach and System Performance Report

Resilience 2050 includes a series of performance measures and targets consistent with the performance-based approach to planning and programming set in federal law and regulations. These will help us gauge the effectiveness of transportation investments relative to regional goals over the 2028-2050 period.

Compliant with requirements of the Infrastructure Investment and Jobs Act (IIJA), we coordinated with the

Maryland Department of Transportation (MDOT) and public transportation providers to develop and adopt a series of regional performance targets. The 25 federally required performance targets cover several broad categories related to how well the transportation system is functioning, including:

- transit asset management
- transit safety,
- highway safety,
- traffic congestion,
- on-road mobile source emissions,
- pavement and bridge condition and
- travel time reliability.

Chapter 5 summarizes each of the performance measures and targets, as well as regional progress thus far towards meeting the targets.

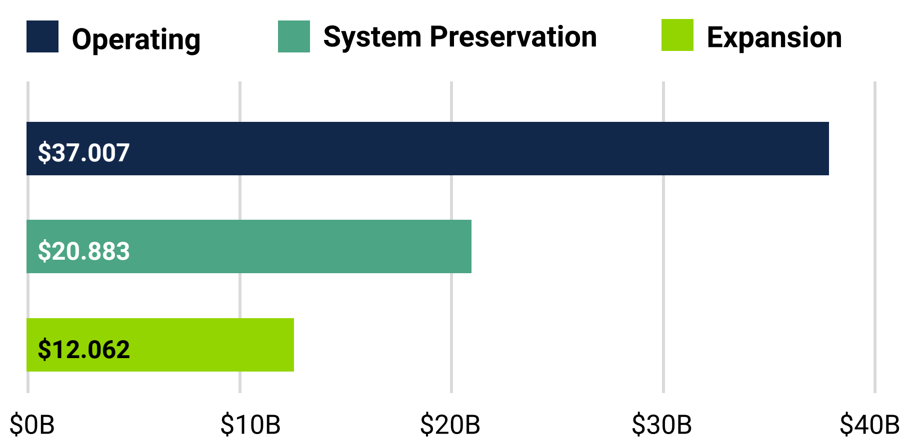
Chapter 6: The Financial Plan

Federal law requires regional transportation plans and programs to be fiscally constrained. That is, estimated costs cannot exceed forecast revenues. The LRTP must include a financial plan showing how the region expects to pay for each project and program.

Chapter 6 includes a forecast of anticipated local, state and federal revenues associated with operating, maintaining and expanding the transportation system through 2050. It also includes a summary of the project selection process for the LRTP, including project submittal, project scoring and cost estimation.

Local jurisdictions and state agencies submitted 98 candidate projects for *Resilience 2050*. Limited financial resources means that some projects will be too expensive to include in *Resilience 2050*, and the rigorous project scoring process helps guide decision-making on which projects make the cut. A project's total score consists of two parts. The policy score is based on how much of a priority the project is for the submitting agency and accounts for approximately 45 percent of the project score. The technical score is based on project consistency with regional goals such as access to key destinations, improving safety, and reducing environmental impacts. The technical score accounts for approximately 55 percent of the project score.

Figure 2 - *Resilience 2050* State and Federal Financial Forecast by Category



Source: Maryland Department of Transportation

The major capital projects in *Resilience 2050* are anticipated to use primarily state and federal funds. The financial forecast includes a total of $69.952 billion in state and federal revenues anticipated to be available for operating, system preservation and expansion in the Baltimore region from 2028-2050.

Figure 2 shows the state and federal financial forecast by category in the Baltimore region.

Most candidate projects are expansion projects that compete for the $12.062 billion in state and federal expansion funds anticipated to be available from 2028-2050. Table 1 shows a breakdown of forecast revenues versus total estimated Year of Expenditure (YOE) costs for expansion projects in *Resilience 2050*. Included in this breakdown are set-aside funds for small programs intended to improve air quality and for Locally Operated Transit Systems (LOTS). See Chapter 7 for further details on these programs. This breakdown demonstrates that the region expects to have sufficient funds to pay for expansion projects in *Resilience 2050* in the time periods in which we expect these projects to be implemented.

Resilience 2050 also includes 13 large-scale system preservation projects along with an estimated breakdown of future system preservation expenditures by category provided by the MDOT Maryland Transit Administration (MTA) and MDOT State Highway Administration (SHA). The financial forecast for *Resilience 2050* includes estimated revenues of $20.883 billion in state and federal system preservation funds available from 2028-2050. Table 2 shows a breakdown of estimated YOE system preservation costs versus forecast revenues by project type, including YOE costs for the 13 system preservation projects included in *Resilience 2050*.

Table 1 - Fiscal Constraint for Expansion Projects

	Category	2028-2039	2040-2050	2028-2050
Estimated Expansion YOE Costs	Projects	$3,607,000,000	$8,084,000,000	$11,691,000,000
	Small Program Set-Asides	$45,000,000	$205,000,000	$250,000,000
	LOTS	$30,000,000		$30,000,000
	Total	**$3,682,000,000**	**$8,289,000,000**	**$11,971,000,000**
Forecast Expansion Revenues		**$3,706,000,000**	**$8,356,000,000**	**$12,062,000,000**

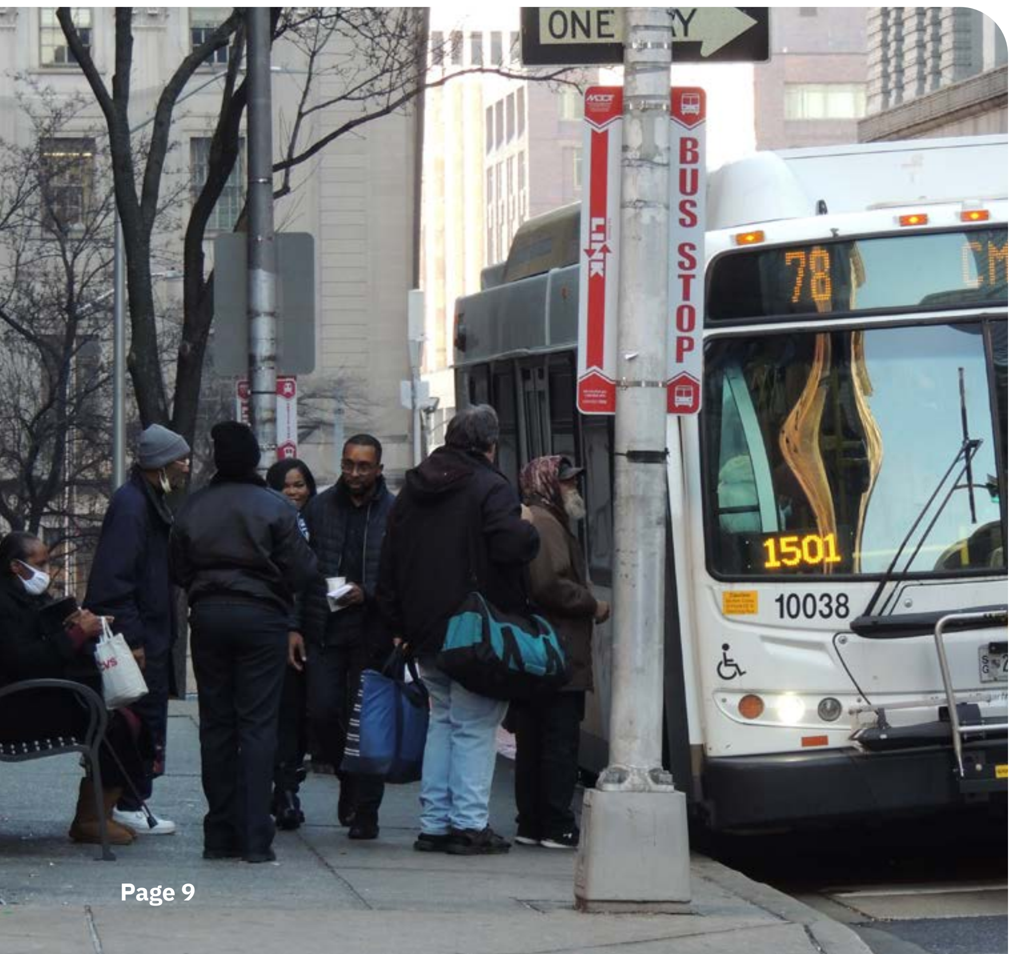
The financial forecast for *Resilience 2050* includes estimated revenues of $20.883 billion in state and federal system preservation funds available from 2028 to 2050. Below is a breakdown of estimated YOE system preservation expenditures versus forecast revenues by project type.

Table 2 - Fiscal Constraint for System Preservation Projects

		2028-2039	2040-2050	2028-2050
Roadway Estimated System Preservation YOE Costs	Transportation Alternatives	$127,000,000	$155,000,000	$282,000,000
	Environmental	$453,000,000	$552,000,000	$1,005,000,000
	Congestion Management	$457,000,000	$557,000,000	$1,014,000,000
	Bridge Replacement and Rehabilitation	$1,525,000,000	$1,444,000,000	$2,969,000,000
	Resurfacing and Rehabilitation	$1,758,000,000	$2,139,000,000	$3,897,000,000
	Safety and Spot	$1,043,000,000	$1,270,000,000	$2,313,000,000
	Urban Reconstruction	$429,000,000	$72,000,000	$501,000,000
	Roadway Subtotal	**$5,792,000,000**	**$6,189,000,000**	**$11,981,000,000**
Transit Estimated System Preservation YOE Costs	Guideway	$296,000,000	$541,000,000	$837,000,000
	Facilities	$464,000,000	$102,000,000	$566,000,000
	Systems	$291,000,000	$501,000,000	$792,000,000
	Stations	$515,000,000	$833,000,000	$1,348,000,000
	Vehicles	$1,804,000,000	$3,555,000,000	$5,359,000,000
	Transit Subtotal	**$3,370,000,000**	**$5,532,000,000**	**$8,902,000,000**
Total Estimated System Preservation YOE Costs		**$9,162,000,000**	**$11,721,000,000**	**$20,883,000,000**
Forecast System Preservation Revenues		**$9,162,000,000**	**$11,721,000,000**	**$20,883,000,000**

Chapter 7: *Resilience 2050* Major Capital Projects

Working with local jurisdictions and state agencies, we developed a preferred alternative for the Baltimore region. This preferred alternative consists of funding allocated for operating, system preservation and expansion. Most of the 92 major capital projects in *Resilience 2050* are expansion projects that expand transit or roadway capacity, while others help our transportation system to function more efficiently or preserve existing transportation infrastructure. Projects were selected by applying the adopted evaluation and scoring criteria, consistent with federal laws and policies and the regions adopted transportation goals.

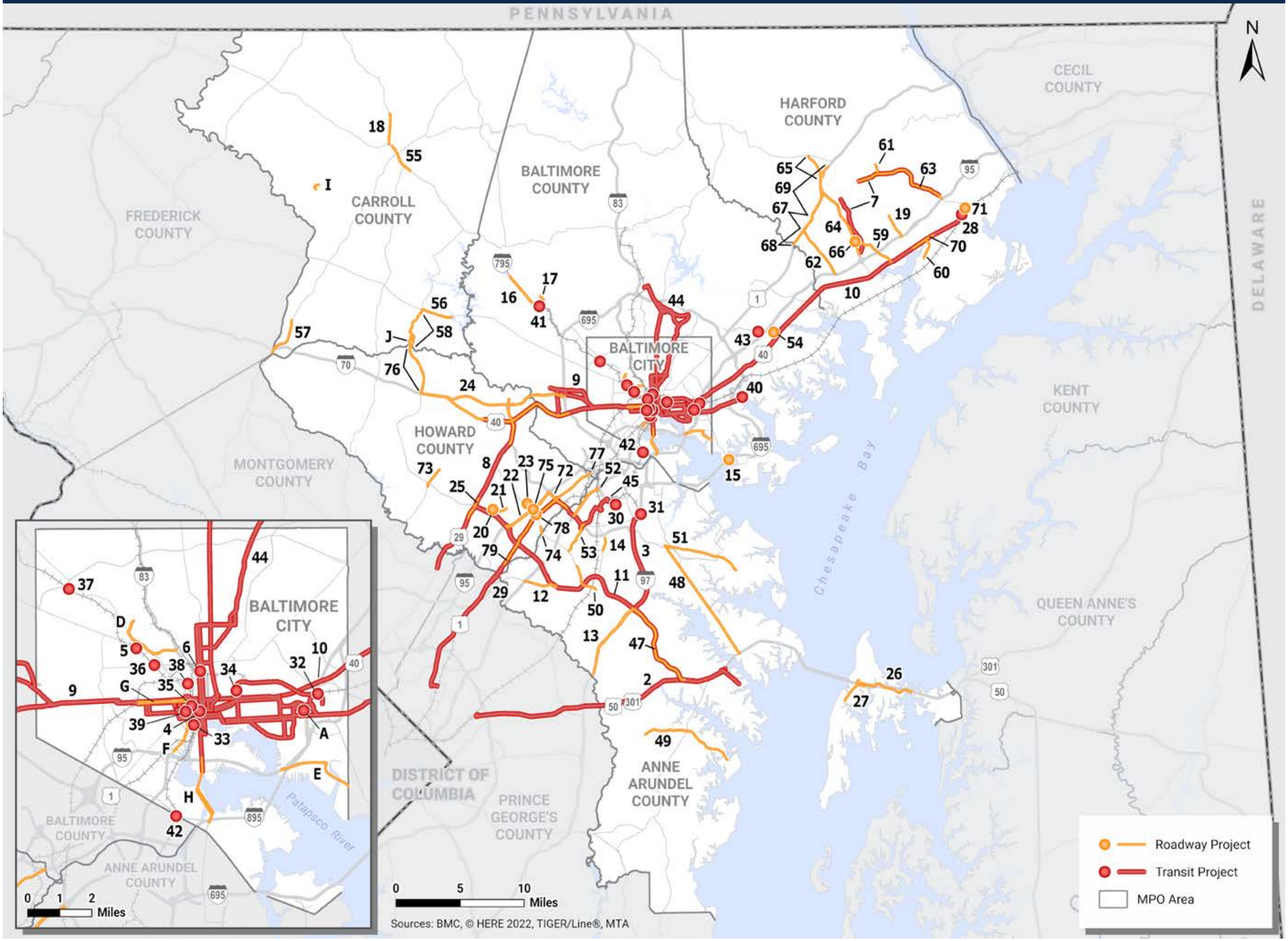


Most *Resilience 2050* projects have only generally defined scopes. Similarly, funds to cover the design, right-of-way and construction phases of these projects have, for the most part, not yet been committed. Such funds would come from forecast revenues the region expects to be available throughout the life of the plan. Project sponsors may or may not be able to commit these anticipated funds to specific projects during the life of the plan. Rather, the projects included in the preferred alternative represent our best judgment about what is desirable and what meets the federal requirement for fiscal constraint, all the while considering existing conditions and future expectations.

Resilience 2050 Major Capital Projects: 2028-2050

Map 2 on the next page shows the locations of major capital projects in *Resilience 2050*. Tables 3 through 9 show major capital expansion and system preservation projects in the timeframes within which they might be implemented along with YOE cost estimates. Chapter 7 provides additional details on these projects.

Map 2 - Locations of Major Capital Expansion and System Preservation Projects: 2028-2050
(See corresponding project numbers and letters in Tables 3-9)



*Projects marked with an asterisk in the following tables are not location specific and do not appear in this map

Table 3 - Transit Expansion Projects: 2028-2039

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
1*	Anne Arundel	Anne Arundel Countywide Microtransit	Countywide	Expand microtransit service in Anne Arundel County from 1 zone in the south to 7 zones.	$3,000,000
2	TBD (Anne Arundel)	Annapolis to New Carrollton Transit	New Carrollton to Parole (21.0 miles)	New Express Bus service between Parole and New Carrollton with stops at major communities along the way.	$3,000,000
3	TBD (Anne Arundel)	Glen Burnie to Annapolis Transit	Cromwell / Glen Burnie to Annapolis / Parole (16.0 miles)	New Express Bus service between Annapolis / Parole and Glen Burnie along I-97.	$7,000,000
• 4 • 5 • 6	MDOT MTA (3 Locations in Baltimore City)	MDOT MTA Transit Hubs: • Charles Center • Mondawmin • Penn Station	Jurisdiction: • Baltimore City • Baltimore City • Baltimore City	MDOT MTA has identified transit hub locations as part of the Regional Transit Plan. Typically, a transit hub includes enhanced amenities (shelters, benches, information).	• $14,000,000 • $7,000,000 • $19,000,000
7	MDOT SHA (Harford)	Transit Signal Priority	MD 22 corridor from MD 543 to Long Drive / Technology Drive (7.4 miles) MD 924 corridor from MacPhail Road to Woodsdale Road (4.7 miles)	Construct queue jump lanes along MD 22 and MD 924 and install equipment on buses that syncs with traffic signals along these corridors.	$2,000,000
8	TBD (Howard)	US 29 Bus Rapid Transit	US 40 to MD 198 (16.0 miles)	Connect Ellicott City to Columbia, Maple Lawn and Burtonsville at MD 198 in Montgomery County, including separated facilities on US 29 to integrate with Montgomery County improvements and the development of a transit center in Downtown Columbia.	$20,000,000
9	MDOT MTA (Regional)	East-West Transit Corridor	Ellicott City to Essex (17.0 miles)	New east-west transit service to connect major Baltimore region destinations like West Baltimore, Downtown, East Baltimore and the western suburbs as identified in the RTP.	$1,829,000,000
10	MDOT MTA (Regional)	MDOT MTA Commuter Service	Harford County to Downtown Baltimore and Harbor East	Additional MDOT MTA commuter bus service from Harford County to Downtown Baltimore and Harbor East.	$2,000,000
11	TBD (Regional)	Annapolis to Fort Meade / Columbia Transit	Annapolis / Parole to Fort Meade to Columbia (25.0 miles)	New Express Bus service between Parole and Columbia with primary service to Fort Meade and stops at major communities along the way.	$45,000,000

**Project does not appear in map*

Table 4 - Roadway Expansion Projects: 2028-2039

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
12	MDOT SHA (Anne Arundel)	MD 198	MD 295 to MD 32 (2.7 miles)	Widen from 2 to 4 lanes and construct a continuous center median. Widen ramp at MD 295. Provide bicycle and pedestrian facilities within project limits.	$275,000,000
13	MDOT SHA (Anne Arundel)	MD 3	MD 450 to MD 32 (6.2 miles)	Targeted widening from 4 to 5 lanes, including intersection improvements, access controls to address safety, TSMO strategies to address congestion, as well as bicycle and pedestrian improvements.	$95,000,000
14	MDOT SHA (Anne Arundel)	MD 170	Norcross Lane to Wieker Road (0.83 miles)	Widen from 2 to 4 lanes, resurface, and restripe along MD 170 and along MD 174 to create new turn lanes and increased capacity at the MD 170 / MD 174 intersection, including sidewalks and bicycle compatible shoulders.	$23,000,000
15	MDOT (Baltimore County)	I-695 at Broening Highway Interchange		Construct a partial interchange at Exit 44 of I-695 to support redevelopment at Sparrows Point.	$147,000,000
16	MDOT SHA (Baltimore County)	I-795	Owings Mills Boulevard to Franklin Boulevard (2.63 miles)	Widen from 4 to 6 lanes and construct a full interchange at Dolfield Boulevard, including TSMO strategies.	$155,000,000
17	MDOT SHA (Baltimore County)	MD 140	Painters Mill Road to Owings Mills Boulevard (0.4 miles)	Widen from 4 to 6 lanes, including a raised median, bicycle accommodations and pedestrian facilities.	$33,000,000
18	MDOT SHA (Carroll)	MD 97	Bachmans Valley Road to MD 140 in Westminster (2.4 miles)	Widen from 3 to 5 lanes, with a full interchange at Meadow Branch Road and bicycle and pedestrian facilities.	$202,000,000
19	MDOT SHA (Harford)	MD 543	MD 136 to I-95 (1.9 miles)	Widen from 2 to 4 lanes, including intersection upgrades at MD 136, turn lanes, capacity upgrades to the MD 543 / I-95 interchange, and bicycle and pedestrian access.	$140,000,000
20	Howard	Broken Land Parkway at Snowden River Parkway	Broken Land Parkway from south of MD 32 to north of Snowden River Parkway; Snowden River Parkway from east of Minstrel Way to Patuxent Woods Drive (0.25 miles)	Capacity, operational and safety improvements at this signalized intersection as well as access improvements to the MD 32 / Broken Land Parkway interchange ramps.	$63,000,000

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
21	Howard	Snowden River Parkway Widening	Broken Land Parkway to Oakland Mills Road (1.1 miles)	Widen from 4 to 6 lanes, including auxiliary lanes and pedestrian, bicycle and transit improvements on both sides of the road.	$21,000,000
22	MDOT SHA (Howard)	I-95	MD 32 to MD 100 (6.0 miles)	Create peak hour part-time shoulder use lanes.	$45,000,000
23	MDOT SHA (Howard)	MD 175 / MD 108 Interchange	0.25 miles in all directions from the current intersection and a direct connection of MD 108 to Columbia Gateway Drive (0.25 miles)	This T-intersection experiences significant congestion and a collision rate higher than almost all intersections in Howard County. A partial grade-separation with direct access into Columbia Gateway will improve intersection capacity and alleviate the high collision rate.	$102,000,000
24	MDOT SHA (Howard)	TSMO System 1	I-70 from I-695 to MD 32 (11.0 miles) US 29 from MD 99 to MD 100 (4.0 miles) US 40 from I-695 to I-70 (10.0 miles)	Implement a combination of information technology and geometric improvements to address safety and operations within TSMO System 1.	$48,000,000
25	MDOT SHA (Howard)	US 29	Patuxent River Bridge to Seneca Drive (1.7 miles)	Widen northbound US 29 from 2 to 3 lanes, including improvements at intersection with Rivers Edge Road.	$103,000,000
26	MDOT SHA (Queen Anne's)	MD 18	Kent Narrows to Bay Bridge – MD 18 and MD 835 on east side of Kent Narrows to MD 18 (5.0 miles)	Widen from 2 to 4 lanes, including utility relocation, new pedestrian improvements, and reconstruction of intersections to improve capacity, safety and mobility on the only alternative route to US 50/301 on the island.	$114,000,000
27	MDOT SHA (Queen Anne's)	MD 8 / US 50/301 Interchange and Service Roads	Skip Jack Parkway south to Davidson Drive; east to Thompson Creek service road (2.0 miles)	Widen from 2 to 4 lanes, convert MD 8 overpass to full divergent diamond interchange with US 50/301, and add Thompson Creek and Cox Creek service roads to improve traffic flow, add capacity and allow for alternative routes to services and residential areas. Provide for bike and pedestrian improvements along existing and new routes.	$90,000,000

Table 5 - Transit Expansion Projects: 2040-2050

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
28	MDOT MTA (Harford)	Aberdeen MARC Station	US 40 at MD 132 (Bel Air Ave)	TOD, new train station, additional parking, US 40 "Green Boulevard," and remove pedestrian overpass and replace with a new pedestrian underpass and green, terraced plaza / amphitheater.	$126,000,000
29	TBD (Howard)	US 1 Corridor Bus Rapid Transit	Dorsey MARC Station to College Park Purple Line Station (19.5 miles)	Emulate light rail operation at a lower cost. Link Howard County commuters from the Dorsey MARC to the Laurel MARC Station and the City of Laurel as well as to College Park and the Purple Line Light Rail.	$281,000,000
• 30 • 31 • 32 • 33 • 34 • 35 • 36 • 37 • 38 • 39 • 40 • 41 • 42 • 43	MDOT MTA 14 Locations throughout the region	MDOT MTA Transit Hubs: • BWI Airport • Glen Burnie • Bayview Medical Center • Camden Station • Johns Hopkins Hospital • Lexington Market • Penn-North • Rogers Avenue • State/Cultural Center • UM Medical Center • Essex • Owings Mills • Patapsco • White Marsh	Jurisdiction: • Anne Arundel • Anne Arundel • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore County • Baltimore County • Baltimore County • Baltimore County	MDOT MTA has identified transit hub locations as part of the Regional Transit Plan. Typically, a transit hub includes enhanced amenities (shelters, benches, information).	• $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000
44	MDOT MTA (Regional)	North-South Transit Corridor	Towson to Downtown Baltimore (14.0 miles)	New North-South transit service to connect Towson to Downtown Baltimore (potentially Lutherville to Port Covington), with associated investments to improve the speed and reliability of transit service in this busy corridor.	$2,025,000,000

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
45	TBD (Regional)	Bus Rapid Transit to BWI	Dorsey MARC Station to BWI Light Rail Station (9.7 miles)	New bus rapid transit service from the Dorsey MARC station to Arundel Mills to BWI consolidated rental car facility to the BWI light rail station.	$240,000,000
46*	TBD (Regional)	Chesapeake Bay Ferry Service		Establish a passenger ferry between numerous ports along the Chesapeake Bay.	$59,000,000

**Project does not appear in map*

Table 6 - Roadway Expansion Projects: 2040-2050

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
47	MDOT SHA (Anne Arundel)	I-97	MD 32 to US 50/301 (6.5 miles)	Widen from 4 to 6 lanes, adding managed lanes (HOV lanes) to address capacity needs. Investigate need for additional interchange access in Crownsville.	$450,000,000
48	MDOT SHA (Anne Arundel)	MD 2	US 50 to MD 100 (10.0 miles)	Widen existing 4-lane sections to 6 lanes to create a continuous typical section throughout corridor, including intersection improvements and pedestrian facilities throughout to connect MD 2 to the B&A Trail at various locations.	$205,000,000
49	MDOT SHA (Anne Arundel)	MD 214	MD 424 to Shoreham Beach Road (7.5 miles)	Widen from 2 to 4 lanes east of MD 2, bicycle improvements throughout most of the corridor and pedestrian improvements in segments. Traffic signal warrant assessments recommended at MD 214 / Riva Road and MD 214 / Stepneys Lane intersections.	$236,000,000
50	MDOT SHA (Anne Arundel)	MD 175	Reece Road to MD 170 (2.7 miles)	Widen from 4 to 6 lanes, including improvements at the MD 32 interchange, and bicycle and pedestrian facilities.	$277,000,000
51	MDOT SHA (Anne Arundel)	MD 177	MD 2 to Lake Shore Drive (6.1 miles)	Widen from 2 to 4 lanes, including intersection improvements and improved bicycle and pedestrian infrastructure.	$223,000,000
52	MDOT SHA (Anne Arundel)	MD 295	MD 100 to I-195 (3.27 miles)	Widen from 4 to 6 lanes, including a new full interchange at Hanover Road and an extension of Hanover Road from the CSX railroad tracks to MD 170.	$393,000,000

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
53	MDOT SHA (Anne Arundel)	MD 713	MD 175 to MD 176 (2.6 miles)	Construct corridorwide improvements including reconstruction and widening, intersection improvements and bicycle and pedestrian accommodations. Primary widening is from 2 to 4 lanes between MD 175 and Stoney Run Drive.	$68,000,000
54	MDOT SHA (Baltimore County)	MD 7 at MD 43 Interchange		Upgrade interchange from partial to full, including two new ramps to accommodate full movements at interchange.	$82,000,000
55	MDOT SHA (Carroll)	MD 140	Market Street to Sullivan Road (2.5 miles)	Widen from 6 to 8 lanes, with a full interchange at MD 97, continuous flow intersections at Center Street and Englar Road, and bicycle and pedestrian facilities.	$474,000,000
56	MDOT SHA (Carroll)	MD 26	MD 32 to the Liberty Reservoir (2.5 miles)	Widen from 4 to 6 lanes, including a raised median, intersection improvements, and pedestrian facilities.	$120,000,000
57	MDOT SHA (Carroll)	MD 27 Corridor Improvements	Carroll County line to Leishear Road (3.2 miles)	Widen to a consistent four lanes, including dedicated turn lanes, signalized traffic control, boulevard separation of lanes, and controlled intersections to allow pedestrian crossings.	$78,000,000
58	MDOT SHA (Carroll)	MD 32	Howard County Line to MD 26 (3.4 miles)	Widen from 2 to 4 lanes with pedestrian and bicycle facilities.	$66,000,000
59	Harford	Abingdon Road	MD 924 to US 40 (3.0 miles)	Capacity improvements including turn lanes, bicycle lanes and sidewalks.	$87,000,000
60	Harford	Perryman Access - Mitchell Lane	US 40 in the vicinity of Mitchell Lane to Canning House Road (2.0 miles)	Construct a new 2-lane road and bridge over Cranberry Run in Perryman, including turn lanes and bicycle and pedestrian access.	$62,000,000
61	Harford	Thomas Run Road	MD 22 to West Medical Hall Road (0.8 miles)	Streetscape and capacity improvements, including center turn lane, sidewalks, bicycle accessibility, pedestrian-scale lighting with banners, crosswalks and street furniture.	$21,000,000
62	MDOT SHA (Harford)	MD 152	US 1 to I-95 (4.3 miles)	Capacity improvements including turn lanes and bicycle and pedestrian access where applicable.	$103,000,000

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
63	MDOT SHA (Harford)	MD 22	MD 543 to I-95 (7.9 miles)	Widen existing 2 and 3 lane sections to 4 and 5 lanes, including an HOV lane from Old Post Road to the Aberdeen Proving Ground (APG) gate, bicycle and pedestrian access, and transit queue jump lanes and transit priority system where applicable.	$221,000,000
64	MDOT SHA (Harford)	MD 24	US 1 Bypass to south of Singer Road (5.0 miles)	Widen from 4 to 6 lanes, including sidewalks and bicycle accommodations where appropriate.	$128,000,000
65	MDOT SHA (Harford)	MD 24 (Rock Spring Road)	US 1 Bypass to MD 23 (1.8 miles)	Widen from 2 to 4 lanes, including turn lanes and completion of shared use path adjacent to the roadway from Forest Valley Road to Red Pump Road.	$44,000,000
66	MDOT SHA (Harford)	MD 24 at Singer Road Interchange		Elevate grade of cross street through movement as well as left turn movements from all directions while allowing MD 24 through and right turn movements as well as side street right turn movements to operate with free-flowing movements.	$182,000,000
67	MDOT SHA (Harford)	US 1	MD 152 to MD 147 / US 1 Business (1.3 miles)	Widen from 4 to 6 lanes, including bicycle and pedestrian accommodations.	$212,000,000
68	MDOT SHA (Harford)	US 1	Baltimore County Line to MD 152 (1.4 miles)	Widen from 4 to 6 lanes, including turn lanes and bicycle and pedestrian access where applicable.	$35,000,000
69	MDOT SHA (Harford)	US 1 Bypass	MD 147 / US 1 Business to Hickory Bypass (4.6 miles)	Widen from 2 to 4 lanes and improve US 1 / MD 24 and US 1 / MD 924 interchanges.	$354,000,000
70	MDOT SHA (Harford)	US 40	MD 543 to Loflin Road (1.7 miles)	Widen from 4 to 6 lanes, including turn lanes, a partial interchange reconstruction at MD 543 and bicycle and pedestrian access.	$93,000,000
71	MDOT SHA (Harford)	US 40 at MD 22 Interchange		Make capacity improvements, reconfigure existing interchange, restrict all left turn movements (allowing room for designated bike lanes), and relocate the existing signal from MD 22 to US 40.	$48,000,000

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
72	MDOT SHA (Howard)	MD 100 Widening	I-95 to Anne Arundel County line (2.0 miles)	Widen from 4 to 6 lanes with additional merge/ diverge lanes.	$47,000,000
73	MDOT SHA (Howard)	MD 108	Trotter Road to Guilford Road (1.67 miles)	Selected road capacity enhancements, improve sidewalks, add shared use paths and upgrade traffic signals.	$64,000,000
74	MDOT SHA (Howard)	MD 175	Oceano to Anne Arundel County Line (0.54 miles)	Widen from 2 to 4 lanes, including bicycle, transit and pedestrian improvements consistent with Anne Arundel County widening proposals.	$24,000,000
75	MDOT SHA (Howard)	MD 175 at I-95 Interchange	1.0 mile	Improve existing full interchange consistent with preferred options in the MDOT SHA MD 175 Improvement Study.	$196,000,000
76	MDOT SHA (Howard)	MD 32	North of I-70 to Carroll County Line (4.0 miles)	Widen from 2 to 4 lanes to provide safety, capacity, operational and access improvements on MD 32.	$79,000,000
77	MDOT SHA (Howard)	US 1	Baltimore County Line to MD 175 (5.5 miles)	Widen from 4 to 6 lanes and construct the revised typical section in the State / County MOU, including connecting community destinations to support safety and access as per the US 1 safety evaluation, functional plans and the regional active transportation priority project.	$205,000,000
78	MDOT SHA (Howard)	US 1 at MD 175 Interchange	0.5 miles	Construct a new grade-separated Single Point Urban Interchange, with MD 175 passing over US 1.	$184,000,000
79	MDOT SHA (Howard)	US 1 Revitalization Breakout Projects	MD 175 to Whiskey Bottom Road (4.5 miles)	Widen from 4 to 6 lanes along with bicycle, pedestrian, transit, streetscape and access improvements consistent with the US 1 Design Manual.	$166,000,000

Table 7 - Transit System Preservation Projects: 2028-2039

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
A	MDOT MTA (Baltimore City)	Eastern Bus Division		Reconstruct the Eastern Bus Division as an electric bus facility.	$464,000,000
B*	MDOT MTA (Regional)	Zero Emission Bus Transition Phase 1	MDOT MTA's core service area in the Baltimore region	Transition 50% of MDOT MTA's 760-bus fleet to zero-emission by 2030. Includes procurement of over 350 Battery Electric Buses by 2030, training the transit workforce, and retrofitting Kirk and Northwest bus divisions with charging infrastructure.	$1,594,000,000
C*	MDOT MTA (Regional)	Light Rail Fleet Mid-life Overhaul	Hunt Valley to BWI/Glen Burnie	Overhaul the entire Light Rail fleet, extending the fleet’s life by approximately 15 years.	$210,000,000

Projects do not appear in map

Table 8 - Roadway System Preservation Projects: 2028-2039

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
D	Baltimore City	Druid Park Lake Drive Complete Streets	Greenspring Ave in the northeast to I-83 in the southeast along Druid Hill Park (2.17 miles)	Redesign Druid Park Lake Drive to implement guidelines and recommendations in the City's Complete Streets Manual. Reduce automobile traffic by removing travel lanes and adding or improving infrastructure and accessible connections for pedestrians, the handicapped, bicyclists, transit users, and e-scooters.	$43,000,000
E	Baltimore City	Keith Avenue / Broening Highway Improvements	Clinton Street to the Baltimore City Line Southeast of Ralls Avenue (2.5 miles)	Keith Avenue and Broening Highway are part of Baltimore City's critical freight route network, connecting I-95 and the Seagirt and Dundalk Terminal Port facilities. Upgrade roadway conditions, improve wayfinding, and integrate complete street amenities to better accommodate safety for transit, pedestrians and bicyclists.	$84,000,000

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
F	Baltimore City	Russell Street Complete Streets Improvements	Annapolis Road to South Greene & South Paca Streets (1.0 mile)	Improve asset conditions and multimodal Complete Streets infrastructure for automobile traffic and pedestrian, transit and freight movement. Support safe mobility and economic development in the city's growing southern edge and Camden Yards.	$54,000,000
G	Baltimore City	US 40 Highway Deconstruction	Smallwood Street to Greene Street (1.5 miles)	US 40 is a depressed expressway in West Baltimore. Building this fragment of an expressway has caused irreparable damage to community cohesion and economic stability. Deconstructing the highway will offer over 60 acres for redevelopment and improvements to adjacent streets.	$157,000,000
H	Baltimore City	Vietnam Veterans Memorial Bridge and Hanover / Potee Street Corridor Improvements	Patapsco Avenue to Wells Street (2.2 miles)	Rehabilitate or replace the Vietnam Veterans Memorial Bridge and improve Complete Streets infrastructure along the Hanover/Potee Streets (MD 2) corridor in south Baltimore. Improve accommodations for pedestrians, bicycles, transit, freight, and auto traffic to support safe mobility and economic development.	$339,000,000
I	MDOT SHA (Carroll)	MD 31 Corridor Improvements	MD 31 from Church Street to High Street and High Street from Main Street to Coe Drive (0.67 miles)	Improve sidewalks, enhance bicycle and pedestrian accessibility, and improve the roadway.	$16,000,000
J	MDOT SHA (Carroll)	MD 851 Urban Reconstruction	Cooper Drive to South Branch of the Patapsco River (1.04 miles)	Roadway reconstruction and improvements to pedestrian and bicycle facilities, as well as streetscape amenities.	$16,000,000

Table 9 - Transit System Preservation Projects: 2040-2050

ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)
K*	MDOT MTA (Regional)	Fleet Replacement with Low-Floor Rail Vehicle		Transition to low-floor Light Rail Vehicles when replacement is needed. This will require significant station retrofits, modifying maintenance facilities, and amending standard operating practices.	$757,000,000
L*	MDOT MTA (Regional)	Zero Emission Bus Transition Phase 2	MDOT MTA's core service area in the Baltimore region	Transition to a 95% zero-emission fleet by 2045. Capital costs for phase 2 are rough estimates and include retrofitting for Washington Boulevard, a 5th Division, and Battery Electric Buses.	$2,228,000,000
M*	MDOT MTA (Regional)	MARC Rolling Stock Overhauls and Replacements	Penn, Camden and Brunswick MARC Lines	Short-term, medium-term, and long-term plans to replace and overhaul MARC locomotives and train sets.	$570,000,000**

**Projects do not appear in map*
***Project benefits multiple MPO regions. Cost listed is 50% of total project cost of $1.14 billion.*

Other Project Categories

Chapter 7 also includes details on other categories of programs and projects, including:

- **Set-aside Funds:** We set aside $250 million in anticipated expansion revenues for programs and initiatives that will improve air quality in the Baltimore region as well as $30 million for Locally Operated Transit Systems. These funds are part of the financially constrained LRTP.
- **Maryland Transportation Authority (MDTA) and Federal Railroad Administration (FRA) Projects:** The fiscally constrained LRTP includes projects that are anticipated to use funds from the Federal Highway Administration (FHWA) or the Federal Transit Administration (FTA). However, *Resilience 2050* must also account for projects funded by other sources that affect air quality and travel demand, funded by agencies such as MDTA (toll revenues) and the FRA.
- **Committed Funding:** *Resilience 2050* covers the timeframe from 2028-2050. To present a complete picture of planned future transportation investments, Chapter 7 lists the major committed projects within the 2024-2027 period of the current adopted TIP.
- **Illustrative Projects:** This list of projects could be included in the LRTP in the future if additional funds beyond those included in the financial plan were to become available.

Appendices

Appendix A: Glossary

This appendix provides definitions and examples of concepts and terms related to the transportation planning process.

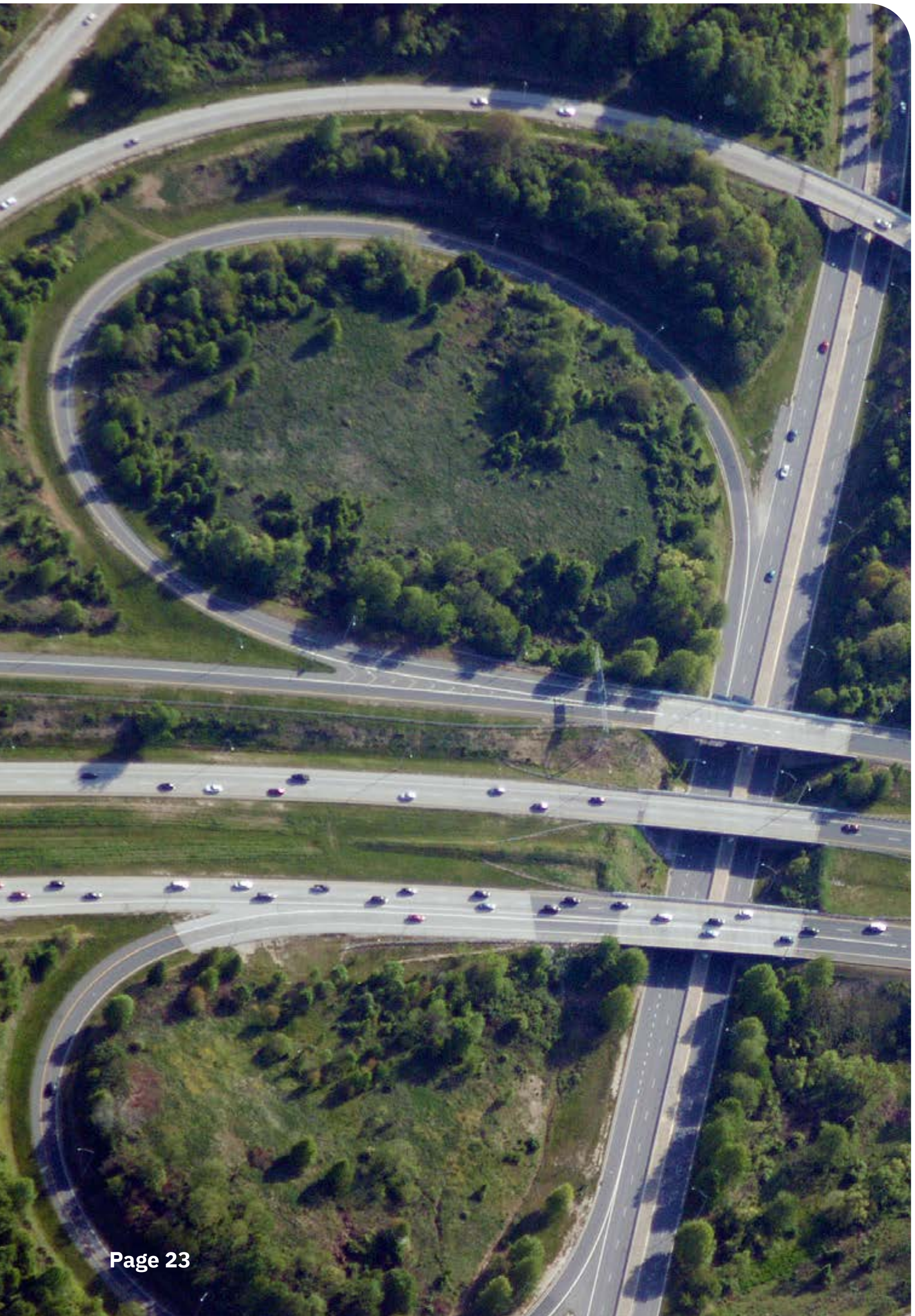
Appendix B: Cost Estimation, Project Evaluation and Scoring

There are always more projects submitted than the region can afford to include in the LRTP. Deciding which projects to include requires a method of prioritizing candidate projects. Projects are scored based on the approved scoring methodology for projects. The number of projects included also depends on estimated project costs and the financial forecast for the region. This appendix includes details on cost estimating methodologies, project evaluation and project scores.

Appendix C: Evaluating Potential Effects of Projects

This appendix contains details on the technical analysis we conducted during the development of *Resilience 2050*. We use our travel demand model, emissions model and socioeconomic forecasts to conduct a variety of analyses including:

- **Air Quality Conformity:** The Baltimore region does not meet the National Ambient Air Quality Standard for ground level ozone. As a result, the region must assess whether the projects in its transportation plans and programs conform to air quality goals. "Conformity" means that the projects in *Resilience 2050* will not cause or contribute to new air quality violations, worsen existing conditions or delay timely attainment of air quality standards. Based on the conformity analysis, we have concluded that implementation of the projects in *Resilience 2050* will not worsen the region's air quality or delay the timely attainment of air quality standards.
- **Travel Demand Effects:** We used a travel demand model to analyze the anticipated effects of *Resilience 2050* projects on various transportation measures including vehicle miles traveled, congestion, average auto occupancy for different kinds of trips such as for work or shopping and the share of persons using transit for trips.
- **Environmental Justice (EJ):** EJ analysis is intended to ensure that that the benefits and burdens of transportation investments are shared as equitably as possible among all affected communities. The Executive Order addressing EJ reinforces the requirements of Title VI of the Civil Rights Act of 1964 that focus federal attention on environmental and human health conditions in minority and low-income communities. We analyzed the potential effects of this plan's major projects on EJ populations for a variety of accessibility measures such as access and travel times to jobs and shopping opportunities.



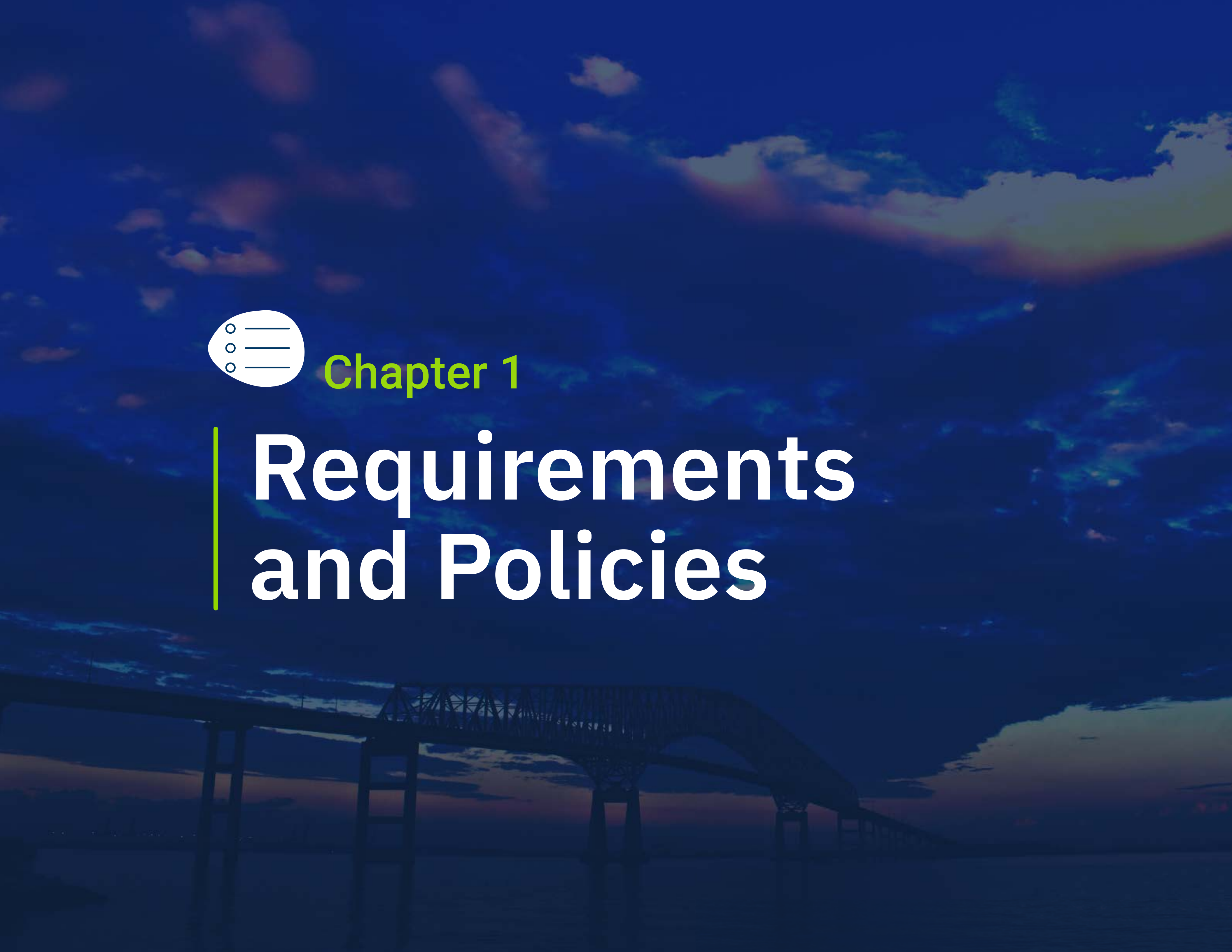
- **Natural and Cultural Resources:** We consulted with federal, state and local agencies responsible for land use management, natural resources, environmental protection, conservation and historic preservation to conduct a broad analysis comparing *Resilience 2050* projects with natural and cultural resources.
- **Strategic Highway Network (STRAHNET):** We conducted a review of projects in relation to the STRAHNET network.

Appendix D: Congestion Management Process

Federal law requires all metropolitan areas with populations greater than 200,000 to have a Congestion Management Process (CMP). The CMP identifies actions and strategies to reduce traffic congestion and increase mobility. Appendix D includes technical details on the region's CMP and how the projects in this plan are consistent with the CMP.

Appendix E: Public Outreach and Engagement

Federal law requires MPOs to consult with state and local officials, transit operators and the public when conducting transportation planning. Part of this requirement is developing a public participation plan that defines a process for providing the public and interested parties with reasonable opportunities to be involved in the planning process. Appendix E includes details on the public participation process and specific outreach efforts in developing *Resilience 2050*. It will include all comments and responses at the end of the process.



Chapter 1

Requirements and Policies

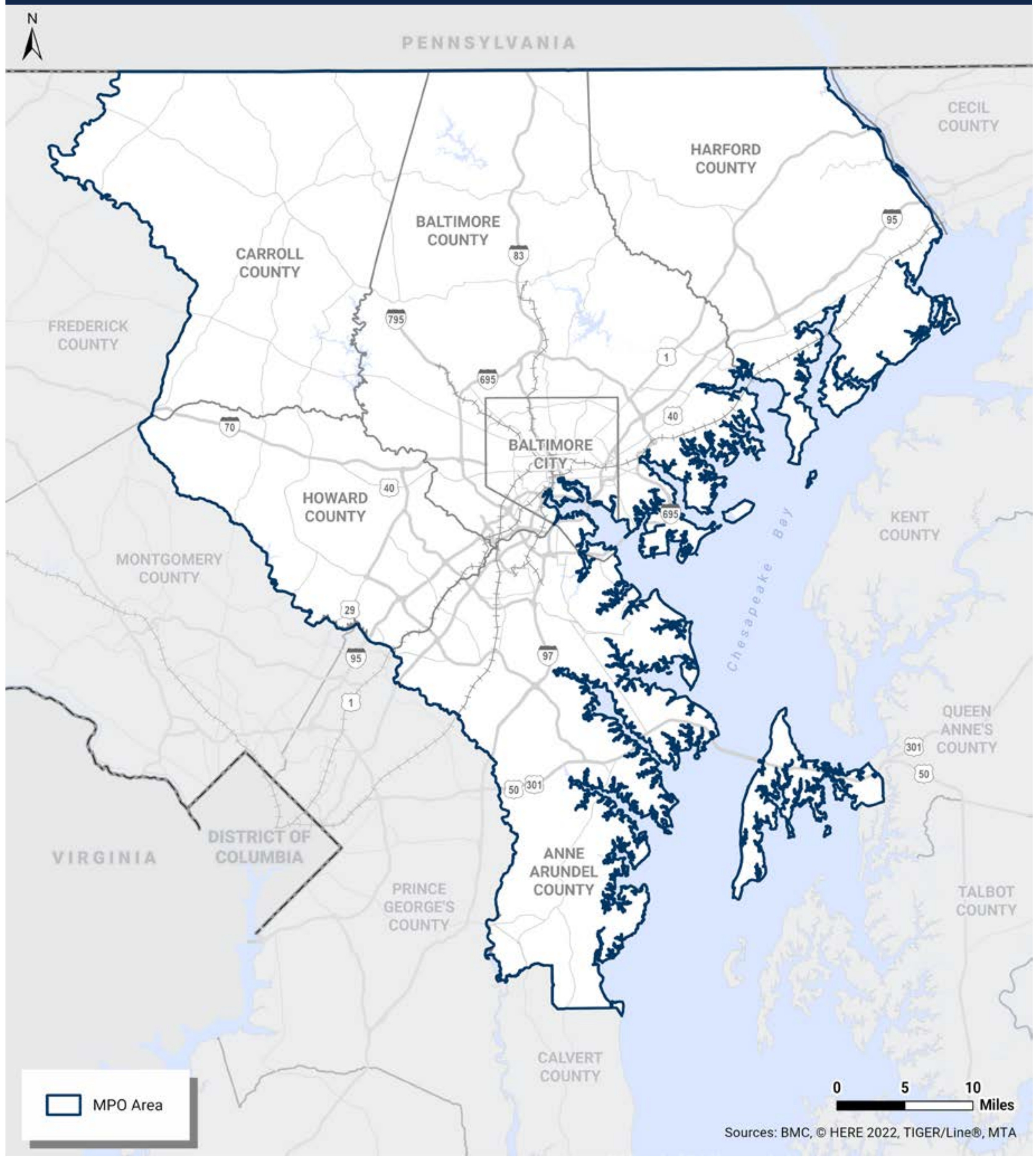
Regional Long-Range Transportation Plan

Resilience 2050: Adapting to the Challenges of Tomorrow is the regional long-range transportation plan (LRTP) for the Baltimore Metropolitan Planning Area (MPA).

This chapter focuses on the legal basis for development of the LRTP. This includes an overview of federal requirements for the planning process, fiscal requirements and civil rights laws.

At a minimum, an MPA must cover the urbanized area and contiguous geographic areas likely to become urbanized within the next 20 years. The Baltimore MPA consists of the city of Baltimore, the counties of Anne Arundel, Baltimore, Carroll, Harford and Howard, as well as a portion of Queen Anne's County (see Map 1).

Map 1 - Baltimore Metropolitan Planning Area



Requirements under Federal Law

The most recent federal transportation legislative program was signed into law on November 15, 2021. The Bipartisan Infrastructure Law, as enacted in the Infrastructure Investment and Jobs Act (IIJA), authorizes the largest federal investment in public transportation in the nation's history. The IIJA provides $550 billion over fiscal years 2022 through 2026 in new Federal investment in infrastructure, including roads, bridges and mass transit, as well as water infrastructure, resilience and broadband. There will be $274 billion in spending for transportation programs above current baseline levels. The IIJA creates more than a dozen new highway programs and also creates more opportunities for local governments and other entities.

The prior program, known as the Fixing America's Surface Transportation (FAST) Act, was signed into law on December 4, 2015. The FAST Act preserves the commitment to the metropolitan transportation planning process established in previous federal initiatives. On May 27, 2016, the U.S. Department of Transportation (U.S. DOT) issued the latest regulations regarding metropolitan transportation planning, specifically outlining the planning requirements associated with the metropolitan planning process, including the regional LRTP.

Metropolitan Planning Organization (MPO)

Federal law requires every urbanized area in the U.S. with a population greater than 50,000 to have a metropolitan planning organization (MPO). An MPO is a regional policy making organization consisting of representatives of local governments and governmental transportation agencies. The purpose of an MPO is to ensure regional cooperation in transportation planning.

The functions of an MPO include:

- Coordinating federal funding for transportation.
- Conducting transportation planning in cooperation with federal agencies, state agencies and the operators of publicly owned transit services.
- Ensuring that transportation expenditures are based on a continuing, cooperative and comprehensive (3-C) planning process.
- Providing reasonable opportunity for input from the public and interested parties.

Baltimore Regional Transportation Board (BRTB):

The BRTB is the federally-designated MPO acting as the regional transportation planning and policymaking body for the Baltimore region. In this capacity, the BRTB is directly responsible for conducting the continuing, cooperative and comprehensive (3-C) transportation planning process for the Baltimore metropolitan region in accordance with the metropolitan planning requirements.

The BRTB provides policy direction and oversight in the development of the federally-mandated regional LRTP, the Transportation Improvement Program (TIP) and the associated Air Quality Conformity Determination.

The BRTB is a 13-member policy board consisting of the cities of Annapolis and Baltimore, the counties of Anne Arundel, Baltimore, Carroll, Harford, Howard and Queen Anne's, as well as the Maryland Department of Transportation (MDOT), the Maryland Department of the Environment (MDE), the Maryland Department of Planning (MDP), the MDOT Maryland Transit Administration (MTA) and a representative of public transportation.

Voting rights are extended to all members with the exception of MDE, MDP and MDOT MTA. These agencies serve the BRTB in an advisory capacity. Annapolis Transit currently serves the role of "representative of public transportation" on the BRTB, based on a vote of the public transit providers in the region.

Representatives from the local jurisdictions and agencies have been designated and empowered by their respective lead elected official or department secretary to integrate locally-oriented policies and needs.

Baltimore Metropolitan Council (BMC)

Baltimore Metropolitan Council (BMC) provides technical staff to assist the BRTB and its advisory committees. BMC supports regional planning by providing:

- long- and short-range transportation planning
- demographic and economic analyses
- travel demand modeling
- air quality modeling
- environmental coordination
- GIS services
- development monitoring (database of building permits)

In addition, BMC hosts other important regional functions and programs, including the Baltimore Urban Area Homeland Security Work Group (responsible for coordinating regional emergency preparedness activities), Reservoir Watershed Protection Committee, Regional Fair Housing Committee and Regional Cooperative Purchasing Committee.

Regional Plan / Regional Program

Federal law requires each MPO to develop an LRTP and a TIP for its region. The BRTB evaluates and selects projects for plans and programs in accordance with regional goals and policies. This is done in consultation with state agencies, transit providers and local jurisdictions.

Regional Long-Range Transportation Plan

Resilience 2050 is the LRTP for the Baltimore region. It establishes the region's broad transportation goals and strategies, which will guide transportation investments over the life of the LRTP (2028-2050). *Resilience 2050* contains a list of the major surface transportation projects the region expects to implement in the period from 2028-2050. The plan also shows revenues the region expects to have available for these projects and estimated costs of these projects.

The BRTB evaluates and selects projects for plans and programs in accordance with regional goals and policies.

Transportation Improvement Program

The TIP is the short-range programming element of the regional plan. Many of the projects in *Resilience 2050* remain conceptual in nature and do not have detailed project scopes. As projects in *Resilience 2050* move from the conceptual into the implementation phase, they enter the TIP. The TIP shows all of the transportation projects with committed federal funding that the region expects to design and/or implement over the next four years. The TIP ensures consistency between plan recommendations and project implementation in the region. For example, all TIP projects are reviewed for consistency with regional goals, strategies, performance measures and targets.

Planning Factors

Federal law requires the metropolitan planning process to provide for consideration and implementation of projects, strategies and services that will address these factors:

- **Economic Vitality**
  Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity and efficiency.
- **Increase Safety**
  Increase the safety of the transportation system for motorized and non-motorized users.
- **Increase Security**
  Increase the security of the transportation system for motorized and non-motorized users.
- **Increase Accessibility**
  Increase accessibility and mobility options of people and freight.
- **Protect the Environment**
  Protect and enhance the environment, promote energy conservation, improve the quality of life and promote consistency between transportation improvements and state and local planned growth and economic development patterns.
- **Enhance Connectivity**
  Enhance the integration and connectivity of the transportation system across and between modes for people and freight.
- **Efficiency**
  Promote efficient system management and operation.
- **Preservation**
  Emphasize the preservation of the existing transportation system.
- **Improve Resiliency**
  Improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation.
- **Tourism**
  Enhance travel and tourism.

Federal law requires MPOs to address **ten essential planning factors.**

Fiscal Constraint

cost ≤ revenues

Federal law requires the LRTP to include a financial plan showing how the region expects to pay for each project and program. In other words, *Resilience 2050* is not a “wish list” of projects, but rather must be fiscally constrained by the revenues anticipated to be available to the region.

For *Resilience 2050*, the BRTB, in consultation with the Maryland Department of Transportation, has forecast the amount of funding from federal, state, local and private sources the region reasonably anticipates will be available for the period from 2028-2050. *Resilience 2050* improves upon the previous LRTP by including a consistent methodology for estimating local revenues available for transportation investments. This methodology resulted from a series of discussions with local jurisdiction staff in spring 2022.

The total estimated costs of *Resilience 2050* projects and programs cannot exceed the total anticipated revenues. Chapter 6 of this document provides details on the anticipated revenues and estimated year of expenditure costs for projects in *Resilience 2050*. Chapter 7 provides further details on these projects.

For the TIP, fiscal constraint means that each programmed project must include (1) a budget showing committed funding and funding sources and (2) a realistic implementation schedule based on when funds will be available.

Performance-Based Approach

Under the IIJA and its predecessor, the FAST Act, the metropolitan transportation planning process for both states and MPOs must "provide for the establishment and use of a performance-based approach to transportation decision making."

Performance Measures and Targets – Highways

Federal law requires the U.S. DOT to establish national standards for asset condition and system performance for facilities on the National Highway System (NHS). The IIJA also continues the Highway Safety Improvement Program established under previous legislation. This program is intended to "achieve a significant reduction in traffic fatalities and serious injuries on all public roads." The performance-based approach found in both the state and the metropolitan planning processes must support national goals (see box).

Each state is required to develop an asset management plan for its NHS facilities and a state highway safety improvement program. This includes a strategic highway safety plan that "identifies and analyzes highway safety problems and opportunities."

National Performance Goals - Highways

> **Safety**
Achieve a significant reduction in traffic fatalities and serious injuries on all public roads.

> **Infrastructure Condition**
Maintain the highway infrastructure asset system in a state of good repair.

> **Congestion Reduction**
Achieve a significant reduction in congestion on the National Highway System.

> **System Reliability**
Improve the efficiency of the surface transportation system.

> **Freight Movement and Economic Vitality**
Improve the national freight network, strengthen the ability of rural communities to access national and international trade markets and support regional economic development.

> **Environmental Sustainability**
Enhance the performance of the transportation system while protecting and enhancing the natural environment.

> **Reduced Project Delivery Delays**
Reduce project costs, promote jobs and the economy and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.

The state plans must include strategies that will make progress toward achieving targets for asset condition, system performance and safety. States establish state performance measures and targets based on the national standards.

MPOs set the regional performance measures and targets, in consultation with states, to use in tracking progress toward attaining critical outcomes for the region.

States establish state performance measures and targets based on the national standards.

Performance Measures and Targets – Transit Systems

Federal law requires the U.S. DOT to implement a national transit asset management system and a national transit safety program.

The National Transit Asset Management System is a "strategic and systematic process of operating, maintaining and improving public transportation capital assets effectively through the life cycle of such assets." The foundation of this system is the concept of state of good repair.

The purpose of the National Public Transportation Safety Plan is to improve the safety of all public transportation systems. This plan includes:

- Safety performance criteria for all modes of public transportation.
- Minimum safety performance standards for public transportation vehicles used in revenue operations.
- A public transportation safety certification training program.

Each direct recipient of federal transit funds (in this region, this is the MDOT Maryland Transit Administration) develops its own asset management and safety plans, consistent with the national plans.

MPOs develop regional transit system performance targets for asset management and safety in coordination with transit providers.

Performance Measures and Targets – More Information

Chapter 5 covers the specific regional performance measures and targets set by the BRTB, in consultation with MDOT and the federal agencies. Where available, it also includes information on the performance of the regional transportation system to date in relation to these performance measures and targets.

Air Quality Conformity

"Conformity" means that the projects in *Resilience 2050* will not cause or contribute to new air quality violations, worsen existing violations or delay timely attainment of air quality standards.

National Air Quality Standards

To protect public health, the U.S. Environmental Protection Agency (EPA) sets the National Ambient Air Quality Standards (NAAQS) for six criteria air pollutants. The EPA then determines the areas that do not meet these standards. The Baltimore region is designated as a nonattainment area with regard to the 8-hour ozone NAAQS.

The region must show that its transportation plans and programs conform to the air quality goals.

State Implementation Plan

The State Implementation Plan (SIP) developed by the Maryland Department of the Environment establishes a plan for how the region will achieve the NAAQS by the required attainment date. The SIP addresses all sources of pollution in the region. For on-road mobile sources of pollution (such as cars, trucks, and buses), the SIP establishes motor vehicle emission budgets.

Conformity Evaluation

The Clean Air Act Amendments (CAAA) require careful evaluation of the relationship between transportation plans and programs and the air quality goals for the state outlined in the SIP. The region must show that its transportation plans and programs do not interfere with the attainment of the NAAQS and are within the EPA-approved motor vehicle emission budgets. *Resilience 2050* demonstrates conformity since the projected emissions levels from its proposed projects are less than the emissions budgets established in the SIP.

See Appendix C for technical details of the air quality conformity analysis performed for *Resilience 2050*.

Congestion Management Process

Federal law requires all metropolitan areas with populations greater than 200,000 to have a Congestion Management Process (CMP).

The CMP identifies actions and strategies to reduce traffic congestion and increase mobility. These include:

- Identifying congested locations.
- Determining the causes of congestion.
- Evaluating the congestion mitigation potential of different strategies.
- Evaluating the effects of previously implemented strategies.

Appendix D includes technical details on the region's CMP and how the projects in *Resilience 2050* are consistent with this CMP.

Consultation with Interested Parties and the Public

Federal law requires MPOs to consult with state and local officials, transit operators and the public when conducting transportation planning.

MPOs are required to develop a public participation plan that defines a process for providing the public and interested parties with reasonable opportunities to be involved in the planning process. Appendix E includes details about the public engagement process during the development of *Resilience 2050*.

MPOs are encouraged to consult or coordinate with planning officials responsible for other types of planning activities affected by transportation. These activities include planned growth, economic development, environmental protection and freight movement.

Federal law also stipulates that the public participation plan considers the needs of people and groups traditionally underserved by transportation systems, including low-income and minority households.

Appendix E presents additional details on the BRTB's public participation process and its specific outreach efforts in developing *Resilience 2050*.

Title VI of the Civil Rights Act

Regional plans and programs must comply with Title VI. The intent of this law is to ensure that public funds are not spent in a manner that encourages, subsidizes, perpetuates or results in discrimination.

Title VI of the Civil Rights Act of 1964 states that no person in the U.S. shall, on the basis of race, color or national origin, be excluded from participation in, be denied the benefits of or be subjected to discrimination under any program or activity receiving federal financial assistance.

Because the BRTB receives federal funding in carrying out the metropolitan planning process, its products (such as this LRTP) and programs must comply with Title VI.

Title VI of the Civil Rights Act of 1964 states that no person in the U.S. shall, on the basis of race, color or national origin, be excluded from participation in, be denied the benefits of or be subjected to discrimination under any program or activity receiving federal financial assistance.

Executive Order – Environmental Justice

Environmental Justice seeks to ensure that the benefits and burdens of transportation investments are shared as equitably as possible among all affected communities.

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority and Low Income Populations," addresses this issue. This Executive Order and its accompanying memorandum reinforce the requirements of Title VI that focus federal attention on environmental and human health conditions in minority and low-income communities.

The U.S. DOT's guiding Environmental Justice principles are summarized as follows:

- To avoid, minimize or mitigate disproportionately high and adverse human health and environmental effects on minority and low-income populations.
- To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process.
- To prevent the denial of, reduction in or significant delay of these protections for minority and low-income populations.

Appendix C includes an analysis of the potential effects of this plan's major projects on Environmental Justice populations.

Chapter 2

Regional Growth, Forecasting and Demographic Trends

How many people will call the Baltimore region home over the next 20+ years? Where will they live, work and play? How can we plan now for a transportation system that accommodates the future growth of the Baltimore region?

This chapter sets the stage for *Resilience 2050* by discussing planning for regional growth. It then details how BRTB members work together to create forecasts of future population, households, and employment in the Baltimore region, and how these forecasts support the development of *Resilience 2050*. The chapter concludes with a discussion of the demographic trends likely to shape the future of the Baltimore region.

Regional Growth and the Transportation System

Over the past several years, the world has faced extraordinary challenges because of the COVID-19 pandemic. During this demanding period, the Baltimore region's transportation system demonstrated its tremendous resiliency and we are beginning to see indicators of recovery. This recovery is measured in growth of various economic indicators that demonstrate a variety of benefits to residents and businesses. Some of the important indicators include economic benefits, such as increased job creation, higher incomes and increased tax revenues, as well as increased social benefits, such as improved infrastructure and public services and higher quality of life for residents. Growth can also lead to environmental benefits, such as the development of cleaner and more efficient technologies and the creation of green jobs. Growth can also lead to some potential challenges, such as inequality and gentrification. However, with the right policies, strategies and investments, regional growth can provide numerous benefits and improve the lives of all residents, the regional economy and the environment.

Continued growth in the region depends on a strong transportation system. Essential outcomes of a strong transportation system improve affordability, availability, efficiency, convenience, safety and speed. A strong transportation system enables people to access essential services, such as healthcare, education and employment opportunities. It also plays a crucial role in connecting people, businesses and markets, allowing for the efficient movement of goods and services and underpins the viability and livability of the region's communities. A strong transportation system can also play a crucial role in reducing congestion and pollution, improving public health and fostering economic development. The degree to which our region can deliver and sustain these outcomes will allow it to thrive or fade.

The region's transportation system influences its growth and development, while the type and location of growth in turn influence travel choices. Transportation systems also affect the viability and livability of the region's communities. Faster and safer travel times improve connections of more disconnected areas to jobs and to markets for products made in those areas. Improvements to transportation systems may provide residents access to jobs that are currently physically out of reach. Information infrastructure is also increasingly important and can replace the need for travel for some, as we've seen since the start of the global pandemic. This said, many jobs cannot be remote and many citizens lack internet access, often because it is either unavailable or unaffordable. Together these issues impact residents' ability to access education, employment, job searches, food and healthcare, as well as the region's industry and business development and our environment.

Growth Management and the Transportation System

Thinking about our system requires planners to consider not only the transportation infrastructure but also the uses of the land served by that infrastructure. Land use planning can influence accessibility and mobility across the transportation network as different land use patterns may require distinct transportation strategies to achieve system efficiencies and address specific objectives and needs.

In addition to land use, planners must consider future growth and how existing zoning designations and land uses will accommodate additional residents and workers. Population in the Baltimore region continues to grow, but is expected to do so at a slower rate than in previous years. According to decennial census data, the region grew by 460,000 persons (19.4%) in the 30-year period between 1990 and 2020. The region is anticipated to grow by 360,000 persons (12.6%) in the 30-year period from 2020 to 2050. Population growth can only occur through natural change (births minus deaths) and migration. The region's aging population and low levels of net migration are contributing to softened population growth expectations through 2050.

Household growth is expected to outpace population growth over the forecast horizon, with growth of 15.0%, while average household size is anticipated to decrease from 2.53 in 2020 to 2.48 in 2050. And employment growth is anticipated to outpace both population and households, with regional growth of approximately 375,000 jobs from 2020 to 2050 (25.5%). These forecasts are generated by local jurisdictions, and are discussed in more detail in the next section of this chapter (see Socioeconomic Forecasting).

Growth management refers to the policies and procedures that local jurisdictions, regions and states use to accommodate more residents and workers. Good planning practice requires frequent and ongoing communication and coordination between land use and transportation planning agencies to avoid unnecessary conflicts and issues. While specific policies, regulations and procedures differ from jurisdiction to jurisdiction, commonalities exist in the form of basic principles shared across the region. An example is a transportation system capable of safely and effectively serving the existing population and any future growth. Other examples include protecting the environment and enhancing community character while supporting the economy.

All local jurisdiction members use their growth management policies, regulations and procedures to encourage, guide and support development in areas where public facilities and services are in place or are planned to be in place. Such an approach is intended to maximize social, economic and environmental benefits and minimize negative impacts and consequences. In addition, growth management is also used to limit the development of land where there may be a particular land use that is valuable to the public. For example, local jurisdictions often use growth management to preserve environmental, historic and/or economic resources and land for future transportation corridors.

Comprehensive Plans and Community Development

Local government members of the BRTB exercise planning and zoning powers and regulate land development. Their comprehensive plans outline strategies, policies, programs and funding for growth and development, resource conservation, infrastructure and transportation, integrated across local jurisdictions, the region and the state.

In developing a comprehensive plan, each local jurisdiction first forecasts the number of new residents and new workers expected in the jurisdiction over a period of 20+ years, and where the new residents and workers might choose to locate. The forecasts, often called “socioeconomic” or “cooperative” forecasts, are then used to plan for the public facilities and services—such as schools, water/sewer lines, roads, police departments and fire stations—needed to accommodate all residents and workers in the local jurisdiction.

Generally, the transportation element of these local Comprehensive Plans discusses the importance of an interconnected transportation system where all modes—vehicle circulation/parking, transit, and bicycle/pedestrian activities—work together. Typically, they also address access to jobs and other opportunities and destinations. These key objectives are supported by policies that promote the management of growth in traffic on key roadways, provide parking solutions that deal with peak and long-term demands, and enhance local and regional transit systems. Improving the transit system can provide stronger links among neighborhoods, employment locations, shopping destinations, schools and other local services. It also can provide transportation options for those who cannot or do not drive, including the physically disabled, the elderly or people with other special needs.

Many jurisdictions have stand-alone elements or plans that further break out specific goals and strategies for individual communities, issues or modes of travel. For instance, some have bicycle and pedestrian master or area plans.

Growth Management – Historical Perspective

The commitment to growth management in the Baltimore region dates from the 1960s. That decade saw innovative policies such as the Urban Rural Demarcation Line (URDL) in Baltimore County and ambitious efforts such as the plan for a completely "new" town, Columbia, in Howard County. In addition, the state of Maryland, considered a pioneer in statewide growth management policies, has provided guidance, technical expertise and regulatory requirements to support these commitments.

State Government

In 1984, to safeguard the Chesapeake Bay from the negative consequences of intense development, the Maryland General Assembly enacted the Chesapeake Bay Critical Area Protection Program, a far-reaching effort to control future land use development in the Chesapeake's watershed. The "critical area" is a ribbon of land within 1000 feet of the tidal influence of the Bay and was determined by the Maryland General Assembly to be crucial because development in this "critical area" has direct and immediate effects on the health of the Chesapeake Bay. The Chesapeake Bay Critical Area Commission was charged with devising a set of criteria to minimize the adverse effects of human activities on water quality and natural habitats and foster consistent, uniform and more sensitive development activity within this sensitive environmental area. In cooperation with the Critical Area Commission, local jurisdictions were required to enact and actively manage growth management programs for their critical area that are partially or entirely within the Critical Area.

Later, the Maryland General Assembly passed a much broader effort to manage the state's growth, known as the 1992 Maryland Economic Growth, Resource Protection, and Planning Act. The Planning Act established the State Planning Policy, which has evolved through subsequent legislation and is currently known as the 12 Visions found in Subtitle 5-7A of the State Finance and Procurement Article. The 12 Visions call for growing smarter and more sustainably and making efficient use of State resources through a more collaborative and informed public process. Among them, the transportation vision promotes multimodal transportation that facilitates

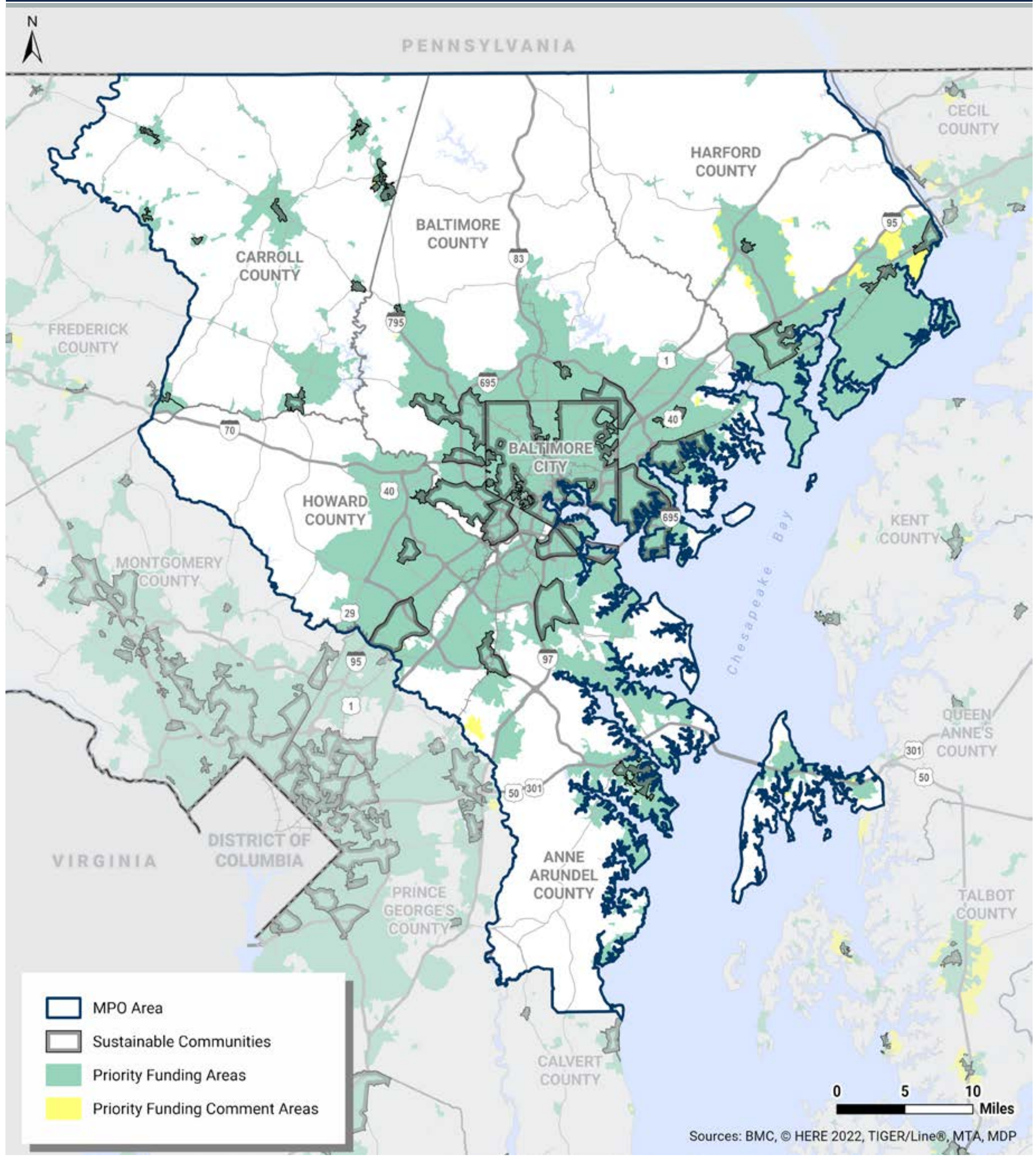
The commitment to growth management in the Baltimore region dates from the 1960s.

"the safe, convenient, affordable, and efficient movement of people, goods, and services within and between population and business centers." The Planning Act requires local jurisdictions to address these visions in their comprehensive plans. It also requires state-funded major transportation or other capital improvement projects to be consistent with the 12 Visions.

In 1997, the Maryland General Assembly enacted the Priority Funding Areas Act. That Act provided a new approach to managing growth statewide based on fiscal incentives, as opposed to regulations. The legislation created five programs to encourage investment in developed areas and preservation of farmland, forests and other natural resources.

The Priority Funding Areas (PFA) program provides incentives for jurisdictions and developers by concentrating growth-related projects in PFAs that are existing communities and places where local governments want state funding for future growth. Growth-related projects include most state programs that encourage growth and development,

Map 1 - Priority Funding Areas and Sustainable Communities in the Baltimore region



such as highways, sewer and water construction, economic development assistance and state leases or construction of new office facilities. The Rural Legacy Areas (RLA) program provides state funds to support the preservation of large, contiguous tracts of land that are designated by local governments and land trusts and are critical to the economy, environment and quality of life.

The Sustainable Communities Act of 2010 established Sustainable Communities (SCs) to stimulate reinvestment in Maryland's older communities by preserving historic or non-historic properties and refocusing the state's community programs.

The Sustainable Growth and Agricultural Preservation Act of 2012 linked development potential to wastewater treatment. This act established four additional designated areas, or tiers, to encourage development in areas with existing or planned public sewer service and to limit development in areas with private septic systems. Local jurisdictions set the boundaries of all designated areas, which the State then uses to set priorities for infrastructure investment statewide.

We also use these designations to evaluate and score transportation projects submitted for inclusion in *Resilience 2050*. Specifically, projects are given more points in the technical project scoring process if they are located within a PFA and/or SC.

Local Government

Each county in the region exercises land use planning authority to guide its growth and development. In 2012, the Maryland General Assembly repealed Article 66B and Article 28 and replaced it with the Land Use Article. The Land Use Article of the Maryland Annotated Code delegates planning and land use regulatory authority to all non-charter counties and all incorporated municipalities. The statute outlines the responsibilities, roles and functions of the planning commission and sets the ground rules for planning and zoning powers for local jurisdictions exercising these powers.

Socioeconomic Forecasting

Planning for a regional transportation system requires an understanding of current and forecast demographic and socioeconomic characteristics across geography and time. As discussed in the previous section, a region's transportation system influences its growth and development, while the type and location of growth in turn influence travel choices.

But how can we attempt to predict where and when growth will occur? This is accomplished through socioeconomic forecasting. This section discusses socioeconomic forecasting and why it is so important for *Resilience 2050* and the work of the BRTB.

Recognizing the transportation/land use connection described above, we strive to coordinate land use planning and transportation decisions among municipal, county, regional and state partners. A vital part of this coordination is the work of the Cooperative Forecasting Group (CFG). The purpose of the CFG, a subcommittee of the BRTB comprised of representatives of state and local planning agencies, is to develop a set of population, household and employment estimates and forecasts at the jurisdiction and small area levels of geography for transportation planning purposes.

These forecasts serve as key inputs to the region's travel demand model, which is utilized to simulate work and non-work travel patterns of individuals across the region. Output from the travel demand model helps to identify regional transportation needs. The CFG forecasts are key to the development of *Resilience 2050*, since travel demand modeling is used to make decisions and analyze LRTP projects. *Resilience 2050* includes a list of planned federally funded major projects that the region expects to implement from 2028 to 2050 as well as analysis of the potential impacts associated with these projects. This requires a forecast of population, households and employment extending through the year 2050.

The CFG forecasts are key to the development of *Resilience 2050*, since travel demand modeling is used to make decisions and analyze LRTP projects.

The CFG follows a cooperative, bottom-up approach to develop population, household and employment forecasts for the Baltimore region. This approach helps to ensure that these forecasts, and the LRTP that relies on the forecasts, are consistent with the growth management policies and procedures of the jurisdictions included in the scope of the forecasts. The cooperative forecasts provide the spatial location and concentration of population, households and employment over time (typically a 30-year period). The current round of forecasts, deemed Round 10, use 2020 as a base year and extend through 2050. It was adopted by the BRTB in July 2022.

Round 10 Development and Methodology

Round 10 development by the CFG started soon after the COVID-19 pandemic began and associated closures took hold in March and April of 2020. The pandemic presented challenges for Round 10, including capturing “pandemic impacts” upon employment in job counts and delays in 2020 census operations and data release schedules. New factors in the Round 10 cooperative forecasts included:

> **Pandemic impacts upon employment totals**: Measuring the scale of the impacts of an event like this in real time is challenging, particularly with any degree of spatial granularity. Moreover, the employment data sets that the CFG utilizes in the development of base-year employment have lags in data release of six months to a year. The CFG adjusted its methodology to reconcile the Round 10 development schedule with data availability that supported the inclusion of pandemic impacts.

> **2020 Decennial Census data:** The decennial census provides the most reliable small area demographic data available, and the CFG incorporated this data (for population, group quarters population and households) into its Round 10 development work upon the release of the block-level 2020 redistricting data file in August of 2021. The incorporation of the redistricting data allowed CFG membership to recalibrate their jurisdictional and small area base-year estimates to this federal source for year 2020, from which population and household data are forecast.

> **New base year 2020 and horizon year 2050:** For Round 10, the base year and horizon year were set to 2020 and 2050, respectively, to serve the timeline requirements of the LRTP.

> **New Transportation Analysis Zone (TAZ) structure:** The TAZ structure was updated to reflect 2020 census geography. TAZs are the unit of geography used to model travel behavior in the travel demand model.

Round 10 Socioeconomic Forecasts

Table 1 summarizes the Round 10 socioeconomic forecasts for population, households and employment for the Baltimore region.

The Round 10 forecasts show that regional population is expected to grow by 360,000 in the 30-year period from 2020-2050 (12.6%). This is slower than the 30-year growth from 1990-2020 when the region expanded by 460,000 (19.4%). Regional employment is expected to grow by 375,000 jobs from 2020-2050, a growth rate of 25.5%. In numeric terms, population and employment growth are quite similar, but the employment growth rate is double that of population.

The Round 10 forecasts use a base year of 2020. It's important to note that the employment growth forecast accounts for the 94,000 jobs (-6.3%) lost in the region in 2020 - largely due to the COVID-19 pandemic. Although the forecasts were developed in a time of uncertainty, the CFG membership assumed in Round 10 that the immediate job losses due to the pandemic would largely be recaptured in the shorter term, and that additional growth would occur beyond the recovery and through the forecast horizon. In the interest of gaining insight into pandemic impacts on future growth patterns and how these changes might impact future forecasting efforts, the CFG proposed a project exploring postpandemic trends in employment, commercial real estate, housing location choice, and travel demand. The project was approved and work will likely begin in late summer 2023.

Household growth is expected to outpace that of population, leading to declining household sizes for the region over the course of the forecast period. The average household size of the region is anticipated to decline modestly over the forecast horizon, from 2.53 in 2020 to 2.48 in 2050. Average household size has an effect upon transportation (and travel demand modeling), as larger household sizes tend to produce more trips than smaller or single-person households.

Table 1 - Round 10 Forecasts for the Baltimore Region (2020-2050)

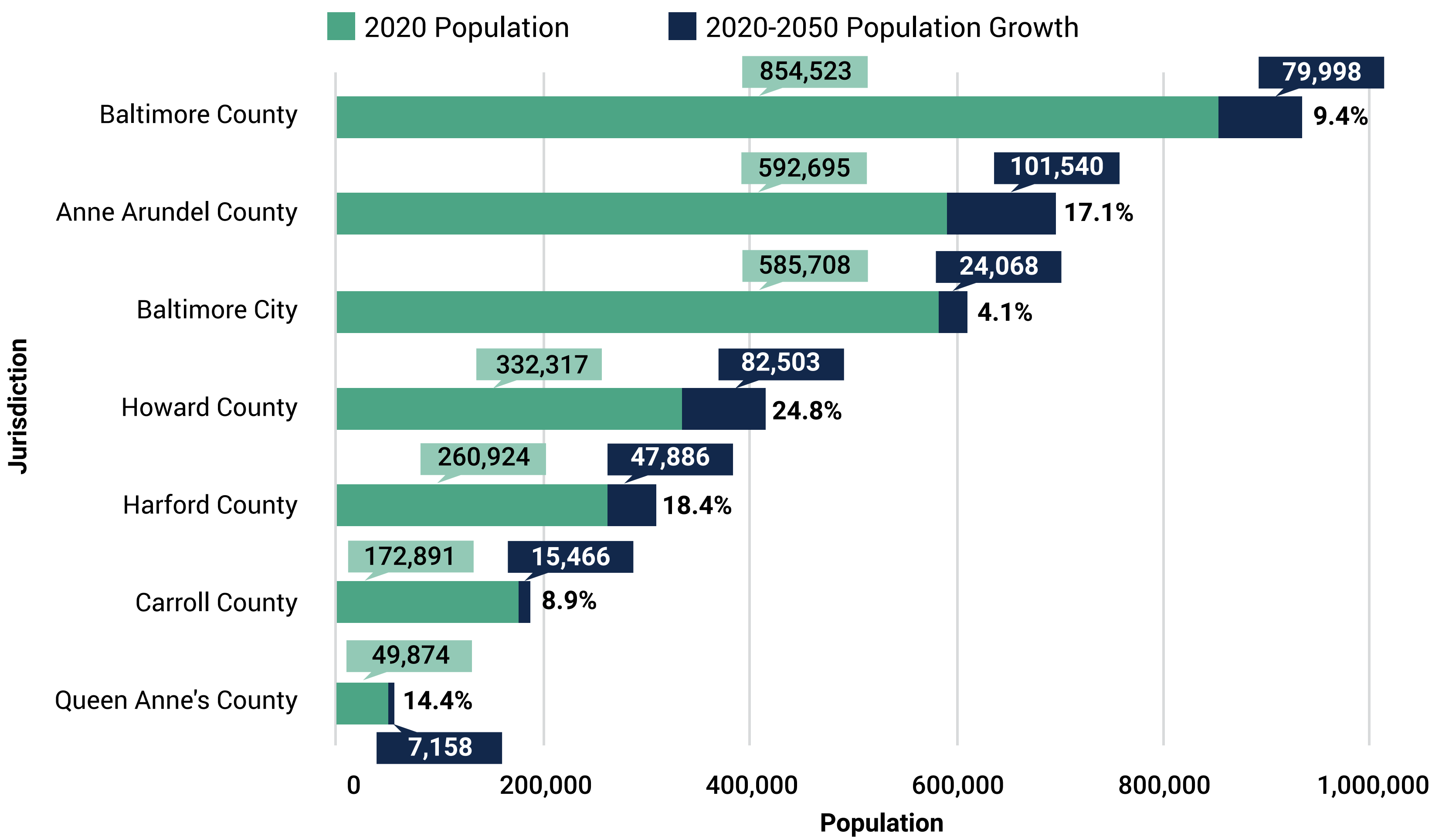
Data Point	2020	2030	2040	2050	Number Chg: 2020-2050	Percent Chg: 2020-2050
Population	2,848,932	2,995,213	3,113,473	3,207,550	358,618	12.6%
Households	1,100,758	1,161,643	1,217,960	1,265,686	164,928	15.0%
Employment	1,470,019	1,617,869	1,743,438	1,844,339	374,320	25.5%

Note: Forecasts endorsed by the Baltimore Regional Transportation Board on July 15, 2022. Source: Local jurisdictions; Cooperative Forcasting Group.

Figure 1 shows Round 10 population levels and growth expectations for each jurisdiction in the Baltimore region.

The chart shows that for population, Baltimore County remains the largest jurisdiction in the region, Anne Arundel County expects the biggest numeric growth (with an additional 102,000 persons from 2020 to 2050), and Howard County has the greatest population growth rate at 24.8%. The 2020 decennial census marked the first time that Anne Arundel County's population surpassed that of Baltimore City. While the Baltimore City population has been in decline for decades, Round 10 indicates slow yet positive growth expectations in Baltimore City, with population growth of 4.1% forecast from 2020 through 2050.

Figure 1 - Round 10 Population Forecasts by Jurisdiction (2020-2050)

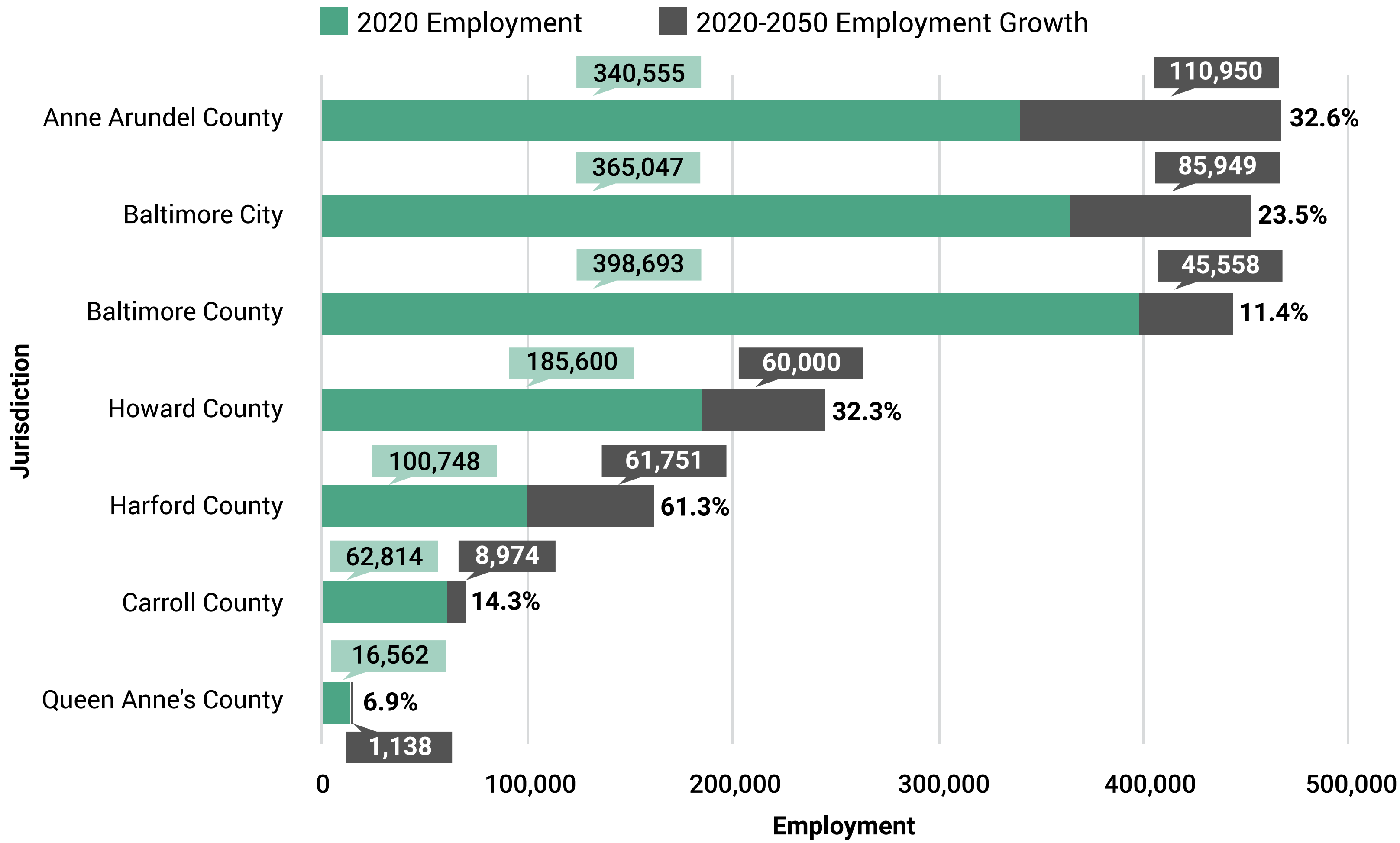


Source: Local Jurisdictions: Cooperative Forecasting Group.

Figure 2 shows Round 10 employment levels and growth expectations for each jurisdiction in the Baltimore region.

For Round 10 employment, the largest numeric increase is expected in Anne Arundel County, where an additional 111,000 jobs are forecast. In 2020, Anne Arundel County was ranked third in terms of total employment. By 2050, the forecast job growth moves Anne Arundel County to the first rank, just ahead of both Baltimore City and Baltimore County. Together, these three jurisdictions account for about 75% of regional employment. The largest percentage increase is forecast to be in Harford County, where employment is expected to grow by 61.3% from 2020 to 2050.

Figure 2 - Round 10 Employment Forecasts by Jurisdiction (2020-2050)



Source: Local Jurisdictions: Cooperative Forecasting Group.

The largest percentage increase is forecast to be in Harford County, where employment is expected to grow by 61.3% from 2020 to 2050.

The Round 10 forecasts served as critical inputs for *Resilience 2050*, including travel demand modeling and air quality conformity analyses. Output from the travel demand model helps to identify regional transportation needs. This informs the decisions we make about potential new projects in developing the long-range transportation plan. Appendix C presents additional information about the travel demand model's forecasts with respect to projects in this plan. For more information on the Round 10 cooperative forecasts, please refer to the Socioeconomic Forecasting White Paper.

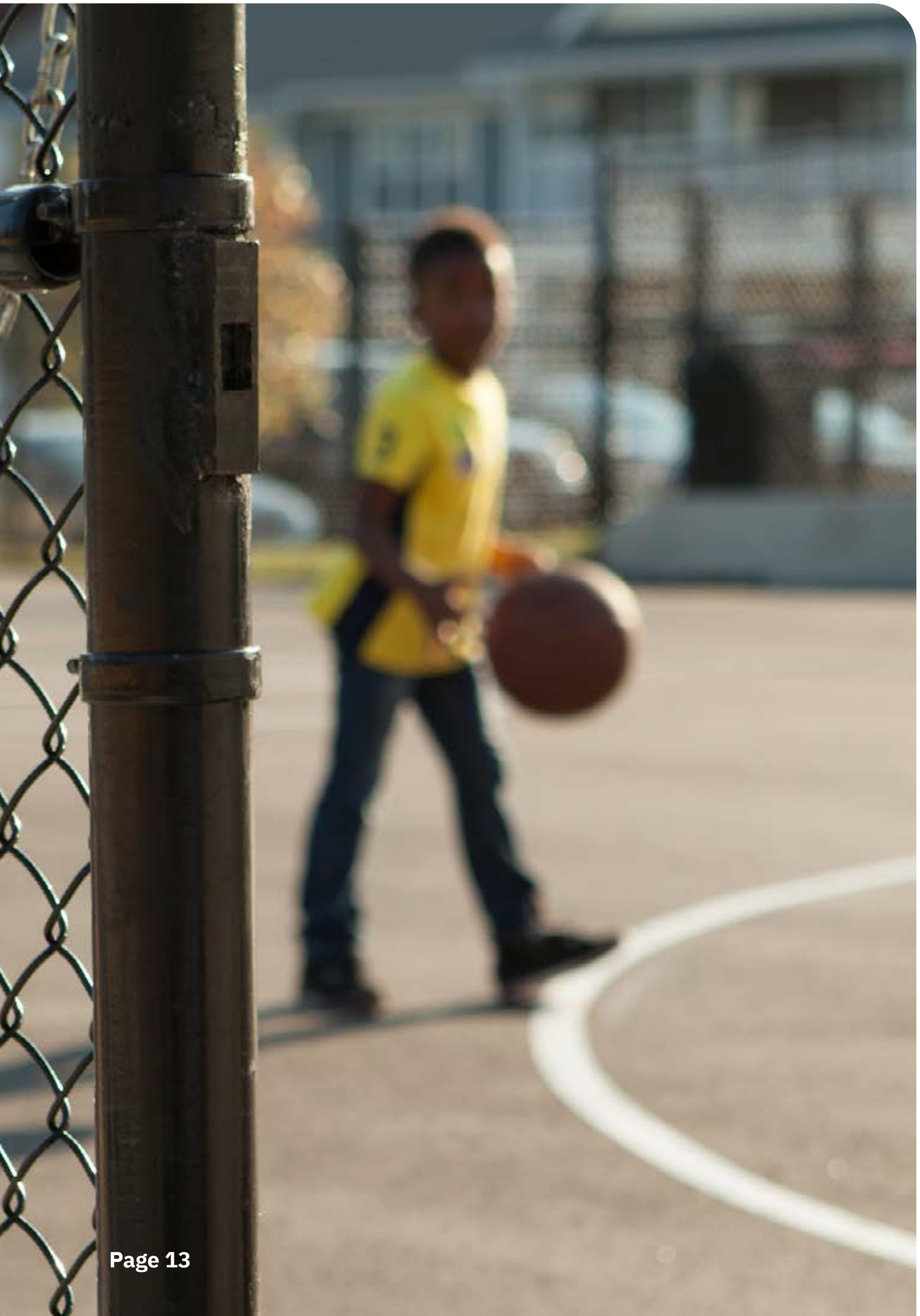
Demographic Trends

Demographic data includes characteristics of a population such as age, sex, race, income, educational attainment and employment status. This data has a profound effect on business marketing strategies and location choices, as well as on public policy decisions and government funding allocations. Additionally, analysis of demographic trends plays a critical role in the planning process at all levels of government including community and economic development and land use, transportation and environmental planning. This section highlights a selection of three demographic trends that are timely, and are likely to have significant impacts upon the future of the Baltimore region: the components of population change; changing age composition; and work from home trends.

Components of Population Change

Future population change can be estimated by understanding three components: 1) births, 2) deaths and 3) net migration. Demographers refer to the difference between the number of births and deaths as the natural change in population. When births exceed the number of deaths in a given time period, an area's population increases, and decreases when the opposite is true. Likewise, migration has two components: persons moving in and persons moving out. When a greater number of people move to an area compared to moving out, the population increases, and decreases when the opposite is true. Persons migrating to the Baltimore region can be from either international (outside the USA) or domestic (from another state or Maryland jurisdiction) locations.

The region's population is getting older, driven by the large "Baby Boomer" generation (those born between 1946 and 1964). The share of the population that is 65 years or older was 13% in 2010 and is expected to represent 20% by 2030. At the same time, the fertility rates of the region (and nation) are in decline, resulting in fewer births. As a result, the region's



population growth due to natural increase (births minus deaths) is projected to turn negative, with deaths expected to exceed births by around 2030. Population changes due to natural increase are depicted in Table 2.

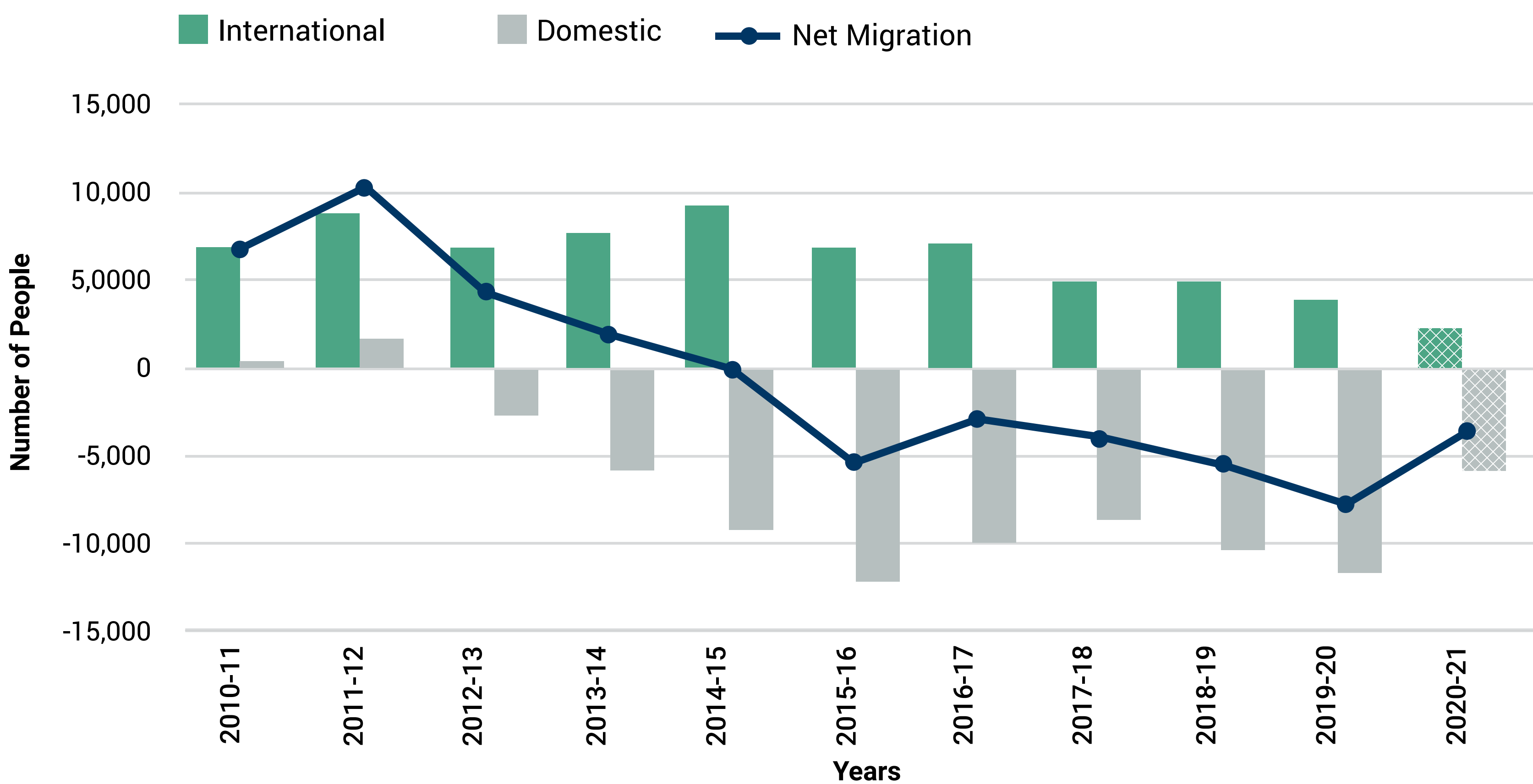
With natural change anticipated to become negative in the coming years, the Baltimore region's future population growth will become more dependent upon migration. However, international migration has been slowing and net domestic migration has been negative (as seen in Figure 3). In this scenario, positive regional population growth is contingent upon attracting more international and domestic migrants, while also retaining current residents.

Table 2 - Baltimore Region Natural Increase (2020-2050)

Horizon Year	Births	Deaths	Natural Increase
2020	180,496	-145,822	34,674
2025	180,358	-161,386	18,972
2030	179,129	-180,186	-1,057
2035	178,451	-200,072	-21,621
2040	181,830	-217,442	-35,612
2045	185,521	-229,310	-43,789
2050	189,699	-234,935	-45,236

Source: BMC cohort component model (pOptics)

Figure 3 - Baltimore Region Migration Trends



Source: U.S. Census Bureau, Population Estimates Program - v2020 (solid) and v2021 (cross-hatched).

Fertility rates of the region (and nation) are in decline, resulting in fewer births. As a result, the region's population growth due to natural increase (births minus deaths) is projected to turn negative, with deaths expected to exceed births by around 2030.

Components of Population Change, Transportation and *Resilience 2050*

The trends and observations in the composition of the population are important in transportation planning, as both the size (number of persons) and the characteristics of the population (working vs. retired and household composition, for example) affect travel demand. These trends prompt questions such as:

- If the growing number of Baltimore region seniors choose to stay and age in place, how might this choice affect travel?
  - Will Vehicle Miles Traveled (VMT) decrease? VMT might decrease as fewer seniors are employed and some age out of their ability to drive safely.
  - Will demand increase for off-peak alternative transportation services related to medical and social appointments?
- If migration is to drive future regional population growth, who are the migrants and where will they choose to live?
  - What will migrants' ages and household structure look like (number of workers and dependents), since larger households produce more travel?
  - Where will migrants choose to live - urban, suburban or rural areas? Will migrants' residential location choices continue the region's sprawling residential pattern and increase demand for automobile infrastructure improvements? Or will migrants' residential location choices cluster in densely populated urban neighborhoods served more by non-automobile modes such as transit, walking and biking?

Age Composition of the Population

When attempting to understand the current and future needs of the population of a given area, it is important to consider not only the size of the population, but also the characteristics of the population. One of the characteristics that is critical in planning to accommodate the future needs of a population is its age structure. Understanding the age structure of the population can help planners anticipate demand for age-specific services, such as public schools or senior services and facilities, and make adjustments to the transportation system in order to better accommodate a changing age distribution. The age composition of the population can also inform analyses of the future of the economy, including consideration of whether there will be enough workers to sustain forecasted job growth and to support dependent populations.

The population of the Baltimore region is aging, mirroring national trends. A variety of factors are contributing to the demographic shift, including the large size of the aging "baby-boomer" generation, advances in science and medicine resulting in longer lifespans and changes in fertility rates largely due to differences in family formation preferences (many are having fewer children, later in-life).

Table 3 provides information on the growth of the median age of the population in the Baltimore region, the pace of growth over time, and some geographical context. The data shows that the median age of the population in the Baltimore region increased by eight years (26%) over the nearly 40-year time period. This is slightly slower than the median age growth for Maryland and the United States.

While the median age is helpful to get a general sense of the age of a population, it does not provide details on the age distribution of the population. When analyzing the current and projected age structure of a population, it can be helpful to understand the shares that are children and seniors, as well as the shares that are of working age, as this distribution can have significant impacts upon the economy of a region. For the purposes of this analysis, dependent populations are comprised of children (persons <18 years of age) and seniors (persons >=65 years of age). The working age population consists of those between 18 and 64 years old.

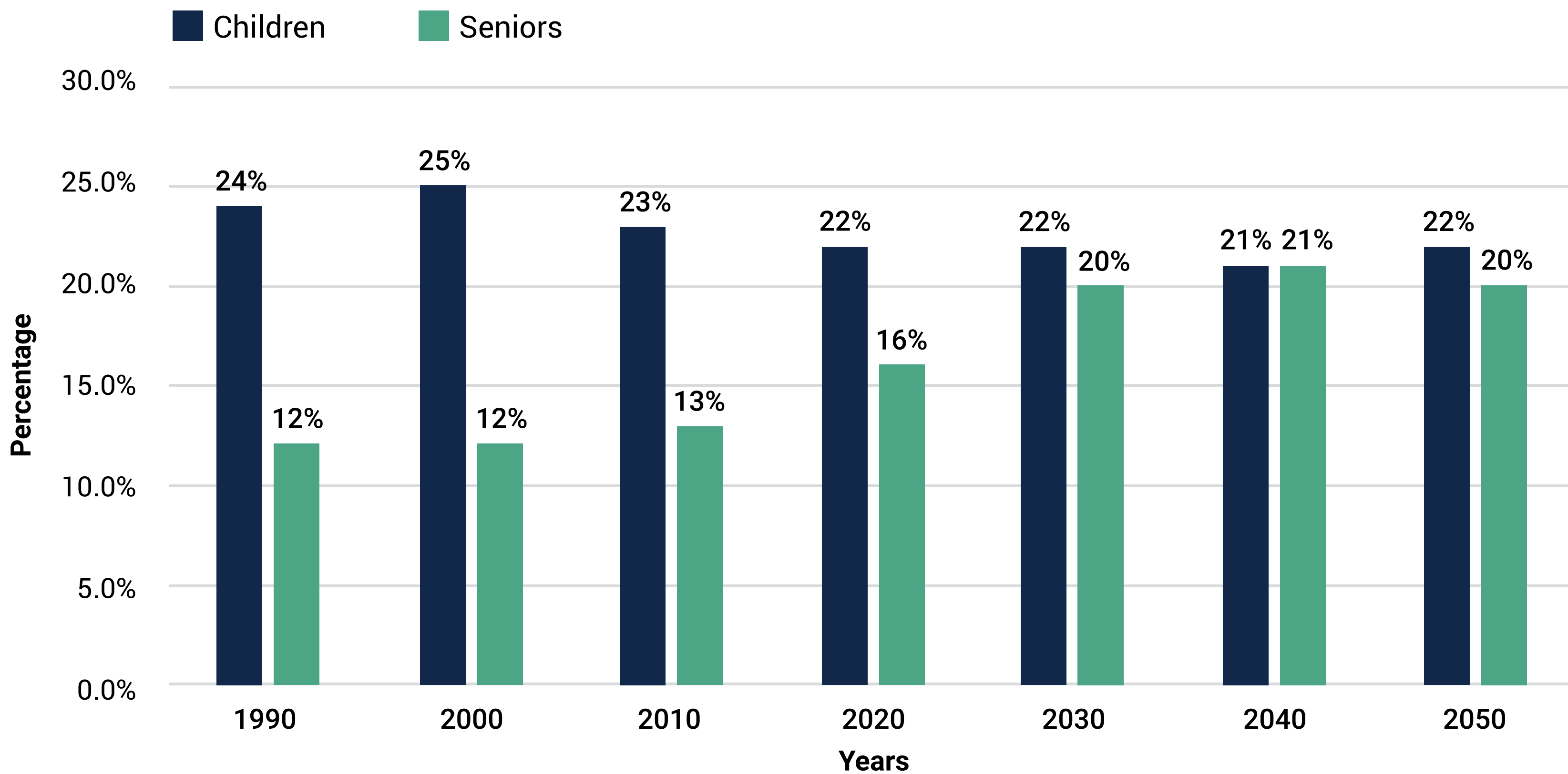
Table 3 - Median Age by Jurisdiction (1980-2019)

Jurisdiction	1980	2019	Chg: 1980-2019	
			Numeric	Percent
Baltimore Region	30.6	38.6	8.0	26%
Maryland	30.3	39.0	8.7	29%
United States	30.0	38.5	8.5	28%

Source: U.S. Census Bureau Decennial Censuses and American Community Survey, Tables B01002, K200103; NHGIS, University of Minnesota.

Figure 4 illustrates a decline in the share of the population that are children, while the share that are seniors is increasing. By 2030, it is projected that the share of the population that are children and seniors will be nearly the same, after many years of the share of children exceeding that of seniors. The share of the population that were children was double the share that were seniors from 1990 to 2000.

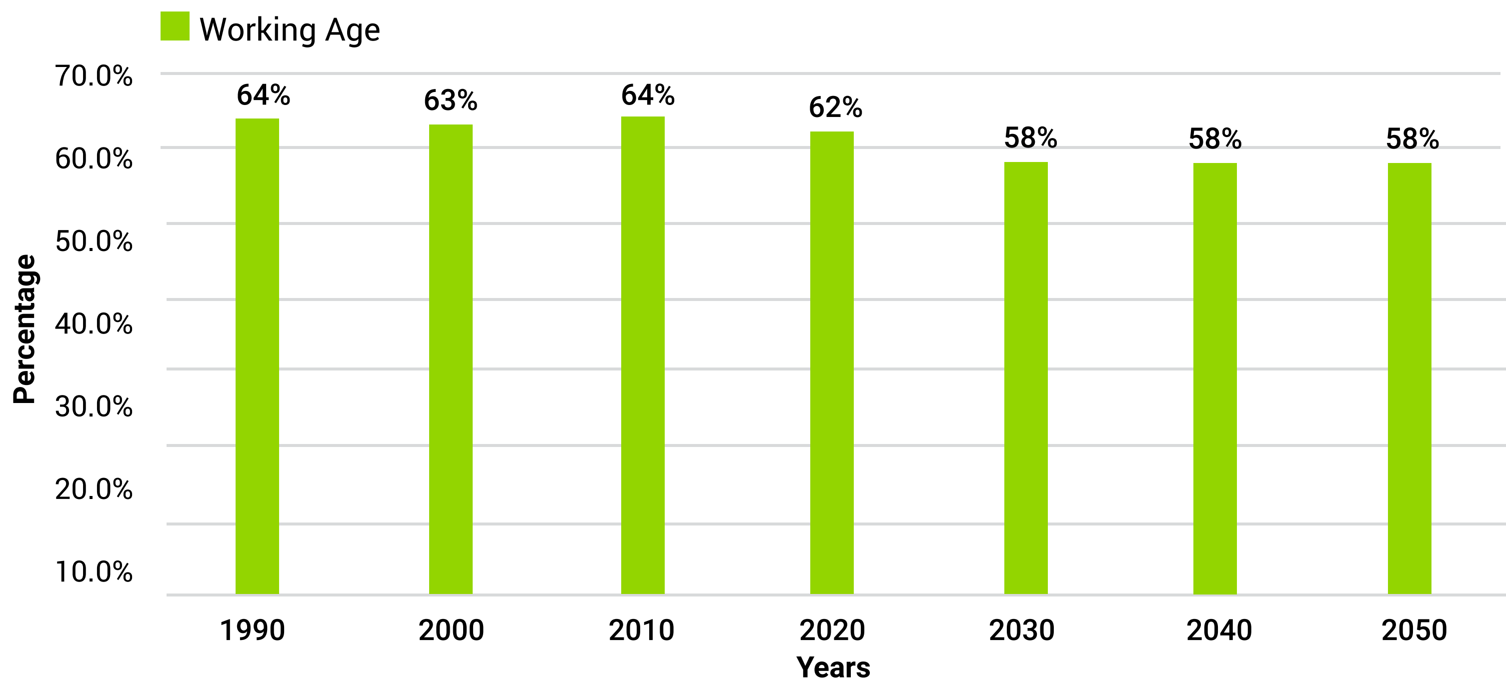
Figure 4 - Share of Population that are Children and Seniors: Baltimore Region



Source: U.S. Census Bureau (Decennial Censuses, American Community Survey); BMC cohort component model (pOPTICS).

Another consideration is the observed and projected decline in the share of the population that is of working age, depicted in Figure 5. In 1990, the share of the population in the Baltimore region that was of working age was 64%. The share declined to 62% in 2020 and is expected to drop further to 58% from 2030 through 2050. This decline prompts a number of questions for planners, economic development professionals and businesses, such as:

Figure 5 - Share of Population that is Working Age (18-64): Baltimore Region



Source: U.S. Census Bureau (Decennial Censuses, American Community Survey); BMC cohort component model (pOPTICS).

- Is the projected size of the working age population adequate to support future job growth?
- Is the projected size of the working age population adequate to support dependent populations?
- Are adjustments necessary to accommodate changes in the demand for services that could accompany smaller shares that are children and working age and larger shares that are seniors?
- Will adjustments be necessary to help increase the size of the employed population, such as attempts to attract additional workers or to increase labor force participation rates?

Analysis of the age composition of the population can also help inform an understanding of the demand for travel. Two of the most significant age-related factors to consider are the presence of senior populations and the number and share of households with workers and children present. For example, senior populations tend to generate fewer trips, as seniors are less likely to be in the labor force and to have children present in their households. Larger households with both workers and children tend to generate more trips, as work and child escort trips increase travel demand. These age-related differences in travel behavior and choices are accounted for in the region's travel demand modeling efforts.

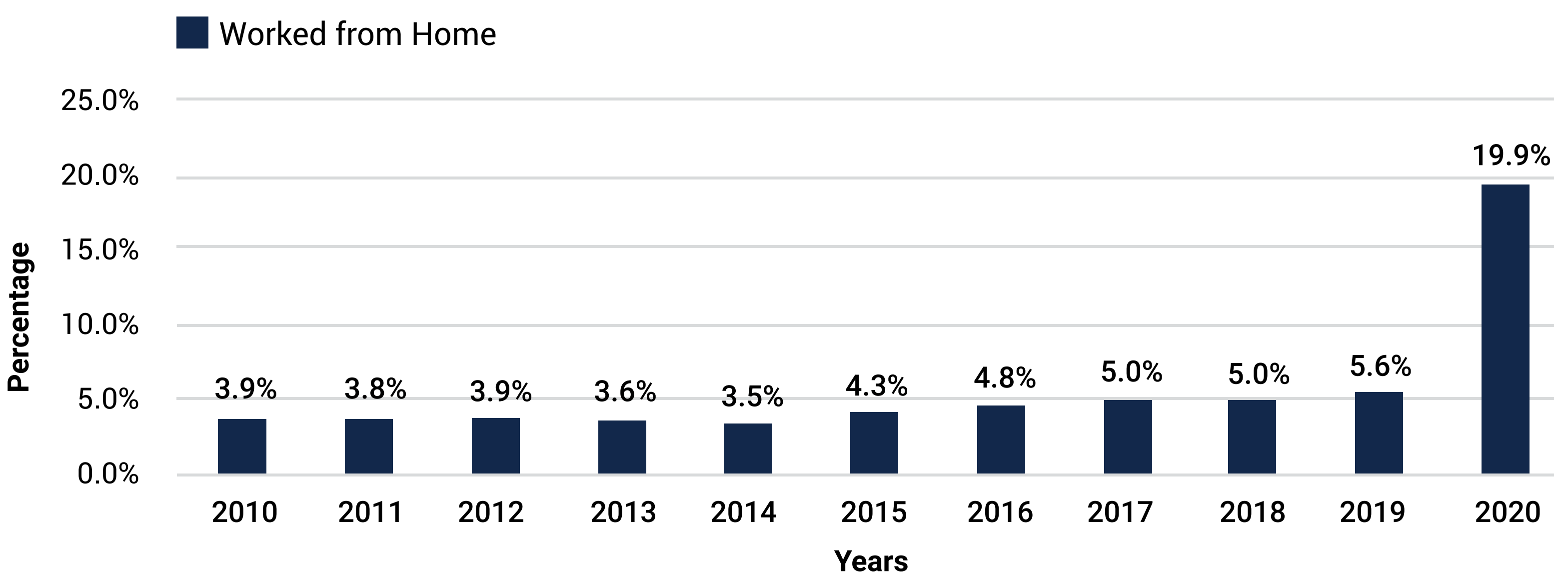
Work From Home Trends

In the decade prior to the COVID-19 pandemic, the share of the population working from home was increasing, but still accounted for a small share of all workers in the region (3.9% in 2010 and 5.6% in 2019). In 2020, the pandemic caused an unexpected large-scale work from home (WFH) experiment. Estimates from the U.S. Census Bureau's American Community Survey (ACS) indicate that WFH was the primary work arrangement for nearly 20% of the region's population in 2020, as depicted in Figure 6.

For context, it is important to note that the WFH share presented in the ACS is likely a lower bound for an estimate of the number of workers that work remotely. The ACS questionnaire refers to the "usual" means of transportation to work, and thus accounts for only those that have WFH as their primary work arrangement at the exclusion of many of those that may work from home on a hybrid basis.

While the share of workers that WFH grew rapidly from 2019 to 2020 and accounted for the primary work arrangement of 1 in 5 workers in the region in 2020, there is variance in the rates of adoption by demographic characteristics of workers and by industry. The ACS also captures demographic details regarding those that WFH. Below are a few observations regarding the rates of WFH by selected demographic characteristics:

Figure 6 - Share of Workers that Worked From Home: Baltimore Region



Source: U.S. Census Bureau, American Community Survey 1-Yr Estimates, Public Use Microdata Sample files.

- > **Sex:** More women than men WFH. In 2020, 21.9% of women and 17.9% of men worked from home.
- > **Age:** Prior to the pandemic, the share of the population that WFH generally increased with age, with a substantial jump from the 55-64 to the 65+ age category. However, once the pandemic began in 2020, workers from 25 to 54 years of age had the greatest shares engaged in WFH.
- > **Race:** Those who identify as White alone, Asian alone or as two or more races had higher rates of WFH than those who identified as other race categories.
- > **Education:** Those with higher levels of educational attainment (Bachelor's Degree and Advanced Degree) had higher rates of WFH than those with lower levels of educational attainment.
- > **Industry:** There is great variation by industry in the share of workers that WFH. In 2020, the three industries with the highest rates of WFH were: Information (39.4%), Professional, scientific, management, and administrative and waste management services (31.5%), and Finance and insurance, and real estate and rental and leasing (31.0%). Lower rates of WFH are evident in industries that are more reliant upon customer interaction or otherwise require in-person work, such as: Arts, Entertainment and Recreation & Accommodation and Food Services; Retail Trade; Construction; and Manufacturing.

The ACS data shows that while the share of workers that WFH has grown over time, there is variance in the rates of adoption by demographic characteristics and by industry. While the rapid adoption of WFH at the onset of the pandemic has been widely reported, the longer-term post-pandemic future of WFH is less clear. Though the specific rates of adoption in the future may be uncertain, it is sure that WFH is more than a short-lived response to a public health crisis, and that it will continue to evolve.

Work from Home, Transportation and *Resilience 2050*

While the precise impacts of WFH adoption upon transportation in the future are uncertain, consideration of the size, location and characteristics of the WFH segment of the workforce will be important for future land use and transportation planning efforts. There are a variety of potential effects that warrant additional consideration, including:

- Travel Differences: What are the differences in trip rates generated by WFH workers? If there is a reduction in trips to the workplace, are other trips taken in their place (kids/errands/other) and with what frequency? What is the overall impact on Vehicle Miles Traveled (VMT) (Up/Down)?
  - > What are the implications for traffic volume and transit?
  - > What does expansion of WFH mean to future funding for transportation? Would gas tax revenue decline?
- Changes in Home Location Choice: For those that can WFH full-time or on a hybrid basis, the reduction in frequency of

commute may lead some to consider living farther from their traditional work location. Will WFH increase sprawl? What are the implications to future land use?

- Impacts upon downtowns and employment centers:
  - Will there be reduced demand for downtown office space? If so, what are the potential effects? Will rents decrease? Will adaptive reuse of some office buildings that are no longer viable increase?
  - Will there be reduced demand for office-supportive businesses (such as restaurants) that primarily rely on office workers?
- Equity Considerations: Many of the jobs that are WFH capable are not accessible to all. For example, educational attainment and income are strong predictors of the ability to work from home. Will low-income individuals and those with lower educational attainment be able to access opportunities enabling them to transition into WFH careers if they would like? Will adequate service be available for those that must commute to work by transit?

We look forward to continuing to monitor the trends and projections presented in this chapter, and to considering their impacts upon the region's transportation needs. For more detailed information on these trends, please refer to the Demographic Trends White Paper.

Chapter 3

Factors and Trends

What Can the Region Expect over the Next 20 Years?

The core of *Resilience 2050* is a list of list of major projects and programs the region intends to implement over the next 20+ years, given the amount of funding reasonably expected to be available. We did not develop this list in a vacuum. Many factors and trends—some known, some anticipated and some unknown at this time—will affect the regional transportation network in the future.

This chapter discusses some of these factors and trends. The goal of this discussion is to provide additional context so that readers can better understand why we made certain decisions, as well as how those decisions might better prepare the region to respond to the uncertainties of the future.

Environmental Issues and Challenges

Chapter 1 of this plan describes the federal requirements the region must meet to maintain conformity with national air quality standards. Besides these air quality conformity issues, the region faces several other environmental challenges.

Greenhouse Gas Emissions and Climate Change

There is a strong link between growth in vehicle miles traveled (VMT) and greenhouse gas (GHG) emissions from the transportation sector. According to the Maryland Department of Transportation's (MDOT) [2020 Greenhouse Gas Reduction Act Plan], statewide VMT has been steadily increasing since 2014, with over 60 billion VMT in 2019. While VMT dropped dramatically in 2020 due to the

COVID-19 pandemic, MDOT anticipates that VMT will rebound back to 2019 levels over the next few years. According to projections by the Maryland Department of Planning (MDP), Maryland may grow to over 6.5 million people by 2030. Coupled with economic expansion and land use changes, VMT could increase to over 69 billion by 2030.

More miles traveled directly equates to the combustion of more gallons of fuel and the release of carbon dioxide. Emissions of carbon dioxide, a key GHG, result from the burning of fossil fuels such as gasoline and diesel fuel. Transportation accounts for thirty-five percent (35%) of emissions in the state, and represents the largest source sector for GHGs in Maryland. Environmentally conscientious planning must consider the implications of potential long-term climate change and the role that vehicle emissions play. GHG emissions that result from human activity contribute to global warming, which is the increase in average global temperature.

Climate Projections for the Region

Temperatures are projected to increase dramatically in the Baltimore region over the coming decades. For example, average temperatures could rise by nearly 5°F by mid-century. The region is also projected to experience approximately 66 days above 90°F and six heatwaves annually by mid-century. As temperatures warm, the number of days below freezing also

Over the past century, the climate has been changing in the Baltimore region:

- **Increasing temperatures:** Annual temperature in the region has increased by 0.2°F per decade; there is a clear upward trend since 1895.
- **More intense storms:** Annual precipitation in the region has increased slightly over the past century. More of this precipitation has been falling in intense storms.
- **Nuisance flooding and sea level rise in the Chesapeake Bay and its tributaries:** This is due to slowly sinking land as well as warming oceans. Relative sea level, measured at the Annapolis tide gauge, has risen by 1.22 feet from 1928 to 2020. Flooding from high tides, also known as nuisance flooding, occurred fewer than 5 days per year in Annapolis in the 1950s but now occurs more than 40 days per year.

will decrease significantly. Each jurisdiction within the region will experience similar projected changes. However, areas along the Chesapeake Bay will continue to be warmer compared to the inland areas. Figure 1 depicts projected increases in annual average temperatures in the Baltimore region.

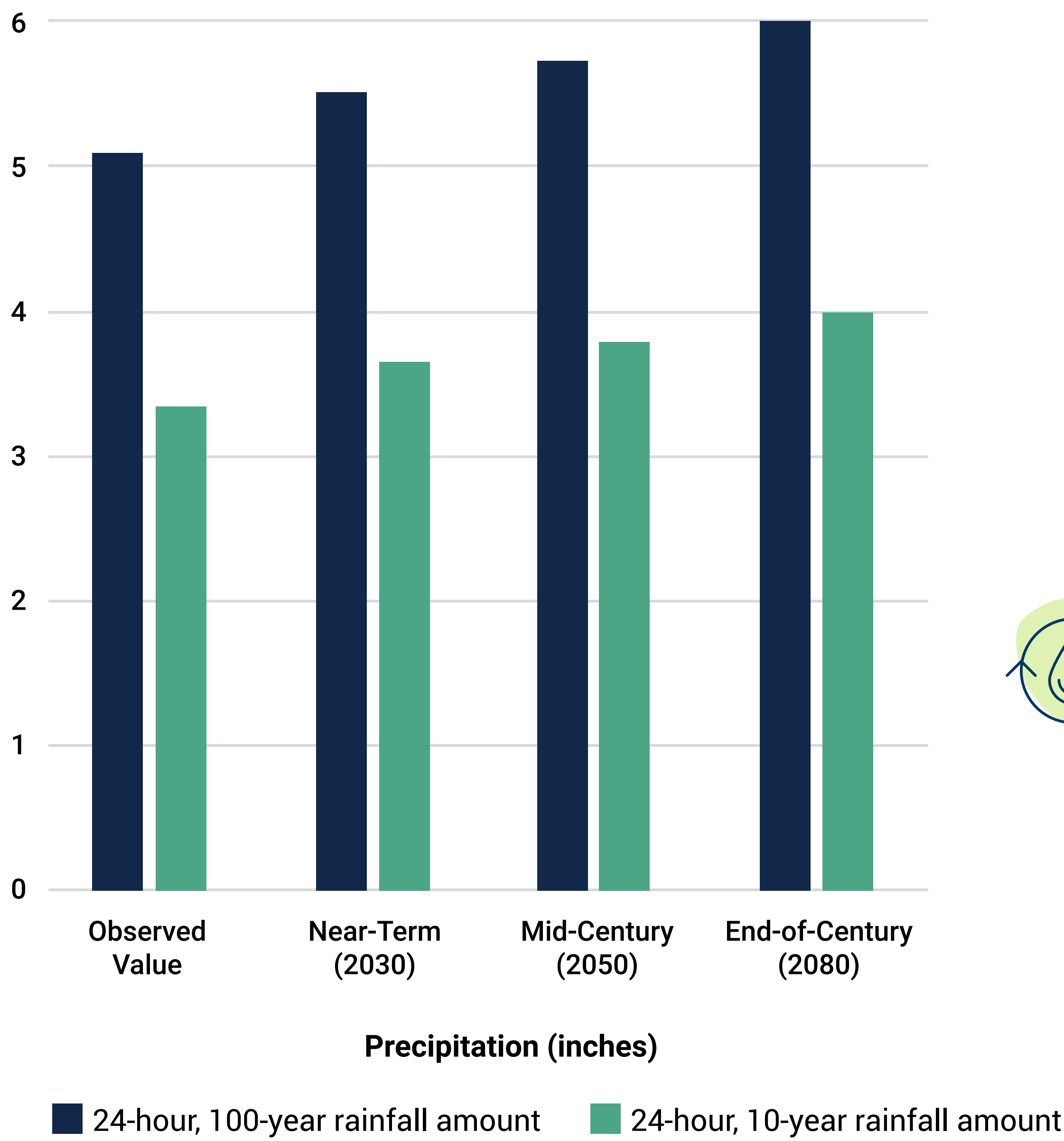
More extreme precipitation events are likely to occur in the Baltimore region over this century. Both the 24-hour, 10-year and 100-year rainfall events[1] are projected to be heavier, but overall average annual precipitation is not projected to increase notably. For example, annual precipitation is expected to increase by about 3 inches by mid-century. The projections indicate more precipitation falling in heavy events within a single day or consecutive days. The projected

Figure 1- Annual average temperatures across the Baltimore region*

**Projected values represent the median result from 32 models for the Regional Concentration Pathway (RCP) 8.5 scenario. RCP 8.5 is one of several climate modeling scenarios adopted by the Intergovernmental Panel on Climate Change and is the scenario used by the Federal Highway Administration. It represents a projected estimate of the concentration of greenhouse gases in the atmosphere; RCP 8.5 assumes a low level of effort to curb emissions.*

[1] A 10-year rainfall event is defined as a rain storm with an amount of rain that is equaled or exceeded once every 10 years. A 100-year rainfall event is defined as a rain storm with an amount of rain that is equaled or exceeded once every 100 years. A 100-year rainfall event is more extreme than a 10-year event.

Figure 2 - Rainfall during extreme events*



** All projections are shown for RCP 8.5.*

changes will be similar across each jurisdiction. The northern part of the region will continue to experience greater annual precipitation relative to the southern portion. Precipitation increases are expected only during certain parts of the year. Precipitation is projected to increase in the winter and spring months, and stay relatively similar during summer and fall months. Figure 2 summarizes the shifting rainfall patterns expected within the region.

More extreme precipitation events are likely to occur in the Baltimore region over this century. Projections indicate more precipitation falling in heavy events within a single day or consecutive days.

Table 1 - Projected relative sea level rise at local tide gauges*

Tide Gauge	Projected Relative Sea Level Rise (ft)		
	Near-Term (2030)	Mid-Century (2050)	End-of-Century (2080)
Baltimore	0.6 (0.4 – 0.9)	1.2 (0.8 – 1.6)	2.3 (1.6 – 3.1)
Annapolis	0.6	1.2	2.4

** Values shown are the state of Maryland's projected sea level rise values above 2000 levels. The projected value represents a central estimate, or the 50% probability that sea level rise is projected to meet or exceed. Values in parentheses indicate the likely range of projected sea level rise; sea level rise has a projected 67% probability of being between these values (not specified in the data source for the Annapolis tide gauge). The 2030 and 2050 projections for sea level rise are for RCP 4.5, though there is very little difference between RCP 4.5 and RCP 8.5 over the next 30 years. The 2080 projections are for RCP 8.5. Source: Sea-level rise: Projections for Maryland 2018.*

Sea level rise will significantly affect the Baltimore region shoreline, as summarized in Table 1. Maryland's coastline will experience minor differences in sea level rise across locations due to local differences in vertical land movements. Scientists determine relative sea level rise based on data from tide gauge stations in the Chesapeake Bay; two of these stations are located in the Baltimore region.

As sea levels rise and storms become more intense, the depth and extent of flooding from storm surges are also expected to become more severe.

Interactive maps for the entire Baltimore region showing inundation depth under different sea level and storm scenarios are available in the interactive MDOT SHA Climate Change Vulnerability Viewer.

Importance of Regional Resilience Efforts

For many years, our work has included reducing emissions and improving air quality. More recently, work has expanded to include adaptation, such as the Climate Change Resource Guide and follow-up recommendations for its implementation and for enhanced inter-jurisdictional coordination on resilience. Regional resilience efforts related to transportation will continue to be closely linked to and supportive of local and state work.

With a renewed focus on climate change and resilience at the national level, there are various new programs and sources of funding, such as through the Infrastructure Investment and Jobs Act (IIJA) and other programs, that directly support enhanced resilience. We will work with public and private partners to apply these programs as appropriate.

Chesapeake Bay

The Chesapeake Bay watershed includes six states and spans 64,000 square miles. There are excess amounts of nutrients (nitrogen and phosphorus) and sediment being deposited into the Bay. Sources of these pollutants include agriculture, urban and suburban runoff, wastewater and atmospheric deposition. Downstream effects of excess nutrients and sediment include loss of water clarity and algal blooms. These create conditions that are harmful for fish, shellfish and other underwater life. For example, algal blooms can block sunlight from reaching underwater grasses and create low-oxygen “dead zones” during decomposition that can suffocate marine life.

The U.S. Environmental Protection Agency (EPA) issued a “pollution diet” in December 2010 across the entire Chesapeake Bay as well as each tidal segment. This pollution diet is in the form of a Total Maximum Daily Load (TMDL), with caps set on levels of nitrogen, phosphorus and sediment going into the Bay. TMDLs are Clean Water Act regulatory tools that set daily limits on pollutants going into water bodies. There are a series of accountability measures to ensure the TMDL caps are being met.

In August 2019, Maryland published the Phase III Watershed Implementation Plan (WIP). This plan is designed to achieve Maryland’s 2025 Chesapeake Bay TMDL pollution targets. Urban stormwater runoff includes runoff from roadways. There are a number of different ways to mitigate the effects that roadways have on stormwater runoff pollution, including grass swales, bioswales, stormwater management ponds, infiltration trenches, submerged gravel wetlands, wet swales, sand filters, bioretention, stormwater wetlands, stream restoration, tree planting and street sweeping.

Different aspects of climate change are predicted to hinder efforts to clean up the Chesapeake Bay. Increased runoff and rainfall events from climate change could affect the Bay through increased erosion and sediment loads. As a result of the potential for climate change to affect water quality in the Chesapeake Bay, the state submitted to the EPA an addendum to the Phase III WIP to address additional load reductions required in order to meet TMDL endpoint goals by 2025.

Environmental Issues and Challenges and *Resilience 2050*

Resilience 2050 demonstrates the high priority placed on environmental issues and challenges through regional goals and strategies focused on implementing environmentally responsible transportation solutions (see Chapter 4) and through the project scoring methodology. The technical project scoring methodology includes 10 technical scoring points related to environmental conservation, amounting to approximately 20 percent of total technical scoring points. The criteria focus on effects on ecologically sensitive lands and culturally significant resources (5 points) and potential for GHG emissions reductions (5 points). A subset of these points focus on anticipated environmental impacts on low-income and minority populations.

Why active transportation is important to the region:

- Air Quality
- Equity
- Health
- Safety

Active Transportation Factors and Trends

Active transportation is critical to the Baltimore region's transportation system and includes bicycling, walking and using electric scooters, electric bicycles and wheelchairs. Almost all trips begin or end with some form of active transportation, including trips made using motor vehicles or transit. Most of us use active transportation on a weekly if not daily basis.

A connected and safe active transportation network benefits the Baltimore region by improving equitable access to destinations that meet the daily needs of a diverse group of users. This can include connections to transit systems, schools, jobs, housing, core services, parks and more. Broadening transportation choices and increasing active transportation use can increase job opportunities, physical activity and economic competitiveness while providing tourism opportunities and reducing motor vehicle traffic and associated emissions.

This section focuses on some of the factors and trends related to active transportation, including the demand for connected networks of active transportation facilities for all ages and abilities, the safety of active transportation users, connections between transit and active transportation, equity considerations, public health and economic competitiveness.

Connected Network of Active Transportation Facilities for All Ages and Abilities

A network of well-connected active transportation facilities that appeals to people of all ages and abilities has the potential to increase bicycle and pedestrian rates. Research has shown that the perception of comfort or traffic stress affects a person's decision to bicycle, walk or use a scooter. Guided by the 2040 Maryland Bicycle and Pedestrian Master Plan 2019 Update, MDOT recently completed a [Maryland Bicycle Level of Traffic Stress (LTS) analysis] of all roadways and bicycle facilities in the state. The LTS analysis identifies how comfortable a bicycle facility or roadway is based on a number of factors. This analysis will allow us to identify and address gaps in the regional bicycle and shared-use network that are currently uncomfortable for most users with the goal of creating a network that is appealing and comfortable for all ages and abilities.

The Baltimore region sidewalk inventory, currently under development, will bring Baltimore region jurisdictions much closer to having the necessary data for a pedestrian LTS analysis. Pedestrian LTS analysis of a geographic area allows for identification of gaps for pedestrians in the active transportation network and aids in identification and prioritization of projects.

Shared-use paths are separated from the roadway and can be used by walkers, bicyclists, wheel chair users and e-scooter users. Bicycle lanes are dedicated lanes on the roadway for use by bicyclists and e-scooter users and can include painted separation from motor vehicle lanes or physical barriers such as a curb, median, parked cars, a landscaped strip or other type of barrier.

Safety

Non-motorist or pedestrian, bicycle and scooter user safety is a priority for us, MDOT and member jurisdictions. Serious and fatal crash rates for drivers and active transportation users are on the rise in the Baltimore region, reflecting national trends. Non-motorists make up a disproportionate share of serious and fatal crashes. Crashes involving non-motorists made up 3.8 percent of all crashes in the Baltimore region in the five years from 2016-2020. However, they accounted for 28.6 percent of all fatalities and 9.3 percent of all injuries.

We are dedicated to understanding the causes of crashes and identifying appropriate and effective safety countermeasures. Safety planning is a critical component of the LRTP as most safety infrastructure projects and awareness programs take many years to create change. The Transportation Improvement Program (TIP), which is focused on projects funded over the next four fiscal years, also incorporates safety in evaluation criteria.

Agencies across the country are focusing on eliminating fatal and serious injury crashes through data-driven systemic approaches including integrating safety into the project selection process and plans at all levels. Strategies include supporting projects that use the Safe System Approach to increase safety for all and advancing Complete Streets and Vision Zero approaches. We work closely with partners at MDOT SHA, MDOT Motor Vehicle Administration and Maryland Highway Safety Office.

Transit

Active transportation and public transit make natural partners as public transit riders often walk, bicycle or use e-scooters or e-bicycles to and from their transit stops. Active transportation travel is well suited to bicycling trips of less than six miles and walking trips of less than one mile. Access to transit expands the reach of active transportation travel throughout a region and beyond. Nationally and regionally, agencies have focused on improving active transportation facilities within walking, bicycling and scooting distance of transit access and on coordinating with transit providers to ensure that active transportation can be combined with transit for longer regional trips.

We will continue to support the efforts of local and state partners to increase active transportation access to transit. In 2022, we approved the Transportation and Land Use Connections (TLC) program, which provides support to member jurisdictions in the form of an annual competition for grants. Funded projects include the planning and preliminary design of shared-use paths and separated bicycle lanes that improve connections to transit stops. We will continue to collaborate with our local and state partners to identify and address gaps in the bicycle and pedestrian network around transit stops.

Equity

A connected active transportation network is critical for linking community members of all ages and abilities to core services and amenities, especially those who walk or bicycle out of necessity rather than choice. The uneven distribution of high quality active transportation and transit access can affect the safety, mobility, health and economic opportunities of vulnerable communities. Nationally, lower income communities of color are overrepresented in bicycle and pedestrian crashes.

Several of the scoring criteria for projects submitted for inclusion in the LRTP include equity components. For example, the Complete Streets technical scoring criteria includes an assessment of the inclusion of Complete Streets features and the project’s impact on improving accessibility for low-income and minority populations.

> Complete Streets includes planning, designing and operating roadways so they are safe to use and support the mobility of users of all ages and abilities. Examples include sidewalks, protected bicycle lanes, public transportation stops, curb extensions and reduced speed limits.

Equity is also incorporated in our projects and assessments through the Vulnerable Population Index (VPI). The VPI allows us to identify areas with concentrations of seven groups determined to be vulnerable based on an understanding of federal requirements and regional demographics. These populations have historically been underserved by the transportation system and may face challenges to accessing employment and core services.

Public Health

Research has shown that bicycling and walking can assist people in meeting recommended levels of physical activity and potentially improve public health due to the health benefits of increased physical activity. A well-connected and comfortable active transportation network can increase access to recreational areas and parks. Replacing a vehicle trip with biking, walking or scooting also reduces greenhouse gas emissions that contribute to poor air quality. However, walking and bicycling rates are impacted by the presence or lack of sidewalks and other pedestrian infrastructure, bicycle lanes, shared-use paths and bicycle boulevards.

We have supported the efforts of member jurisdictions in planning Bike to Work Week in the Baltimore region, which celebrated its 25th anniversary in 2022. Bike to Work Week is a campaign celebrating bicycling as a healthy and affordable commuting option while promoting public awareness of its safety and environmental benefits. Bike to Work Week helps raise awareness of the rules of the road for drivers, pedestrians and bicyclists, and also highlights the need to improve bicycle facilities to improve safety.

Economic Competitiveness

A thriving regional economy is tied to improved job opportunities, social mobility and strong communities. Impact reports of trails networks have shown that active transportation and recreation can support a region's competiveness, as they are valued by existing and potential residents and visitors. A connected active transportation network can support a region's sustainability and resilience while encouraging tourism and spending in businesses nearby. Destination active transportation trails such as the Great Alleghany Passage in western Maryland and Pennsylvania can be particularly popular draws for tourists.

Active transportation infrastructure can increase the value of nearby properties and in turn increase the demand for and vitality of communities. However, rising property values can raise issues of affordability and potential displacement. There is a national discussion about the role of communities and policymakers in mitigating the risks associated with rising property values. An expanded regional active transportation network could increase the Baltimore region's economic competitiveness, sustainability and resilience, encourage tourism and increase the appeal of communities. However, the region will need to continue to discuss equity issues associated with a potential rise in property values.

Active Transportation and *Resilience 2050*

There is an increasing interest in a regional network of active transportation facilities that is comfortable and safe for all ages and abilities. The Baltimore region has over 300 miles of shared-use paths and over 200 miles of bicycle lanes. These numbers continue to increase annually as local jurisdictions and MDOT SHA work to realize the design and construction of planned bicycle and shared-use facilities.

We will continue to collaborate with local and state members to coordinate and promote active transportation planning in the Baltimore region. The IIJA significantly increased federal funding for active transportation and the safety of vulnerable road users. Our work, and that of our regional partners and the state to coordinate on active transportation projects and policies, places the Baltimore region in a strong position to leverage this increased funding to expand the region's active transportation network and improve safety.

The project scoring process for *Resilience 2050* includes additional points for projects

Specific actions we are taking include:

- **Continuing to dedicate support to active transportation-related projects such as:**
  - Developing a vision for a regional network of bicycle and shared-use facilities improving regional connectivity, safety and mobility.
  - Leading preliminary design of additional segments of the Patapsco Regional Greenway (PRG) and other shared-use facilities.
  - Managing the development of concept plans of pedestrian and bicycle infrastructure improvements.
- **Providing staff support to the Bicycle and Pedestrian Advisory Group (BPAG), a subcommittee made up of representatives from member jurisdictions and the state which promotes the sharing of information and ideas for improving active transportation in the region.**
- **Continuing bicycle and pedestrian counts throughout the region such as counts conducted before and after a project is constructed and to assess a location under consideration for long-term counter installation.**
- **Tracking the deployment, management and advancing technology of micromobility in the region to assist member jurisdictions in taking advantage of its benefits while minimizing potential downsides.**
- **Supporting the inclusion of Complete Streets and active transportation projects in the LRTP and TIP.**

incorporating Complete Streets features. Approximately 90 percent of the projects in *Resilience 2050* include some Complete Streets features, with 65 percent including Complete Streets features throughout the majority of the project. These features range from reduced speed limits and bicycle and pedestrian facilities to mid-block crossings and crossing treatments such as High-Intensity Activated CrossWalk (HAWK) signals. Approximately 70 percent of the *Resilience 2050* projects include pedestrian and bicycle facilities such as sidewalks, mid-block crossings, ADA improvements, shared-use paths and bicycle lanes.

We also approved inclusion of a list of top active transportation projects totaling more than 175 miles of bicycle and pedestrian facilities in *Resilience 2050* under set-aside funding. The $250 million in set-aside funding is included in *Resilience 2050* to encourage programs and projects that reduce emissions due to the Baltimore region's nonattainment status for air quality. See Chapter 7 for a summary of set-aside funding and the full list of top regional active transportation projects.

Transit Factors and Trends

Robust transit moves people to their destinations in an efficient, affordable way. Public transportation systems in the greater Baltimore region include buses, trains, ferries, light rail transit, bus rapid transit, paratransit and metro services that are available for use by the public and generally run on a scheduled timetable.

Planning for the development of new or expanded transit service in the urban, suburban and rural communities that make up the greater Baltimore region should take into consideration its wide-ranging benefits. Public transportation systems create a groundwork on which our communities may thrive – becoming healthier, more livable and more prosperous in a number of ways.

Public transportation supports residents, businesses and communities in our region by helping to provide connections to jobs, education, family and friends, recreation, healthcare and other services. Transit services that connect people to their destinations in the urban, suburban and rural cores of our region contribute to community vitality, help create a more equitable transportation system, improve air quality, foster economic growth and support better health outcomes for an improved quality of life.

Why transit is important to the region:

- Better health
- Cleaner air and reduced greenhouse gas emissions
- Improved mobility
- A more equitable transportation system
- Economic benefits to the community
- Improved commuter productivity

Transit in the Baltimore Region

Prior to the pandemic, nearly 300,000 public transit trips via bus and rail and 9,000 paratransit trips were taken daily throughout our region (MDOT MTA, 2020). Although factors such as ongoing patterns of working from home and staff shortages have significantly affected transit ridership, recovery has slowly begun. Overall, transit trips make up approximately 3 percent of trips by all modes of travel in the Baltimore region, led by the urban and suburban activity centers.

Multiple transit operators at the state, county and private levels serve the greater Baltimore region, providing both fixed route and demand-response service. MDOT MTA operates:

- local service and commuter service within the Baltimore region;
- service to Union Station in Washington, D.C. via MARC;
- connections to other transit modes including Amtrak and Greyhound;
- connections to other origins/destinations outside of the Baltimore region.

Additionally, services provided by the region's Locally Operated Transit Systems (LOTS) provide some supplemental service within jurisdictional boundaries in Anne Arundel, Baltimore, Carroll, Howard, Harford and Queen Anne's counties and Baltimore City. One regional provider includes service to multiple counties. While the majority of transit services in the region collect fares from passengers, some local services are free to riders.

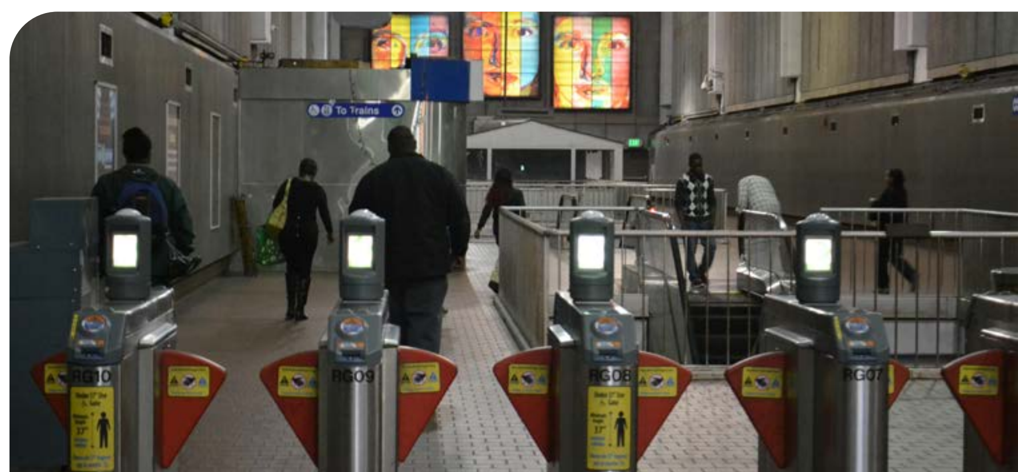
Transit agencies in the Baltimore region and across the United States have struggled with decreased ridership, difficulties with operator hiring and retention, and other challenges to operations as a direct result of the COVID-19 pandemic. However, these struggles also provide an opportunity for transit agencies to develop new solutions to increase ridership, improve operations and plan for improved access for those who need it most.

Equity

While the greater Baltimore region is home to 45 percent of the state's population and 51 percent of the state's jobs, a commute to work by transit currently takes, on average, 71 percent longer than by personal vehicle. While the COVID-19 pandemic caused a dramatic drop in transit ridership, essential workers and workers with low incomes continued to rely on public transportation. However, many destinations in the region are still inaccessible by transit, and residents without access to cars or other affordable transportation modes are likely to have reduced access to jobs and services. Any planning for new or enhanced transit service should include an evaluation of equitable access to opportunities including jobs, recreation, schools and health care, as well as differences in access times by transit modes.

Transit Ridership

Public transit ridership has not made a steady recovery. Ridership levels have rapidly risen and fallen in response to COVID-19 levels across the country. Traditional weekday commuter service has seen some of the most dramatic decreases in ridership. Emerging commuter patterns as office workers keep hybrid schedules, a preference for mid-week office days, travel demand at peak hours, and car traffic bouncing back from the lows of 2020 have created unpredictable conditions. Such rapid changes and fluctuations have often made it difficult for transit agencies to keep up with service needs to connect the greatest number of riders to their destinations in this current era. To attract more riders, some transit agencies have responded by adjusting bus and subway routes and service, offering less service during historic rush-hour times and more service at other times to locations such as medical appointments, highly trafficked areas or sports and entertainment events.



Fare Policies

Frequent, reliable service with few transfers may make public transit more appealing to drivers. Since the onset of the pandemic, revised fare structures and simplified fare structures have been gaining in popularity, especially among transit networks that have adopted smart fare collection systems. These systems make it easier to cap fares and/or offer fare free service to specific populations. Some LOTS in the region have offered reduced prices or temporary free fares to better serve lower-income communities and essential workers, as well as to attract new suburban commuters. Offering flexible and discounted mobile options for paying fares not only improves equitable access, but also may simplify the overall rider experience.

Microtransit

One of the goals of the Statewide Transit Plan is to provide fully accessible transit for people of all cognitive and physical abilities. In some areas throughout the region, in part due to a shortage of drivers, there are evening and weekend service gaps, lack of service to some locations, or the need to make reservations during operating hours well in advance. Various service providers have been exploring the potential to mix fixed routes and microtransit service to create a stronger transit network. For example, buses may provide high frequency, all day service on core routes, complemented by microtransit in areas on the edge of the core service area. Microtransit could potentially help ridership grow to complement fixed route levels, or serve areas that do not warrant fixed route frequency, particularly in rural areas. Microtransit pilots across the country have demonstrated great promise in filling such gaps.

Funding

Nearly all transit funding in the Baltimore region comes from either federal or state government sources. MDOT MTA is the only direct recipient of federal transit grant funding, and in turn allocates all such funding and provides technical assistance to the LOTS as sub-recipients. Much of existing transit budgets in the Baltimore region are currently committed to operating and maintaining the current transit system and its infrastructure. Unlike other peer states, local jurisdictions in the region do not have formal input on budgeting and allocation decisions, and also do not contribute substantial funds to transit through taxes or other means. As a result, implementation of new strategies, expanded services and capital projects may require either new funding sources or the reallocation of existing funds. Equitable prioritization based on the greatest needs in the state after MTA fulfills other obligations around the state may also be required, particularly in the Maryland portion of the Washington Metropolitan Area Transit Authority (WMATA) service area.

Transit and *Resilience 2050*

We work together with our local and state members in coordinating and promoting transit and human service transportation planning in the Baltimore region, and in providing technical support to these providers through an array of studies and tasks.

Implementation is underway on a number of the strategies identified in the Regional Transit Plan for Central Maryland, including the first of the 30 Regional Transit Corridor studies identified in the plan. MDOT MTA is leading evaluations of two early opportunity corridors including an East-West corridor between Ellicott City and Bayview and a North-South corridor between Towson and downtown Baltimore. In 2022, BMC completed a pilot feasibility study that included an assessment of land use and zoning updates that would support the development of transit, as well as an early screening against potential funding source requirements. This pilot serves as a model for continued regional priority corridor feasibility studies.

We will lead several technical and skills development tasks to support the LOTS and MDOT MTA bus modes. Current projects in our work program include a task to identify common regional data standards and needs, partnership with MDOT MTA and the Transportation Association of Maryland to implement trainings and the development and maintenance of a regional transit dashboard.

More than 30 transit projects were submitted for inclusion in *Resilience 2050*, all of which were selected for the Preferred Alternative. See Chapter 7 for further details on transit projects in *Resilience 2050*.

Highway Safety Factors and Trends

From 2016-2020, the number of traffic fatalities continued to increase both nationally and in Maryland. While the U.S. showed an increase of close to three percent during those years, Maryland and Baltimore region traffic fatalities increased approximately nine percent. Beginning in 2020, likely correlated with the onset of the COVID-19 pandemic and associated safer-at-home guidelines, national fatalities increased to 38,824, a seven percent increase from 2019. From 2019 to 2020, fatalities in Maryland and the Baltimore region increased to 573 (up 7.1%) and 248 (up 19.2%), respectively. VMT decreased significantly in 2020, pushing the national fatality rate to 1.34 and the Maryland fatality rate to 1.11 deaths per 100 million VMT.

Figures 3 and 4 show the Maryland and Baltimore region fatality trends for that period to illustrate the

Figure 3 - VMT and Fatalities in Maryland

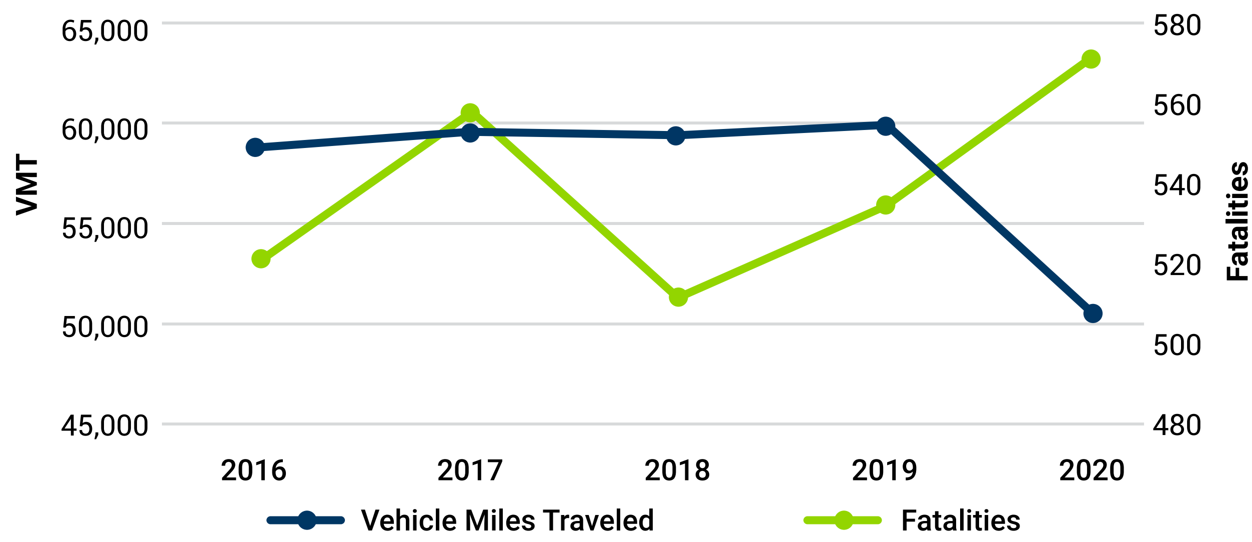
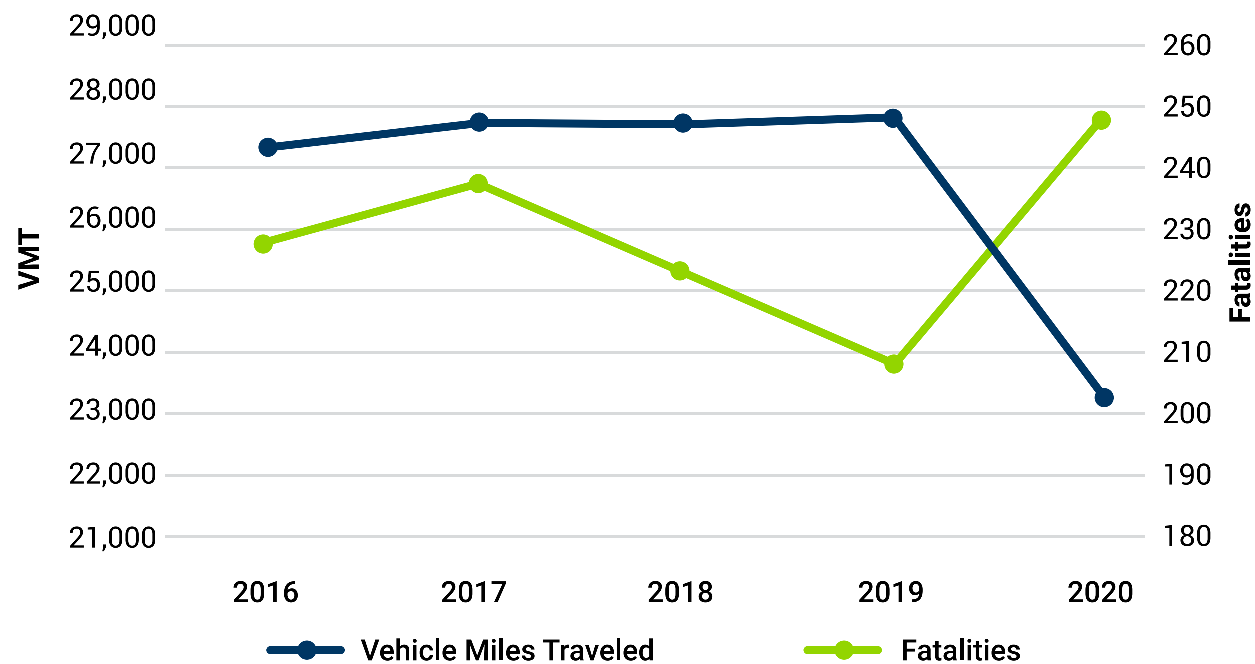


Figure 4 - VMT and Fatalities in the Baltimore Region



decrease in VMT and associated increase in fatalities. Maryland saw a 15.9% decrease in VMT and 7.1% increase in fatalities from 2019-2020. The Baltimore region saw a 16.3% decrease in VMT and 19.2% increase in fatalities from 2019-2020.

Looking more closely at the 2021 crash report data from the Maryland State Police, approximately 79 percent of Maryland fatal crashes occurred on state-maintained roadways, close to 76 percent were vehicle occupants (drivers and passengers), 30 percent involved an alcohol/drug-impaired driver, close to 17 percent involved speeding and one-quarter of all fatalities were a non-motorist. The state observed seat belt use rate was 91.4 percent. However, about 26 percent of all fatalities were unrestrained vehicle occupants.

Several contributing trends have remained constant for many years: impaired driving, non-motorists and speeding. These continue to be significant safety concerns throughout the Baltimore region and new legislation, innovative technologies and planning will have an effect on the associated fatalities. In 2022, Maryland voters approved the legalization of marijuana for recreational use (to begin July 1, 2023), which is anticipated to lead to an increase in impaired driving. Capabilities of connected and autonomous vehicle technology continues to advance and become more common among newly purchased vehicles, which will reduce the likelihood of a crash, injury or fatality (see the emerging technologies section of this chapter for more information on connected and autonomous vehicles).

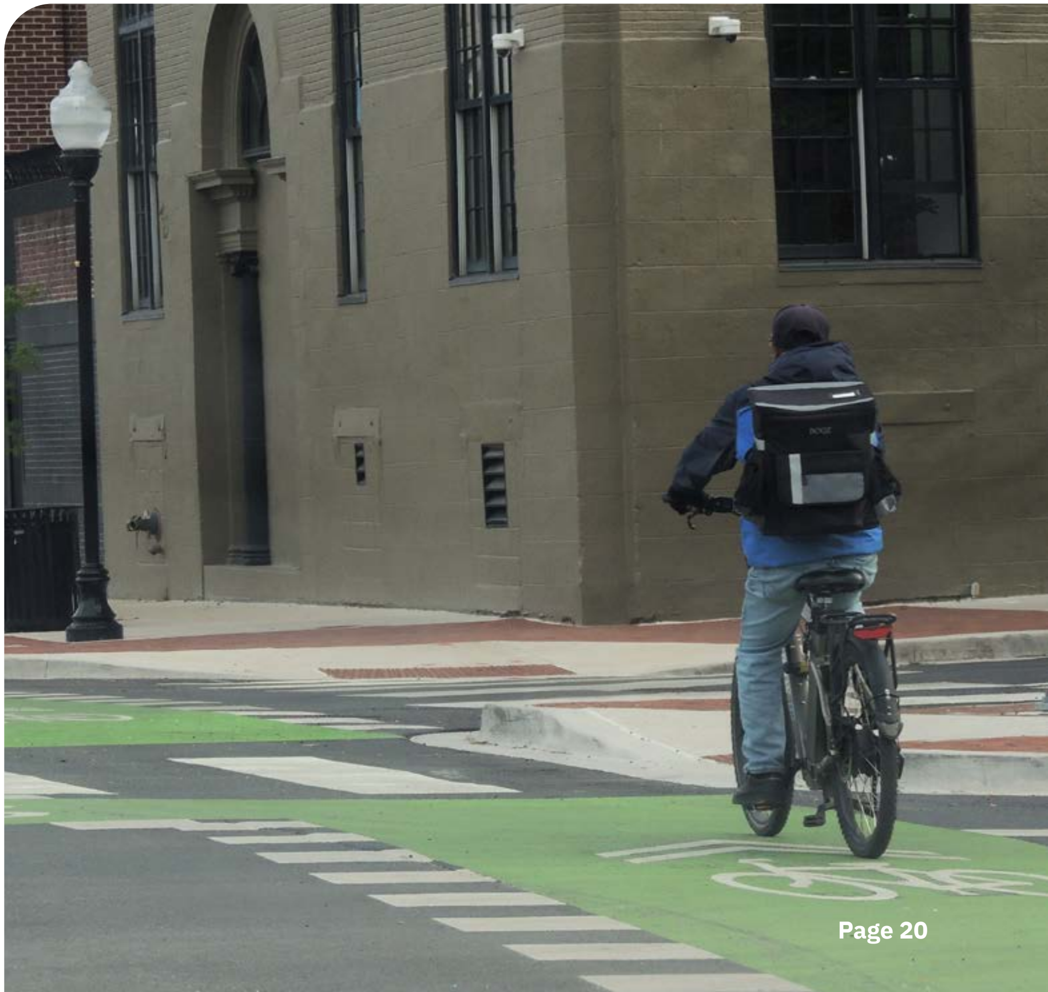
Vulnerable Road Users/Non-motorists

Non-motorists (pedestrians, bicyclists, non-vehicle occupants) are the most vulnerable users of the roadway network since they lack a physical structure for protection. In Maryland, over 20 percent of all traffic-related fatalities are non-motorists and, over the last five years (2017-2021), an average of 30 percent of the Baltimore region's traffic fatalities were non-motorists. This alarming issue has many contributing factors including but not limited to higher travel speeds and an increase in larger, heavier vehicles during a time of increased promotion of walking and biking for better health. Thus, vulnerable road users have become a focus of safety strategic planning at the state, regional and local levels.

With a multitude of factors, this complex concern for non-motorist safety needs a varied approach utilizing outreach, enforcement, road design and technology. The Look Alive campaign with Signal Woman (lookalivemd.org) was created for the Baltimore region and aims to educate pedestrians, bicyclists and vehicle drivers/operators on how to safely share the road. That program includes visual media, social media and in-person events held in areas of high risk for non-motorists.

Along with Look Alive, there is a law enforcement training seminar focused on enforcing safe roadway crossing. The Maryland Highway Safety Office provides funding for enforcement of non-motorist safety laws, with a focus on drivers not stopping for crosswalk users.

The MDOT SHA developed a Context-Driven Guide and Toolkit centered on establishing safe and effective multimodal transportation systems. These resources work with the state's Pedestrian Safety Action Plan, which aims to work with communities to improve pedestrian safety. Those materials are in use at the state, regional and local levels with roadway planners and engineers to bring a focus to vulnerable road users moving forward.



Innovation in vehicle design and road signal technology can also improve non-motorist safety. As vehicle manufacturers continue to implement advanced driver assistance systems (ADAS), such as Automatic Emergency Braking with Pedestrian Detection or stand-alone pedestrian detection and bicycle detection modules, drivers will increasingly be made aware of the presence of non-motorists. In traffic signal design, rectangular rapid-flashing beacons (RRFB) and pedestrian hybrid beacons (PHB), also known as high-intensity activated crosswalk (HAWK) signals, are becoming more common. Non-motorists can activate the RRFB, which then flashes a signal to attract drivers' attention from the roadside sign. The PHB functions similarly, but the flashing signal bridges the roadway like a traffic light.

Strategic Highway Safety Plans and the Safe System Approach in Local Safety Planning

A marquee safety planning concept is a Strategic Highway Safety Plan (SHSP). The State is currently implementing its fifth SHSP, which was adopted in December 2020 and covers 2021 through 2025. Several years ago, MDOT suggested that each of Maryland's twenty-four jurisdictions develop local strategic plans to complement the State plan. This is important as a notable portion of serious crashes occur on roads that are maintained by local departments of public works or transportation and are under the authority of local police departments or sheriff's offices. In 2020, 40 percent of all crashes, 37 percent of injury crashes, and 28 percent of fatal crashes occurred on county and municipal-maintained roadways (MHSO, 2021). The implementation of local SHSPs ensures that the entire roadway network and population are considered for safety countermeasures. All jurisdictions in the region have an SHSP, with six being implemented.

The Safe System Approach (SSA) is a systemic approach focused on reducing roadway fatalities and serious injuries to zero. Under the SSA, road safety is a shared responsibility among everyone, including those that design, build, operate and use the road system. We are beginning to incorporate the SSA into our work.

Through consultant work, we have undertaken an SSA project to implement and correlate SSA principles and elements into the existing local SHSP frameworks. Those local safety teams are the ideal partners for the SSA because one of its principles is shared responsibility. The process must include planners, behavioral safety and many other experts in transportation fields. That project will deliver best practices, case studies and guidelines for local agency use of the SSA by the end of fiscal year 2023. The SSA is heavily utilized at the national level in the 2021 IIJA and the National Roadway Safety Strategy. Applying the SSA to local SHSPs will enhance each jurisdiction's ability to secure funding and improve safety strategically.

Highway Safety and *Resilience 2050*

Resilience 2050 demonstrates the high priority placed on safety through regional goals and strategies focused on improving system safety (see Chapter 4) and through the project scoring methodology. The technical project scoring methodology allocates 10 out of 50, or 20 percent, of the technical scoring points to projects addressing key safety focus areas including non-motorist safety, speeding and impaired or distracted driving. Points are also allocated to projects anticipated to improve safety for low-income and minority populations. The technical scoring methodology places additional emphasis on non-motorists through five points allocated to projects improving Complete Streets features.

Freight Movement Factors and Trends

The Baltimore region is home to 2.8 million people and is Maryland's leading goods movement center. Each year, more than 307 million tons of freight valued at nearly $1 trillion move over Baltimore's highway, rail, port and airport facilities, serving domestic and international demand for a wide range of goods. The Baltimore region is home to the nation's sixth largest port and two Class I and III regional railroads, as well as the Baltimore/Washington International Thurgood Marshall Airport (BWI). Situated at the midpoint on the eastern seaboard, the Baltimore region also has an extensive roadway network. Maintaining and improving our existing transportation network will improve freight movement and economic growth for our region.

Port of Baltimore

In 2019, the Port of Baltimore handled a record 43.6 million tons of cargo, including 37.4 million tons of international cargo. The Port of Baltimore ranks 11th among major U.S. ports for tons of cargo handled and 9th nationally for total cargo value.

The MDOT Maryland Port Administration periodically updates the economic impacts of the Port of Baltimore on the State of Maryland. Statistics from 2017, the most recent year of data availability, on the economic impacts for cargo and cruise activity are detailed below.

Port activity generates approximately 37,300 jobs in Maryland:

- 15,330 are direct jobs generated by cargo and vessel activities at the Port.
- 16,780 are induced jobs, i.e. jobs supported by the local purchases of goods and services by direct employees. These jobs would be lost in the short term if the direct jobs were lost.
- 5,190 are indirect jobs, i.e. jobs supported by the business purchases of the employers who create the direct jobs. These jobs, too, would be lost in the short term if the direct jobs were lost.

Approximately 101,880 other jobs in Maryland are directly related to activities at the Port. Related jobs are those jobs with Maryland companies that choose to import and export their cargo through the Port of Baltimore, but have the option of shipping their products or supplies through other ports.

The Port of Baltimore is also a major source of personal, business and tax revenue in Maryland. In 2017, the Port was responsible for $3.3 billion in personal income and generated $2.6 billion in business revenues. Port activities also generated $395 million in state, county and municipal tax revenues. The Port's average annual salary for direct job holders is 9.5 percent higher than the average annual wage for Maryland, as reported by the U.S. Bureau of Labor Statistics.

Rail Freight in Maryland

Maryland has a rich history of railroads, including North America's first railroad. Baltimore merchants chartered the Baltimore & Ohio Railroad (B&O) in 1827. The B&O Railroad expanded south to Washington, D.C. and westward to help capture growing trade within the interior of the United States.

Maryland's freight and passenger railroads carry millions of passengers and millions of tons of cargo each year. Railroads are designated as Class I, II or III according to their annual revenue. There are seven Class I railroads in the U.S., but only NS and CSX operate in Maryland. Freight rail accounts for just under 800 miles of track in the state, as shown in Table 2. Table 2 also includes details on passenger rail in Maryland, including Amtrak, MARC and tourist railroads. Freight railroads transport eleven percent of the tonnage and four percent of total value that passes

Table 2 - Railroads Operating in Maryland

Railroad	Miles Leased	Miles Owned/ Operated	Total Miles Operated (Trackage Right Excluded)
Class I Railroads	5	514	519
Class II Railroads	0	0	0
Class III Railroads	115	132	247
Amtrak	0	97	93
MARC	0	3	3
Tourist Railroads	7	17	24
Total Mileage	**127**	**763**	**886**

to, from and within Maryland. Maryland's freight railroads employ over 2,500 people, which includes direct, indirect and induced jobs, according to the American Association of Railroads (AAR). In addition, nearly 2,700 Marylanders are employed by MARC and Amtrak.

Both passenger and freight rail benefit the region's transportation system and environment. More people and goods moved by rail means less people and goods on already congested highways and interstates. Rail services also help to reduce wear and tear on roadways and provide a safe and affordable transportation option. The AAR estimates that rail is four times more fuel efficient than trucks and produces 75 percent less greenhouse gases on a per ton-mile basis.

Howard Street Tunnel

Maryland has long been considered a freight bottleneck because of the inability to provide double stack trains through the Howard Street Tunnel. By stacking two freight containers on top of each other, double stacking essentially allows for double the efficiency and doubles the amount of freight moved. CSX and NS, along with public sector stakeholders, are making significant investments to provide double stack clearance along the National Gateway and Crescent Corridors including the $466 million Howard Street Tunnel project.

The Howard Street Tunnel project is being funded with a combination of federal INFRA discretionary grant funds, state funds from Maryland and Pennsylvania, and private funds from CSX. When complete, the project will eliminate all double stack obstructions between Baltimore and Philadelphia and provide economic benefits, economic growth and additional jobs for the Baltimore region. The project will also reduce truck trips, yielding other benefits including reduced congestion on Maryland's highway system, increased roadway safety, decreased fuel consumption, and improved air quality. Construction began in early 2022 in Pennsylvania, with completion expected in mid-2025.

Air Freight in Maryland

The Baltimore Washington International (BWI) Thurgood Marshall Airport employs over 9,700 people, with thousands more employees related to airport operations. Air cargo at BWI has averaged annual increases of more than 19 percent over the last five years and has more than doubled since 2015. BWI also recently became one of Amazon's top five busiest air cargo facilities in the nation (out of 35). Air cargo at BWI accounts for 57 percent of regional air cargo and exceeds the amount of cargo at Dulles International and Reagan National airports combined.

The pandemic had a significant impact on air travel. Business and leisure travel were greatly reduced due to travel restrictions and public health concerns. This led to an unprecedented demand for e-commerce. Data shows that freight (by weight) increased by 17.4 percent from February 2019 to February 2021. BWI set a new annual record for cargo

Freight and the Infrastructure Investment and Jobs Act (IIJA)

In November of 2021, President Joe Biden signed the Infrastructure Investment and Jobs Act, or IIJA. The IIJA continues to build upon past legislation, adding roughly $244 billion in new investments affecting freight transportation, including $110 billion for roads and bridges, $66 billion for railroads and $25 billion for airports.

IIJA established the Office of Multimodal Freight Infrastructure and Policy, which will administer multimodal freight grant programs, facilitate information sharing between private and public sectors, conduct research on freight mobility, provide technical assistance to cities and states, and manage planning activities such as the National Freight Strategic Plan and National Multimodal Freight Network.

The IIJA also provides additional guidance on freight planning including key updates to the National Freight Plan for assessing the environmental impacts of freight movement on air quality and wildlife habitat loss, the unique impacts of the national freight system on rural, underserved, and disadvantaged communities, and considering the impacts of e-commerce on the national multimodal freight system. The IIJA also recommends that states consider the impacts of e-commerce and the impacts of extreme or severe weather on freight infrastructure when developing state freight plans.

operations in 2021, with more than 618.8 million pounds of cargo transported. In 2021, BWI's cargo operations accounted for more than 55 percent of the total air cargo flown through the region's three major commercial airports. July 2021 marked a record month for cargo shipments at BWI, with nearly 56.3 million pounds of cargo. The airport's 200,000 square-foot Midfield Cargo Building H, which opened in 2019, has helped accommodate cargo increases.

Bottlenecks

Over the last few decades, the U.S. has seen steady growth in the demand for freight transportation. Unfortunately, freight transportation capacity, especially highway capacity, has failed to keep pace with the growing demands. The combination of growing demand and limited capacity results in congestion, less reliable trip times and difficulties meeting delivery times.

Bottlenecks on roadways that serve a high volume of trucks can be considered "freight bottlenecks." These roadways tend to serve international gateways, major domestic freight hubs and major urban areas such as Baltimore City. The majority of bottlenecks (60 percent) can be attributed to non-recurring events such as weather, work zones, crashes, breakdowns and poorly timed traffic control.

Recurring bottlenecks have the greatest impact on freight movement. There are many causes for recurring truck bottlenecks. Steep grades, lane drops, merges and signalized intersections are just a few. Most freight bottlenecks occur on Interstates or arterial roadways, but bottlenecks can also happen in localized places such as entrances to ports and airports.

Bottlenecks cause significant delays and costs in the Baltimore region. In 2019, there were 3.32 million truck person-hours of delay with an estimated cost of over $161 million. Table 3 summarizes hours of delay and its associated costs for jurisdictions in the Baltimore region.

What We Are Doing to Address Issues

We work with stakeholders to ensure that our transportation system supports the safe and efficient movement of freight upon which our economy, jobs and consumers rely. Our Freight Movement Task Force (FMTF) includes representatives from MDOT SHA, MDOT Maryland Port Administration, MDOT Maryland Transportation Authority, Maryland Motor Truck Association, Federal Highway Administration, Federal Motor Carrier Safety Administration, NS, CSX, private sector consultants and others. The mission of the FMTF is to provide the freight/goods movement community a voice in the regional transportation planning process and to serve as a forum for Baltimore region freight stakeholders to share information.

Table 3 - Truck Person-Hours of Delay and Costs in Baltimore Region Jurisdictions (2019)

Location	Hours of Delay	Cost of Delay
Anne Arundel County	653,512	$31,987,810
Baltimore City	940,853	$44,819,136
Baltimore County	1,018,310	$49,574,336
Carroll County	116,448	$5,822,750
Harford County	213,428	$10,553,599
Howard County	335,256	$16,344,500
Queen Anne's County	40,065	$1,930,658
Total	**3,317,872**	**$161,032,789**

Source: MDOT SHA Maryland Roadway Performance Tool

MPOs may designate Critical Urban Freight Corridors (CUFCs) in consultation with the state in urbanized areas with populations of 500,000 or more. A public road designated as a CUFC must meet one or more of the following four elements:

- Connects an intermodal facility to the highway freight system, the Interstate System or an intermodal freight facility
- Is located within a corridor of a route on the highway freight system and provides an alternative highway option important to goods movement
- Serves a major freight generator, logistic center or manufacturing and warehouse industrial land
- Is important to the movement of freight within the region, as determined by the MPO or state

Table 4 lists the current CUFCs for the region. We anticipate approving an updated list of CUFCs in early summer 2023 as the maximum allowable CUFC mileage has increased from 25 to 50 miles.

We are also responsible for approving the short-term TIP for the region. The TIP has included several capital projects that include federal freight program funds from the National Highway Freight Program (NHFP) including:

- I-695: US 40 to MD 144 – NHFP funds in FY 2018
- I-83 Bridge Replacement over Padonia Road – NHFP funds in FY 2018
- I-695: I-70 to MD 43 – NHFP funds in FY 2022 and 2023
- I-695: Reconstruction of Interchange at I-70 – NHFP funds programmed for FY 2025-2026
- I-695: Bridge Replacements at Benson Ave. and US 1 – NHFP funds in FY 2018 (Complete)
- I-695: Bridge Replacement on Crosby Road – NHFP funds in FY 2018 (Complete)

In addition to freight movement, truck parking is increasingly a concern for drivers and motor carriers. In an effort to better facilitate freight travel and truck parking across Maryland, MDOT SHA has engaged in multiple endeavors including the 2020

Table 4 - Critical Urban Freight Corridors in the Baltimore Region

Jurisdiction	Road Name	Starting Point	Ending Point	Miles	Cumulative Total
Baltimore City	Broening Highway	Boston Street	Belclare Road	1.9	-
	E. Lombard Street	Haven Street	Kane Street	1.0	2.9
	Boston Street	Fleet Street	I-895	1.9	4.8
	O'Donnell Street	S. Conkling Street	Dundalk Avenue	1.7	6.5
	MLK Jr. Boulevard	N. Howard Street	I-395	1.7	8.2
Anne Arundel County	New Ridge Road	MD 100	Stoney Run Road	1.8	10.0
	MD 100	MD 295	I-97	5.6	15.6
Baltimore County	Rolling Mill Road	Erdman Avenue	Eastern Boulevard	1.3	16.9
	US 40 (Pulaski Highway)	Philadelphia Road	MD 695	2.7	19.6
	Broening Highway	Belclare Road	I-695	2.0	21.6
Carroll County	MD 97	MD 140	Bachmans Valley Road	1.8	23.4
Harford County	MD 543 Interchange	I-95	I-95	0.0	23.4
Howard County	MD 175	US 1 (Washington Boulevard)	MD 108	1.0	24.4
	US 1	Montevideo Road	Assateague Drive	0.6	25.0

Statewide Truck Parking Study. This study seeks to identify truck parking needs and the development of an emergency truck parking program allowing trucks to use park-and-ride facilities during emergencies such as storms or major roadway disruptions. MDOT SHA is currently assessing truck parking data and is identifying state-owned property and potential partnerships with private property owners that could support truck parking expansion. This includes non-traditional parking locations such as big lot properties that do not mind truckers on site.

Trends in Freight Delivery – Questions to consider

Planners need to consider questions related to how goods might be delivered in the future. For example:

- What role might autonomous trucks play in freight delivery over the next five, ten or twenty years? Are there other factors particular to the trucking industry that transportation planners, economists, and regional decision makers should consider?
- How will consumers' changing habits continue to shape how goods are delivered? A February 2019 analysis by the American Transportation Research Institute noted that the annual growth of e-commerce has ranged between 13 and 16 percent over the last five years, compared to the 1-5 percent annual growth in traditional retail sales. How will this trend affect the trucking industry?
- How will the changing habits of consumers affect land use decisions about whether and where to place stores and distribution centers? How will locations and operating hours of stores and distribution centers affect decisions on how customers, workers and freight operators will access such facilities?
- Will expectations about the amount of time needed to deliver goods continue to evolve—from next-day to same-day to, potentially, same-hour?
- Could drone deliveries eventually become a viable alternative to traditional shipping, and how might this affect the trucking industry?

These are just some of the questions that planners will need to consider in the coming years. We don't have the answers to these questions yet. Evolving preferences and business models demand at least an awareness of the potential for change. There could be great opportunities to operate more efficiently and rethink the "business as usual" approach. We will continue to stay informed about trends in freight delivery so that the region will be prepared to accommodate change.

Emerging Technologies

This section focuses on a few of the emerging technologies that have significant potential to transform the transportation industry during the planning period for *Resilience 2050*. These include Mobility on Demand, micromobility, electric cars and Connected and Automated Vehicles. All of these technologies are already operating in the region in some form. We will continue to research the potential impacts of these technologies, encouraging policies and programs that support implementation where appropriate while also recognizing the significant uncertainties surrounding implementation. In preparation for *Resilience 2050*, we released a more detailed Emerging Technologies white paper.

Mobility on Demand (MOD)

MOD is an innovative transportation concept already operating in the region. These services allow consumers to access mobility, goods and services on demand by dispatching or using ride-sourcing from a variety of providers. Services currently operating in the region include transportation network companies such as Uber and Lyft, e-scooters and e-bike sharing services, shuttles, public transportation, courier network services and Personal Delivery Devices such as Kiwibot. Connected and automated vehicle services will very likely be used sometime in the *Resilience 2050* planning period.

Micromobility

An emerging technology that has become more important to the region of late is micromobility. Micromobility is the use of small, fully or partially human-powered vehicles such as bikes, e-bikes and e-scooters for typically short distance travel purposes. The Federal Highway Administration used the Society of Automotive Engineers International's Taxonomy and Classification of Powered Micromobility Vehicles to broadly define micromobility as "any small, low-speed, human- or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles, e-scooters and other small, lightweight, wheeled conveyances."

Private companies, taking advantage of recent innovations in battery and vehicle design, have increased their availability to the public via shared-use fleets. These companies offer a service that has proved a popular transportation option as an alternative mode for short trips. These vehicles are rented through a mobile app or kiosk, and are “dockless”, meaning they are picked up and dropped off in the public right-of-way. State and local laws govern operations of these services. State and local agencies monitor and respond to emerging technologies in order to protect the public interest and adapt to and take advantage of how these technologies are reshaping the mobility choices of our residents and businesses.

Baltimore City has the largest set of micromobility services in the region, has a growing record of accomplishment since the launch of its dockless vehicle program in 2019 and offers an array of best practices for others. Its annual permit program has seen stiff competition and saw an impressive pre-COVID ridership high of over 76,000 weekly trips in September of 2019.

The Future of Micromobility in the Region

Some services are (or very soon will be) available in many places in the region (e.g. Annapolis, Columbia, Gateway, Ellicott City), and new services are expected to continue to grow. Public safety is a major concern. While the majority of e-scooter trips end without incident, much work remains to improve comfort and safety for e-scooter riders with different levels of experience, training and travel needs.

Future service should address issues such as speed management, user education, improved roadway design, community engagement to help mitigate risks for vulnerable road users and the need for a connected network of facilities dedicated to serving micromobility.

Vehicle Technologies: Electric Vehicles, Advanced Driver Assistance Systems & Connected and Automated Vehicles (CAV)

In the Baltimore region, the majority of the traveling public goes to work, school, play and other activities by automobile. However, while vehicles are expected to continue to remain the dominant means of getting around, the vehicle fleet is changing in ways that can address some of their issues of safety and impacts to the environment. In our region, we are seeing an ongoing rise in the number of electric and other alternatively fueled vehicles being registered for use on our roadways.

Electric Vehicles

As of January 31, 2023, there are 64,395 electric vehicles registered in Maryland. President Biden signed an executive order in August of 2021 that called on the federal government to do all it can to support electric vehicles by setting a goal that "…50 percent of all new passenger cars and light trucks sold in 2030 be zero-emission vehicles." Increasing electrification of our vehicle fleet would provide multiple benefits, from reducing the carbon footprint of the transportation sector, to saving money and supporting the economy. A California rule requiring 100 percent of new cars, light trucks and SUVs sold in that state to be zero-emission vehicles by 2035 is expected to significantly motivate manufacturers and the market in ways that may have implications here in Maryland. While electric vehicles are expensive to many, they cost considerably less to drive than those using diesel fuel or gasoline.

Electrifying heavy trucks and buses could also provide significant benefits as these are among the most polluting vehicles on the road. Heavy-duty trucks are responsible for nearly a quarter of the greenhouse gas emissions from the nation's transportation sector, itself the biggest contributor of those emissions in the economy. Logistics companies are realizing that shifting away from internal combustion engines could provide large economic benefits to high-use commercial fleets, especially as purchase prices drop and the market changes because of policies like California's. In our region, Amazon has begun its efforts to increase shipments made by electric or non-motorized vehicle. Additionally, Walmart intends to complete converting its fleet to electric, hydrogen or renewable diesel vehicles by 2040. These efforts and others have the potential to transform at least 30 percent of new trucks to zero-emission vehicles by 2030 — and as much as 100 percent of the additions to urban fleets of transit buses, trash trucks, postal vehicles, cargo vans and heavy-duty trucks. This would have significant positive impacts on the region's air and water resources.

Advanced Driver Assistance Systems (ADAS)

We are also seeing advanced vehicle technologies appear in our vehicles. ADAS technologies currently include Automatic Emergency Braking, Lane Keeping Assistance, Blind Spot Warning and other advanced safety technologies. ADAS are passive and active safety systems designed to remove human error when operating vehicles of many types. ADAS systems use a combination of sensor technologies to perceive the world around the vehicle, and then either provide information to the driver or take action when necessary. ADAS technologies enable cars to take actions similar to a driver – sensing weather conditions, detecting objects on the road – and make decisions in real time to improve safety. ADAS features can include automatic emergency braking, driver monitoring, forward collision warning and adaptive cruise control.

Driver assistance technologies are already helping to save lives and prevent injuries. Many vehicles on the road today have the crash avoidance features mentioned above. In addition, Maryland now has more than forty connected vehicle roadside units in Montgomery and Prince George's counties that broadcast key roadway information to drivers. Data is exchanged with these in-vehicle technologies, and data security is a concern. In response, MDOT launched a statewide system allowing any agency to register their roadside units. This is intended to increase trust and cybersecurity of connected vehicle data exchanges.

Drivers and operators must understand the limitations of these technologies. While an ADAS can often steer, brake and accelerate vehicles on its own, the driver must be prepared to take control quickly when the technology malfunctions or cannot handle a particular situation. Drivers may become complacent or unaware of the limits of ADAS features, resulting in an emergency when they are not alert to the need to take over driving quickly. This is reflected in the unfortunate and growing record of crash data, demonstrating drivers don't yet have a firm understanding of the limitations of current driver assist technologies. Driver education of the capabilities and limitations of these technologies is critical. The need for driver education is expected to continue throughout the planning period as new technologies emerge.

Connected Vehicles (CV)

CV technologies use onboard communication devices and systems to address safety, efficiency and mobility on our roadways. Connected vehicles use technology to either communicate with each other, connect with traffic signals, signs and other road items, or obtain data from a cloud. The connected vehicle concept uses technology to “sense” what other travelers (vehicles, bicyclists, pedestrians, wheelchairs, motorcycles, buses, trucks and others) are doing and identify potential hazards. They are leveraging technologies and solutions to improve traffic flow, an important consideration as travel patterns and congestion return to pre-pandemic levels. Connecting to databases and platforms and allowing vehicles to communicate in real time helps vehicles adjust speed and route and avoid conflicts.

CV (and CAV – see below) technologies are not only transforming vehicles, they are subtly forcing a reimagining of the design of transportation infrastructure. Fully realizing the benefits of CV requires designing connectivity into roads, sensors and cameras, signage and traffic lights. These shifts are anticipated to be a significant challenge throughout the planning period.

Additionally, each CV contributes and benefits from the real time exchange of information with other vehicles and roadside infrastructure, resulting in huge amounts of data. This data is a valuable product and raises complex questions surrounding data management and ownership. These issues represent possible implementation barriers throughout the planning period.

Automated Vehicles (AV)

AV technology is evolving to deliver greater safety benefits than earlier technologies. However, with the exception of Personal Delivery Devices (see below), fully automated vehicle technology is not expected to appear until later in the planning period. Automated driving systems, or automated vehicles, are operating in other parts of the country. The U.S. Department of Transportation defines automated vehicles as those in which at least some aspect of a safety-critical control function (e.g., steering, throttle or braking) occurs without direct driver input. Automated vehicles may be autonomous (i.e., use only vehicle sensors) or may be connected (see discussion in above section) and communicate with other vehicles, or may be both connected and autonomous. Connectivity is an important input to realizing the full potential and implementation of automated vehicles.

AVs use sensors and other technologies to understand the environment to assist drivers, and eventually perform driving tasks in place of a human driver. AVs can operate independently from other vehicles and infrastructure using onboard sensors. There are several “levels” of automation:

- Level 0: No Automation;
- Level 1: Driver Assistance;

- Level 2: Partial Automation;
- Level 2+: Advanced Partial Automation;
- Level 3: Conditional Automation;
- Level 4: High Automation; and,
- Level 5: Full Automation.

Vehicles with an automated driving system (i.e., level 5), which some refer to as "self-driving" cars, are a future technology and are not available for purchase and use today.

Connected and Automated Vehicles (CAV)

Connected and Automated Vehicles (CAVs) combine the two technologies discussed above. They use special short-range radios to wirelessly communicate with each other and with vehicles around them, traffic infrastructure and other travelers and automate some or all of the driving functions. The vehicle and roadside infrastructure – like traffic signals, crosswalk signs and blind roadway curves – communicate to make traveling safer.

CAV technology has the potential to save lives, prevent injuries and reduce crashes. CAV could also increase mobility to meet the needs of those with disabilities, the elderly or those otherwise unable to drive. CAV technology may also help traffic move more efficiently by providing accurate data to drivers and traffic managers. As traffic moves more efficiently, there will be a reduction in vehicle emissions and improved air quality.

While the expectation is that CAVs will lead to all of these benefits, there will likely be challenges as well. Some can be identified in advance, such as the need to ensure these technologies are deployed equitably, the potential for cyberattacks on CAVs and changes to land use to accommodate CAVS. Of course, unanticipated challenges will also arise. The public sector must work with the private sector to identify and address any challenges as early as possible to maintain and even increase safety, mobility, and equity.

Transit and Transit Signal Priority

Fully realizing the promise of connected vehicles requires transit agencies to revisit transit signal priority (TSP) systems in the hopes of restoring route reliability and on-time performance. TSP is a general term for operational improvements that use technology to reduce time at traffic signals for transit vehicles by holding green lights longer or shortening red lights. TSP may be implemented at individual intersections or across corridors or entire street systems.

Connected and Automated Vehicle Technology has the potential to save lives, prevent injuries and reduce crashes.

TSP systems haven't evolved much and rely on transmitters on buses that send messages to receivers installed on traffic signals. They are also quite expensive and require annual maintenance to guarantee operation.

Recent advances in communication technologies and access create opportunities for transit agencies to reduce the cost of TSP solutions while maximizing their current investments. Transit agencies have begun placing tracking devices on each of their vehicles to understand in near real-time where vehicles are located. This technology is beginning to bridge the gap between transit vehicles and traffic signals to facilitate transit priority in a more reliable, sustainable, cost-effective and intelligent way.

AV Shuttles

Self-driving shuttles are in use around the world. Autonomous shuttles are vehicles that move autonomously at low speeds (less than 50 miles per hour) on pre-charted routes under remote surveillance and environment restrictions for operations. Autonomous vehicles under this category are electric, used to ferry people or deliver goods and may be manned or unmanned. These are often small transit vehicles that can transport 10 to 15 passengers in a relatively small area defined by pre-charted maps and well-defined routes. They also require geography-specific customizations like identifying common objects and understanding the local traffic laws and regulations. The driving scenario for the vehicle is generally simple, with well-defined emergency protocols. Shuttles typically have a remote operator functioning as a safety fallback. In addition, shuttles generally do not share the road space with faster moving traffic.

Autonomous shuttles have functioned best in closed environments such as campuses (business, industrial or educational), certain city centers and suburban neighborhoods. A self-driving shuttle had operated within National Harbor in Prince George's County, but is no longer operating. A public-private collaboration, the Mid-Atlantic Gigabit Innovation Collaboratory (MAGIC), is now working to enable a self-driving shuttle in Westminster. This work is in the early stages and an estimate for deployment is not yet available.

Truck Platooning, Personal Delivery Devices and Unmanned Aerial Vehicles

Truck Platooning

Technologies that support the movement of freight and goods have already started in the region. Truck platooning is a technology involving truck operators with vehicle-to-vehicle (V2V) communications technology on board. This V2V technology enables truck operators to safely close distances between moving vehicles, allowing two or more vehicles to be electronically synced to one another. The platooning vehicles wirelessly communicate information on braking, speed and oncoming obstacles, allowing the following trucks to have consistent and predictable driving behavior. The use of these systems drastically reduces the reaction time of the following trucks in a platoon, thereby reducing the likelihood of rear-end or chain-reaction crashes.

Platooning in Maryland is only currently allowed on the state's controlled access highways. As the technology evolves, consideration of platoons with more than two trucks, platoons for other heavy vehicles including buses and military vehicles and platoons with a human driver in the lead vehicle and an automated driver in the following vehicle may be considered. This technology is expected to improve safety, the environment, commerce and infrastructure for Maryland's roadways and freight services.

Personal Delivery Devices (PDD)

PDDs have also begun delivery services in the region. PDDs have emerged as an innovative technology promising to improve the efficiency of deliveries. A 2021 law set out specific rules for PDDs in Maryland, authorizing PDDs and defining guidelines to operate on any highway, roadway, sidewalk, shoulder, footpath, bicycle trail or crosswalk in the state.

Morgan State University has begun the use of PDDs on campus. A private company has deployed a fleet of "KiwiBots" to provide the university's food-service provider, Sodexo, delivery services. MSU students can use their mobile device to place orders and meet the small, semi-autonomous robots on campus between classes or whenever is most convenient. Kiwibot's PDDs are the first permitted automated vehicle on the streets in Maryland and the company hopes to expand. This and other similar PDD services will require reviews of the route and safety considerations from multi-disciplinary experts including staff from state and local public safety and public works agencies, as well as providing notice to the general public.

Unmanned Aerial Vehicles (UAV)

UAV systems, sometimes called drones, are being explored as a means to transport lightweight packages, medical supplies, food and other goods. Currently, companies in the

image courtesy of FedEX

U.S. and worldwide are actively vying to define their markets and begin operations. This newer mode of transportation has the potential to change last-mile delivery economics for smaller and lighter packages by replacing deliveries currently made by traditional car, van or truck delivery services.

Potential benefits of UAV delivery include reductions in traffic congestion, environmental pollution, delivery times and transportation costs. There are, however, significant challenges to broader overall usage and acceptance of drone delivery systems. Their use in the region for such purposes is expected to be limited throughout the planning period.

While broader usage of UAVs or drones for delivery remains a challenge, MDOT currently uses drones in a variety of ways. Current uses of drones by MDOT include assessing damage to the transportation network, conducting stormwater facility inspections, tracking construction projects, assessing utilization of Park-and-Rides and viewing geohazards such as sinkholes.

Emerging Technologies and *Resilience 2050*

Technologies are constantly changing and there remains a significant amount of uncertainty surrounding the impact of emerging technologies. As use of these emerging technologies becomes more widespread, we will continue to monitor potential risks and impacts and identify actions to take. Understanding the potential and consequences of technologies is important to help to ensure the region harnesses the positive effects of technology and avoids or minimizes potential negative effects.

We must be prepared to face rapid advances and implementation issues while continuing to make investment decisions and develop programs and projects that support a safe, efficient, accessible, equitable and environmentally responsible transportation system for all users.

Our specific actions will include:

- Tracking technology development and deployment within the region, nationally and internationally to understand and plan to take full advantage of the benefits and minimize disadvantages from new and emerging technologies
- Investigating how to use newly available data to enhance transportation planning
- Working with stakeholders, especially elected officials and the public, to manage expectations and perceptions, minimize future problems and leverage opportunities
- Building technical, institutional and policy capacity, and including new partners as necessary
- Working to monitor deployment throughout the region to ensure equitable distribution of the benefits technology can offer

Travel and Tourism

Federal law requires that metropolitan regions consider a series of factors when developing their transportation programs and plans. These factors address issues such as supporting the economic vitality of the metropolitan area, increasing the safety of the transportation system for motorized and non-motorized users, and protecting and enhancing the environment, among others. “Enhance travel and tourism” was added as a factor starting with the Fixing America’s Surface Transportation (FAST) Act and is maintained in the IIJA.

The conference report prepared during the development of the FAST Act notes that:

- One out of every nine jobs in the U.S depends on travel and tourism, and the industry supports 15 million jobs in the U.S.
- The travel and tourism industry employs individuals in all 50 states, the District of Columbia, and all of the territories of the U.S.
- International travel to the U.S. is the single largest export industry in the country, generating a trade surplus balance of approximately $74 billion.
- Travel and tourism provide significant economic benefits to the U.S. by generating nearly $2.1 trillion in annual economic output.
- The U.S. intermodal transportation network facilitates the large-scale movement of business and leisure travelers, and is the most important asset of the travel industry.

Understanding the Context: Enhancing Travel and Tourism

Our advisory Technical Committee has heard presentations from two organizations charged with promoting tourism in the area: Visit Baltimore and the Maryland State Office of Tourism Development.

In its 2022 Annual Report, the Maryland Tourism Development Board reports that Maryland’s tourism economy began to recover from COVID-19 related declines in late 2020. The recovery continued in 2021, with visitation increasing by 42 percent to reach 35.2 million trips. This is 84 percent of pre-pandemic levels. Visitor spending grew by a similar 41 percent to reach $16.4 billion. Growth from 2020 to 2021 spanned many sectors, with transportation spending by travelers increasing by 53 percent, recreational spending increasing by 44 percent, lodging spending surging by 41 percent and food and beverages spending increasing by 34 percent.

Tourism also supports Maryland employment along with its tax base. Tourism supported employment decreased by 30 percent from 2019 to 2020 due to the COVID-19 pandemic. However, it increased by 8.2 percent in 2021 to nearly 113,000 jobs. The number of jobs is still about 37,000 below pre-pandemic levels. Sales and use tax revenue attributable to tourism decreased by 31 percent to $294.1 million in FY 2021. It rebounded by more than 100 percent to $615.8 million in FY 2022.

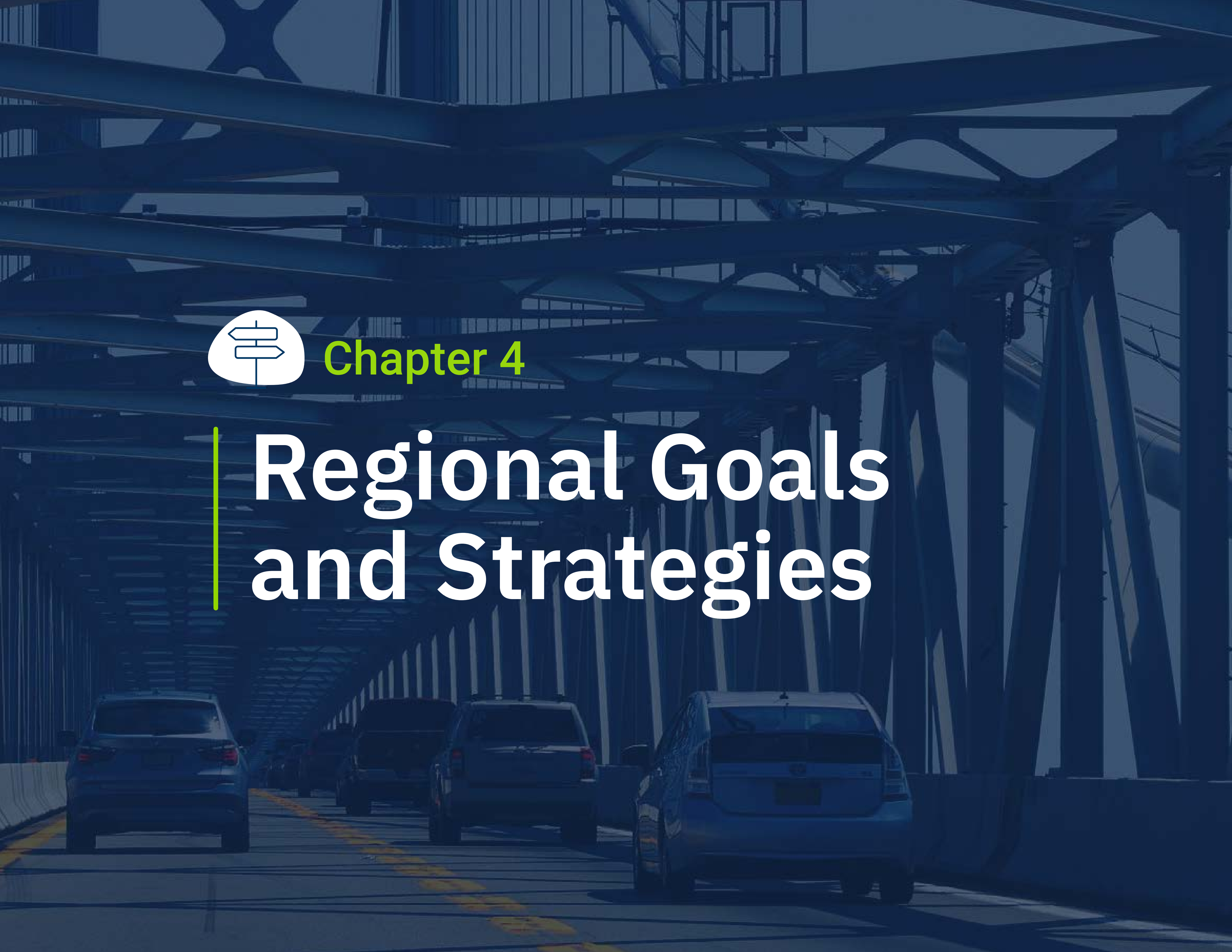
Visit Baltimore is the official destination marketing organization for Baltimore. It strives to inspire people to visit the Baltimore region, generate economic benefits through the power of collaboration and partnership, provide stakeholders with the necessary tools and information to make their products and services competitive and approaches its work through the lens of Diversity, Equity, and Inclusion (DEI).

Visit Baltimore has highlighted some recent statistics regarding the impact of travel and tourism in Baltimore. Domestic travel to Baltimore increased by 13.3 percent in 2021, resulting in 24.3 million people visiting for overnight and day trips. The economic impact of these visitors brought in $2.7 billion to Baltimore's economy in 2021. Baltimore Convention Center events alone brought in an estimated economic impact of $90 million in 2021.

Enhancing Travel and Tourism – Input from Advisory Committees

Building on input from tourism agencies, the Technical Committee recommended additional language related to travel and tourism to support our regional transportation goals and to address the new planning factor. This language was included in the previous LRTP and is also supported in the goals and strategies for *Resilience 2050*. The goal for promoting prosperity and economic opportunity includes the following strategy related to tourism: "Invest in upgrading transportation assets and facilities that promote tourism and the movement of tourists within and through the region." This could include:

- improving roadway, transit, pedestrian and bicycle access to regional and local tourist attractions
- analyzing peak travel volumes and times in key tourism corridors, and
- improving and promoting information systems (e.g., signage, bus service information, smartphone applications) that visitors can use to reach destinations easily and safely.



Chapter 4

Regional Goals and Strategies

Regional Goals and Strategies

The BRTB has adopted nine broad regional goals with supporting implementation strategies. Together, these goals and strategies form the core principles and activities that will help the BRTB to guide transportation investments over the 2028-2050 time period.

Goals represent the guiding principles for the region's transportation system. These principles describe the system the region would like to achieve, given the will and the resources.

Definitions

- A **goal** is a broad aspiration or guiding principle for the region (such as “Improve system safety”).
- A **strategy** is an approach or policy to help the region implement a goal (such as “Eliminate hazardous or substandard conditions in high-crash locations and corridors (all modes) using best practices and proven countermeasures”).
- A **performance measure** is a specific metric the region can use to assess progress toward achieving a goal (such as “Decrease the number of highway fatalities”).
- A **performance target** is a specific level to be reached by a certain date (such as “Decrease the number of highway fatalities to 202 by 2030”).

Regional Implementation Strategies

This chapter presents detailed strategies the BRTB has adopted to support the broad regional goals. Strategies are approaches or policies to help the region implement goals and to make progress toward meeting performance targets.

How Were the Goals and Strategies Developed?

In 2020 and 2021, the BRTB reviewed and suggested updates to the goals and strategies in preparation for *Resilience 2050*. The nine broad regional goals from the previous LRTP were retained, with some additions and updates made to the strategies for each goal.

In developing regional transportation goals and strategies, the BRTB considered:

- Federal, state, regional and local requirements and policies, including the Infrastructure Investment and Jobs Act (the federal authorizing legislation) and its regulations (described in Chapter 1)
- Factors, trends and technologies that could affect how the region's transportation systems will perform over the next 25 years (discussed in Chapter 3)
- Comments and recommendations from BRTB advisory groups
- Input received in fall 2021 during the public comment period

The BRTB held a public comment period for the goals and strategies in fall 2021. People were able to review the goals and strategies and submit comments using an online survey or via email, twitter, voicemail and fax. The comment period also included presentations to BRTB subcommittees and a recorded presentation shared with interested parties online and via email. In total, the BRTB received 165+ comments from more than 30 participants. The BRTB's Technical Committee revised the goals and strategies based on public comment. The BRTB adopted the revised goals and strategies in November 2021.

The BRTB received **165+** comments while developing LRTP goals and strategies.

Regional Transportation Goals

Goals That Address the Basic Functions of Transportation

- **Improve Accessibility**
  Identify and support multimodal options and systems that promote equity, are resilient and sustainable and enable all individuals to reach their destinations safely and seamlessly.
- **Increase Mobility**
  Help people and freight to move reliably, equitably, efficiently and seamlessly.

Goals That Address the Conditions or Effects of Transportation

- **Improve System Safety**
  Reduce the number of crashes, injuries and fatalities experienced by all users of the transportation system toward meeting Zero Deaths Maryland.
- **Improve and Maintain the Existing Infrastructure**
  Improve the conditions of existing transportation facilities; systematically maintain and replace transportation assets as needed.
- **Implement Environmentally Responsible Transportation Solutions**
  Pass on to future generations the healthiest natural and human environment possible.
- **Improve System Security**
  Provide a secure traveling environment for everyone; improve the region's ability to respond to natural and human-caused disasters.
- **Promote Prosperity and Economic Opportunity**
  Support the vitality of communities and businesses, opportunities for workers and the movement of goods and services within and through the region.

Goals That Address the Transportation Decision-Making Process

- **Foster Participation and Cooperation Among All Stakeholders**
  Enable all interested and affected parties to participate and cooperate to find workable solutions.
- **Promote Informed Decision Making**
  Ensure that adopted transportation policies and performance measures guide the regional decision making process.

Goals help to shape the vision for the future.

GOAL

Improve Accessibility

Identify and support multimodal options and systems that promote equity, are resilient and sustainable and enable all individuals to reach their destinations safely and seamlessly.

Improve Accessibility

A. Increase transportation options and equity for all segments of the population, including minority and low-income communities and disabled, elderly and carless individuals.

B. Continue to improve conditions for pedestrians and transit riders to meet or exceed Americans with Disabilities Act requirements.

C. Leverage transportation funds in coordination with other funds to provide affordable options for accessing necessities or amenities (such as jobs, health care, child care, education).

D. Continue to invest in high quality, safe, sustainable and comfortable bicycle and pedestrian facilities, with an emphasis on facilities that are separate from vehicular traffic and link to activity centers and public transit.

E. Integrate strategies identified through the Coordinated Public Transit – Human Services Transportation Plan into regional planning and decision-making.

F. Improve system connectivity and continuity among all modes and across geographic boundaries, including institutional and private systems, and greater coordination of investments, service and fare integration across the region's public transit system.

G. Encourage the private sector to provide appropriate access on commercial properties for bicyclists, pedestrians, transit users and shared mobility users.

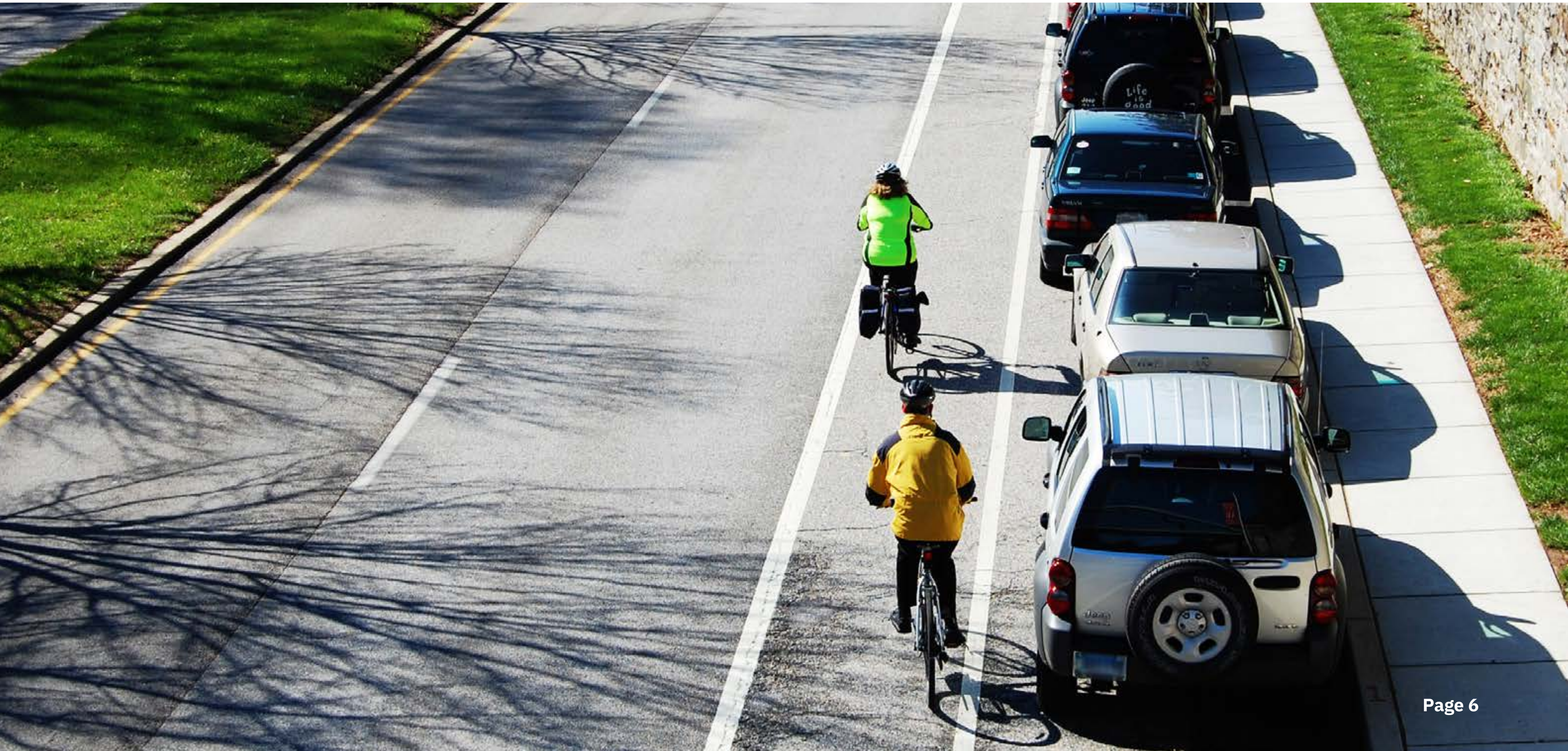
H. Support operating policies that enable year-round, obstacle-free access to pedestrian, bicycle and transit facilities.

I. Improve frequency, reliability and operating hours of existing transit services.

GOAL

Increase Mobility

Help people and freight to move reliably, equitably, efficiently and seamlessly.



Increase Mobility

A. Continue to coordinate with MDOT and local agencies to improve travel time reliability through performance-based planning and programming.

B. Continue to refine and implement a Congestion Management Process (CMP) that incorporates transportation systems management and operations strategies to optimize the performance of the existing transportation system and minimize impact and costs.

C. Analyze congestion causes and mitigation strategies for corridors and locations experiencing recurring high congestion levels.

D. Consider how all modes — roadway, transit, pedestrian, bicycle and shared mobility — can work together to address system capacity needs.

E. Support a regional multimodal freight network for safe and efficient freight movement.

F. Increase mobility, including traffic and transit incident response and recovery, through traffic and transit system management and operations techniques.

G. Reduce the effects of non-recurring incidents (such as crashes, weather-related delays and special events) by enhancing methods of sharing information across agencies and modes, responding to and managing these incidents and sharing information with travelers.

H. Develop and support a regional long-distance bikeway network, including consistent guide signage.

GOAL

Improve System Safety

Reduce the number of crashes, injuries and fatalities experienced by all users of the transportation system toward meeting Zero Deaths Maryland.

Improve System Safety

A. Continue to coordinate with MDOT and local agencies to improve roadway and transit safety through performance-based planning and programming.

B. Adopt relevant state and local plans that seek to reduce transportation-related injuries and fatalities.

C. Improve traveler safety in all modes through traffic and transit system management, communication systems, local governance and policies and operations techniques.

D. Eliminate hazardous or substandard conditions in high crash locations and corridors (all modes) using best practices and proven countermeasures.

E. Improve conditions to enable non-motorists to travel more safely on a day-to-day basis, including safe interactions with users of other modes and safe access to transit stations and stops.

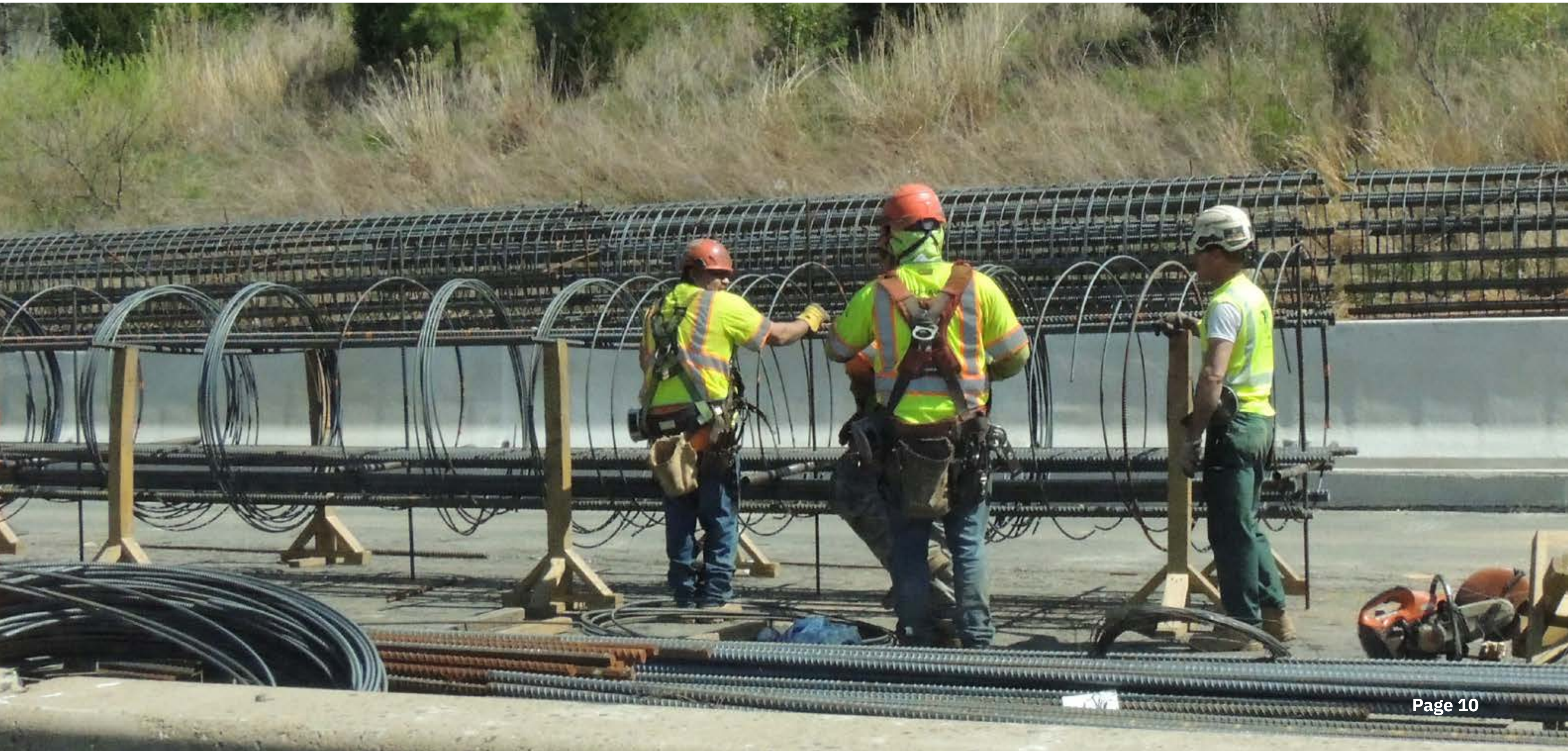
F. Support research into better understanding the causes of bicycle and pedestrian crashes and injuries to promote more effective countermeasures.

G. Educate all travelers of all modes on safe travel techniques using different outreach methods, such as media and educational campaigns.

GOAL

Improve and Maintain the Existing Infrastructure

Improve the conditions of existing transportation facilities; systematically maintain and replace transportation assets as needed.



Improve and Maintain the Existing Infrastructure

A. Continue to coordinate with MDOT and local agencies to preserve and maintain the condition of roadway and transit systems through performance-based planning and programming.

B. Maintain traffic signal and Intelligent Transportation System (ITS) systems on a timely, systematic basis.

C. Maintain and replace aging transit vehicles on a timely, systematic basis.

D. Research and invest in cost-effective measures that will reduce emissions and life-cycle costs of transit rolling stock and infrastructure elements.

E. Continue to improve the condition of existing transit infrastructure and stations/stops.

F. Increase emphasis on improving the condition of existing pedestrian and bicycle facilities.

G. Encourage local agencies to develop comprehensive asset management programs to monitor the conditions of transportation assets and repair/replace those assets on a timely, systematic, cost-effective basis.

GOAL

Implement Environmentally Responsible Transportation Solutions

Pass on to future generations the healthiest natural and human environment possible.

Implement Environmentally Responsible Transportation Solutions

A. Continue to coordinate with MDOT and local agencies to reduce excessive delay and increase the share of non-SOV (single-occupancy vehicle) travel through performance-based planning and programming.

B. Reduce transportation-related criteria air pollutant emissions to support improvements in human health and ensure that the region conforms to the applicable state air quality plan.

C. Reduce surface runoff and water pollution resulting from the transportation system.

D. Reduce energy use of the transportation system.

E. Reduce transportation-related greenhouse gas emissions in accordance with state and local plans.

F. Preserve and protect natural and cultural resources.

G. Incorporate resilience in transportation planning and maintenance and efforts to address current and anticipated climate change hazards.

H. Promote policies and programs that encourage the adoption of electric and alternative fuel vehicles, including the installation of the infrastructure required for electric and alternative fuel vehicles.

GOAL

Improve System Security

Provide a secure traveling environment for everyone; improve the region's ability to respond to natural and human-caused disasters.

Improve System Security

A. Continue to improve personal security of transit riders by incorporating tools and strategies throughout the transit system (such as closed-circuit TV, additional staff and other security-related features).

B. Continue to work with state and local agencies as well as other stakeholders to coordinate responses to large-scale incidents, including evacuation routes and procedures.

C. Continue to review evacuation routes and identify bottlenecks. Consider alternatives that would improve traffic movement through these points of limited capacity in emergency situations (such as improving traffic operations, identifying alternate routes and modes, expanding existing roadways).

D. Improve the capabilities of jurisdictions to respond to and recover from emergencies, including security threats and natural disasters, through traffic and transit system management and operations approaches.

E. Identify policies and procedures for communication, resource sharing and cooperative response to emergencies among transportation and non-transportation response agencies.

F. Identify other sources of funding (state, federal, private) that could be used to implement regional security priorities.

G. Incorporate options for multimodal mobility and strategies for system management in the transportation network to facilitate expanding capacity for the movement of people during emergencies.

H. Plan for the predicted impacts of climate change (such as rising sea level, higher storm surge, hotter temperatures) on the transportation system.

GOAL

Promote Prosperity and Economic Opportunity

Support the vitality of communities and businesses, opportunities for workers and the movement of goods and services within and through the region.

Promote Prosperity and Economic Opportunity

A. Emphasize the coordination of land use decisions, transportation planning, housing availability and employment opportunities, including consideration of the connections between land use decisions and the costs of transportation.

B. Consider affordable housing and workforce/economic development planning when determining long-range priorities.

C. Concentrate transportation investments within locally- and state-designated growth areas to enable prosperity in existing communities and the optimal use of prior public investments, including transportation investments.

D. Invest in transportation infrastructure (all modes) that improves access to regional generators of economic activity (such as activity centers and freight corridors) with an emphasis on improving access through active transportation and high quality transit.

E. Coordinate with communities to provide context-sensitive infrastructure and facilities that integrate with community assets, needs and preferences.

F. Consider the harms and inequities associated with prior transportation investments and seek to ensure that future transportation investments promote equitable access to opportunity for workers and communities underserved by existing transportation systems — low-income and minority households — as well as disabled, elderly, Limited English Proficiency and carless individuals.

G. Invest in upgrading transportation assets and facilities that promote tourism and the movement of tourists within and through the region.

GOAL

Foster Participation and Cooperation among All Stakeholders

Enable all interested and affected parties to participate and cooperate to find workable solutions.

Foster Participation and Cooperation among All Stakeholders

A. Coordinate transportation planning across all modes, across geographic boundaries and among all stakeholders.

B. Provide adequate and timely notice for key decisions and planning efforts through traditional means as well as social media options. Engage with and encourage input early and often from interested parties with a diverse stake in the performance of the region's transportation system.

C. Increase coordination, communication and engagement with underserved communities. Hold public outreach events at accessible venues within affected communities.

D. Prioritize environmental justice through programs and policies to ensure that the benefits and burdens of transportation projects are shared equitably. This includes considering the needs of and actively engaging with those traditionally underserved by existing transportation systems — low-income and minority households — as well as disabled, elderly, Limited English Proficiency and carless individuals.

E. Engage with state and local agencies, businesses, developers and communities to identify and build support for new approaches and public/private partnerships for funding improvements to the transportation system.

F. Work with planners and engineers in all jurisdictions to develop common policies and design strategies for transportation facilities, including Complete Streets policies, equity analyses, public engagement strategies and design templates.

G. Improve upon the planning process through periodic evaluations. Utilize performance metrics and solicit stakeholder feedback to foster continuous improvements.

GOAL

Promote Informed Decision Making

Ensure that adopted transportation policies and performance measures guide the regional decision making process.

Promote Informed Decision Making

A. Analyze, compare and share data on system conditions, system performance and the effects of transportation investments relative to established performance measures and targets for use in transportation planning and decision-making.

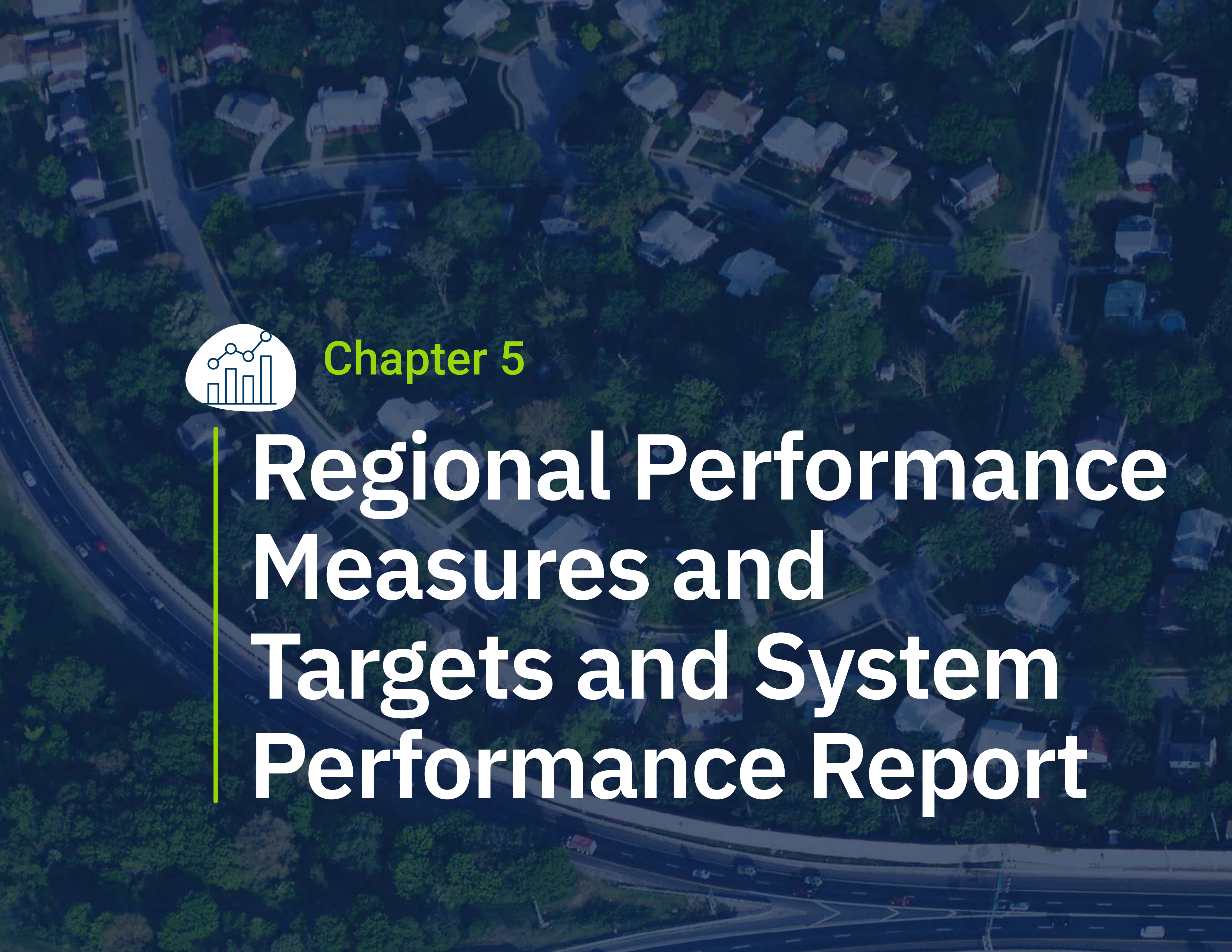
B. Develop regional assessments of demographic, travel, land use, environmental, fiscal and technology trends for use in all plans, programs and projects.

C. Increase the public's and elected officials' understanding of the trade-offs involved in transportation alternatives.

D. Consider the potential effects of and promote, where appropriate, emerging technologies (such as increasing vehicle/infrastructure connectivity) and alternative options to SOV travel (such as ride hailing services, micro-transit services, ridesharing, active transportation and telework). This includes considering and analyzing the uncertain impacts of these technologies on traveler safety, roadway congestion, equity and land use when planning for new and improved transportation facilities.

E. Improve information systems that all travelers can use to reach destinations easily and safely.

F. Pursue a comprehensive approach to advancing equity for all, including people of color and others who have been historically underserved, marginalized and adversely affected by persistent poverty and inequality.



Chapter 5

Regional Performance Measures and Targets and System Performance Report

Introduction

As part of the long-range transportation planning effort for *Resilience 2050*, we have adopted a series of performance measures and targets. Performance targets cover several broad categories related to how well the transportation system is functioning. These categories include the condition of transit assets, transit safety, highway safety, traffic congestion, on-road mobile source emissions, roadway and bridge conditions and the reliability of travel times for vehicles and trucks. These measures and targets will help the BRTB to gauge the effectiveness of transportation investments over the 2028-2050 period.

Adoption of specific performance measures and targets to be tracked falls under federal guidance for performance based planning and programming (PBPP). PBPP provides a link between long-range transportation decisions and associated investment decisions that affect the performance of the region's transportation system. Connecting performance measures to goals and objectives through target setting provides a basis for understanding and sharing information with stakeholders and the public.

As noted in Chapter 4, in developing goals, strategies, measures and targets, we considered:

- Federal, state, regional and local requirements and policies, including the Infrastructure Investment and Jobs Act (IIJA), the federal authorizing legislation, and its regulations (described in Chapter 1),
- Factors, trends and technologies that could affect how the region's transportation systems will perform over the next 25 years (discussed in Chapter 3) and
- Comments and recommendations from the public and advisory groups.

Definitions

- A **goal** is a broad aspiration or guiding principle for the region (such as "Improve system safety").
- A **strategy** is an approach or policy to help the region implement a goal (such as "Eliminate hazardous or substandard conditions in high-crash locations and corridors (all modes) using best practices and proven countermeasures").
- A **performance measure** is a specific metric the region can use to assess progress toward achieving a goal (such as "Decrease the number of highway fatalities").
- A **performance target** is a specific level to be reached by a certain date (such as "Decrease the number of highway fatalities to 202 by 2030").

Performance Based Planning and Programming (PBPP) and Federal Legislation

Federal legislation has increasingly emphasized PBPP. Federal surface transportation legislation adopted in 2012 known as the Moving Ahead for Progress in the 21st Century (MAP-21) Act required MPOs to incorporate a more comprehensive performance-based approach to decision-making. The Fixing America's Surface Transportation (FAST) Act of 2015 and Infrastructure Investment and Jobs Act (IIJA) of 2021 continued this emphasis on PBPP. Once legislation is adopted, federal agencies release specific rules that help to enact the legislation through a process known as federal rulemaking. This process often takes several years or longer.

Federal rulemaking released in 2016 specifies 25 performance measures and targets that MPOs must adopt. The rules also require us to coordinate target selection with the Maryland Department of Transportation (MDOT) and public transportation providers to ensure consistency. These rules were released while the previous LRTP, *Maximize2045*, was in development. All targets aside from those for transit safety were considered and adopted prior to the adoption of *Maximize2045* in July 2019. As a result, *Maximize2045* was our first LRTP to include the same set of performance measures and targets summarized in this chapter.

We must also track progress towards the achievement of targets in order to gauge the effectiveness of regional transportation investments over time. When *Maximize2045* was adopted in 2019, we had only just adopted most of the targets, and thus did not have a time-series of data for comparison. Now that several of the targets have been in place for a few years, there is baseline data for several of them. This allows us to begin to track the region's progress towards achievement of the targets.

Resilience 2050 is the first LRTP to report on the Baltimore region's progress in meeting some of the adopted performance targets. We report this data when available. We will continue to track the region's performance relative to the targets detailed in this chapter and share updated data when available. This will help members to identify areas of success as well as areas that may merit additional investment to improve performance.

The following sections summarize each of the 25 performance measures and targets as well as regional progress thus far towards meeting the targets.

> Federal rulemaking specifies 25 performance measures and targets that MPOs must adopt.

Performance Measures Tracked*

Condition of Transit Assets

1. Condition of vehicles used for revenue service
2. Condition of vehicles used for non-revenue service
3. Condition of transit facilities
4. Condition of transit infrastructure (rail fixed-guideway, track, signals, systems)

Transit Safety

5. Number of reportable fatalities and rate per total vehicle revenue miles
6. Number of reportable injuries and rate per total vehicle revenue miles
7. Number of reportable safety events and rate per total vehicle revenue miles
8. Mean distance between major mechanical failures

Highway Safety

9. Number of fatalities
10. Rate of fatalities per 100 million vehicle miles traveled (VMT)
11. Number of serious injuries
12. Rate of serious injuries per 100 million VMT
13. Number of non-motorist fatalities and serious injuries

Traffic Congestion

14. Annual hours of peak-hour excessive delay (PHED) per capita
15. Share of non-SOV (single-occupancy vehicle) travel

On-road Emissions Reduction

16. Total emissions reduction for each criteria pollutant for which the area is designated nonattainment or maintenance [*Note: parts of the Baltimore region are not in attainment with respect to ozone*]

Pavement Condition

17. Share of pavement on the interstate system in good condition
18. Share of pavement on the interstate system in poor condition
19. Share of pavement on the National Highway System (NHS) (excluding the interstate system) in good condition
20. Share of pavement on the NHS (excluding the interstate system) in poor condition

Bridge Condition

21. Share of NHS bridges by deck area classified as in good condition
22. Share of NHS bridges by deck area classified as in poor condition

Travel Time Reliability

23. Share of person-miles traveled on the interstate system that are reliable
24. Share of person-miles traveled on the non-Interstate NHS that are reliable
25. Share of interstate system mileage providing for reliable truck travel times

** Performance measures simplified here. See full text in this chapter for method and details.*

Regional Performance Measures and Targets and System Performance Report

The following sections provide details and definitions associated with each performance measure by category. Each section also includes details on the condition and performance of the region's transportation system assets as well as specific targets we can use to assess performance relative to programmed and potential improvements.

For all of the performance measure areas, the state DOT (that is, MDOT) must develop a series of performance targets. The MPO (that is, the BRTB) then must either adopt the state targets or develop its own regional targets.

All of the state and regional measures and targets will be used to guide MDOT and the BRTB in carrying out the requirements of the applicable Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) laws and regulations and in assessing the performance of the state's and region's transportation systems.

For all of the performance measures, the state DOT must develop a series of performance targets. The MPO must either adopt the state targets or develop its own regional targets.

Transit Asset Management

Public transit supports residents, businesses and communities by helping to provide connections to jobs, education, family and friends, recreation, healthcare and other services. In order to do so efficiently, transit agencies must maintain their transit assets in a state of good repair. Transit Asset Management (TAM) pertains to the condition of all transit assets, including vehicles, facilities and infrastructure. In 2016, the U.S. Department of Transportation estimated that 21 percent of buses and 10 percent of rail transit assets were in marginal or poor condition, with a backlog of $105.1 billion in deferred maintenance and replacement.

The FTA defines two categories of public transit providers. Tier I providers include providers with 101 or more vehicles in revenue service during peak regular service or operators of rail fixed-guideway public transportation systems. Tier II providers include providers that do not operate rail fixed-guideway public transportation systems and have 100 or fewer vehicles in service during peak regular service.

MDOT MTA is a Tier I agency and Maryland's direct recipient of federal transit funds, while all Locally Operated Transit Systems (LOTS) in the Baltimore region are Tier II agencies. Since the LOTS are sub-recipients of federal funds, MDOT MTA oversees the LOTS annual asset management requirements.

Tier I providers must develop and carry out an annual TAM plan, while Tier II providers may participate in a group TAM plan. Tier II providers in the Baltimore region participate in a group plan. The plan includes an asset management performance review and sets new targets to monitor and manage public transportation assets to improve safety and increase reliability and performance.

As an MPO, we must adopt new targets on a four-year cycle when updating the long-range transportation plan. Thus, we adopted new targets in 2023 to coincide with the development of *Resilience 2050*. We adopted the statewide Tier I targets and elected to adopt regional Tier II targets rather

Table 1 - MDOT MTA Tier I Revenue Vehicle Performance and Targets

Mode	Asset Class	2022 Performance	2023 Target
Bus	Articulated Bus	0%	18.5%
Bus	Bus	11.5%	3.1%
Bus	Over-the-road Bus	22.2%	22.2%
Light Rail	Light Rail Vehicle	0%	0%
Metro	Heavy Rail Passenger Car	100%	100%
MARC	Commuter Rail Locomotive	0%	0%
MARC	Commuter Rail Passenger Coach	14.7%	14.7%
Mobility	Automobile	100%	100%
Mobility	Cutaway Bus	45.9%	39.2%
Mobility	Minivan	0%	0%
Mobility	Sports Utility Vehicle	0%	0%

Table 2 - Baltimore Region Tier II Revenue Vehicle Performance and Targets

Asset Class	Current Asset Count	2022 Performance	2023 Target
Articulated Bus	0	0%	0%
Automobile	14	57.1%	58%
Bus	106	23%	23%
Cutaway	156	40.8%	41%
Ferryboat	4	100%	100%
Minivan	7	25%	25%
Sports Utility Vehicle	0	0%	0%
Trolleybus	1	100%	100%
Van	9	0%	0%

Table 3 - MDOT MTA Tier I Non-Revenue Vehicle Performance and Targets

Asset Class	2022 Performance	2023 Target
Automobiles	26.9%	24%
Trucks and other Rubber Tire Vehicles	14.6%	16.1%
Steel Wheel Vehicles	75%	75%

Table 4 - Baltimore Region Tier II Non-Revenue Vehicle Performance and Targets

Asset Class	Current Asset Count	2022 Performance	2023 Target
Automobiles	13	23.1%	24%
Trucks and other Rubber Tire Vehicles	13	30.8%	31%

than statewide targets. Asset classes covered by the four required TAM targets include revenue vehicles, non-revenue vehicles, facilities and infrastructure. FY 2022 baselines and FY 2023 TAM targets we adopted are as follows:

1. Percentage of revenue vehicles within an asset class that have either met or exceeded their Useful Life Benchmarks (ULBs). Tables 1 and 2 summarize these targets for Tier I and Tier II, respectively.
2. Percentage of non-revenue vehicles that have either met or exceeded their ULBs. Tables 3 and 4 summarize these targets for Tier I and Tier II, respectively.
3. Facilities: Percentage within an asset class rated below condition 3 on the FTA Transit Economic Requirements Model (TERM) scale. The TERM scale is used to develop values to determine FTA's transit state of good repair backlog. Table 5 summarizes the TERM scale

Table 5 - Transit Economic Requirements Model (TERM) Scale

Rating	Condition	Description
5	Excellent	No visible defects, new or near new condition, may still be under warranty
4	Good	Good condition, but no longer new, may have some slightly defective or deteriorated component(s), but is overall functional
3	Adequate	Moderately deteriorated or defective components but has not exceeded useful life
2	Marginal	Defective or deteriorated component(s) in need of replacement; exceeded useful life
1	Poor	Critically damaged component(s) or in need of immediate repair; well past useful life

Table 6 - MDOT MTA Tier I Facilities Performance and Targets

Asset Class	2022 Performance	2023 Target
Administrative / Maintenance Facilities	5.3%	5.3%
Passenger / Parking Facilities	1.7%	1.7%

Table 7 - Baltimore Region Tier II Facilities Performance and Targets

Asset Class	Total Number of Facilities	2022 Performance	2023 Target
Administrative / Maintenance Facilities	22	0%	0%*
Passenger / Parking Facilities	0	0%	0%*

** Regional targets were not independently calculated and are the same as the state targets of 0%.*

and Tables 6 and 7 summarize the facilities targets for Tier I and Tier II, respectively.

4. Infrastructure (rail fixed-guideway, track, signals, systems): percentage of track segments with performance restrictions. Table 8 summarizes the Tier I targets. Infrastructure targets do not apply to the Tier II LOTS.

Table 8 - MDOT MTA Tier I Infrastructure Performance and Targets

Mode	2022 Performance	2023 Target
MARC Commuter Rail	0%	0%
Metro Heavy Rail	1.4%	3.5%
Light Rail	8.3%	6.5%

Progress Toward Transit Asset Management Targets and *Resilience 2050*

Our Transportation Improvement Program (TIP) is a short-range program of planned federally funded transportation improvements over the next four years. As projects in the LRTP move from the conceptual stage to the implementation phase, they enter the TIP. The TIP details project funding by project phase, funding source and fiscal year.

The most recent TIP, the 2024-2027 TIP, includes thirteen projects related to the purchase, maintenance and rehabilitation of transit assets. MDOT MTA is the project sponsor for all TAM related projects except for the Parole Transportation Center, which is sponsored by Anne Arundel County.

The 2024-2027 TIP includes a total of $972 million in TAM related investments. Federal sources such as Congestion Mitigation and Air Quality (CMAQ) and FTA sections 5307, 5337, and 5339 account for $766.2 million of this total. Matching funds account for the remaining $205.9 million. This investment represents 22.9 percent of the $4.24 billion programmed in the 2024-2027 TIP.

The financial plan for *Resilience 2050* includes nearly $21 billion for system preservation from 2028-2050. Since *Resilience 2050* is a long-range planning document, specific details are not yet available for many system preservation projects. However, *Resilience 2050* does detail several large-scale system preservation investments that, if implemented, will help the region to achieve its TAM targets. These investments include (implementation timeframe; Year of Expenditure estimated cost):

- **Eastern Bus Division**: Reconstruct the Eastern Bus Division as an electric bus facility (2028-2039; $464 million),
- **Light Rail Fleet Mid-Life Overhaul:** Overhaul the entire Light Rail fleet (2028-2039; $210 million),
- **Light Rail Fleet Replacement with Low-Floor Vehicles:** Transition to low-floor Light Rail vehicles when replacement is needed (2040-2050; $757 million),
- **MARC Rolling Stock Overhauls and Replacements:** Short, medium, and long-term plans to replace and overhaul MARC locomotives and train sets (2040-2050; $570 million) and
- **Zero Emission Bus Transition:** Transition 50 percent of MDOT MTA's bus fleet to zero emission in Phase 1 (2028-2039; $1.594 billion) and 95 percent in Phase 2 (2040-2050; $2.228 billion)

Further details on system preservation revenues and these specific system preservation projects are available in Chapters 6 and 7, respectively.

Transit Safety

Investments in transit must also ensure that transit riders on all modes reach their destinations safely. FTA requires every transit operator that is a direct recipient or sub-recipient of FTA grant funds to develop and implement a Public Transportation Agency Safety Plan (PTASP). Issued in 2019, FTA’ s final rule to establish and implement Safety Management Systems includes four performance measures for state DOTs, MPOs, and LOTS to use under the PTASP and National Public Transportation Safety Plan.

The adopted performance measures include:

1. Fatalities: The total number of reportable fatalities and rate per total vehicle revenue miles (VRM) by mode
2. Injuries: The total number of reportable injuries and the rate per total VRM by mode
3. Safety Events: The total number of reportable events and the rate per total VRM by mode
4. System Reliability: The mean distance between major mechanical failures by mode

The thresholds for reportable fatalities, injuries and safety events are defined in the National Transit Database (NTD) Safety and Security Reporting Manual. Reportable major mechanical failures are defined in the NTD Glossary as “a

Table 9 - Transit Safety Performance Measures and Targets – MDOT MTA

Mode of Transit Service	Fatalities	Fatalities (per 1M VRM)	Injuries	Injuries (per 1M VRM)	Safety Events	Safety Events (per 1M VRM)	Miles between Major Mechanical Failures
Local Bus	2	0.1	141	7.1	57	2.9	6,000
Light Rail	1	0.3	16	5.5	19	6.6	900
Metro Subway	1	0.2	42	9.3	8	1.9	6,000
Mobility	0	0.0	77	4.3	33	1.9	15,000
Commuter Bus	0	0.0	0	0.0	0	0.0	25,000

failure of some mechanical element of the revenue vehicle that prevents the vehicle from completing a scheduled revenue trip or from starting the next scheduled revenue trip because actual movement is limited or because of safety concerns."

Operators are required to review their plans annually, and update as needed. An agency is required to submit updates to their MPO; the MPO then has 180 days to adopt the new targets. All statewide LOTS updated their plans and communicated those measures to us in January 2023. MDOT MTA updated its plan and communicated those measures to us in February 2023. We adopted the four required transit safety performance targets in March 2023.

Tables 9 and 10 summarize the required transit safety performance measures and targets for MDOT MTA and the regional LOTS.

Progress Toward Transit Safety Performance Targets and *Resilience 2050*

The 2024-2027 TIP includes nine projects related to the transit safety performance measures. MDOT MTA is the project sponsor for all of these projects aside from the Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Transit Priority Project (Baltimore City) and State Safety Oversight (MDOT Office of the Secretary). The 2024-2027 TIP includes a total of $576.6 million in transit safety related investments. Federal sources account for $452.8 million of this total. Matching funds account for the remaining $123.8 million. This investment represents 13.6 percent of the $4.24 billion programmed in the 2024-2027 TIP.

Table 10 - Transit Safety Performance Measures and Targets – LOTS

Locally Operated Transit System	Fatalities	Fatalities (per 100k VRM)	Injuries	Injuries (per 100k VRM)	Safety Events	Safety Events (per 100k VRM)	Miles between Major Mechanical Failures
Annapolis Transit Fixed Route Demand Response	0 0	0 0	0 0	0 0	3 0	0.17 0	Not Available Not Available
Anne Arundel OOT Fixed Route Demand Response	0 0	0 0	1 1	0 0	2 1	0 0	25,000 75,000
Baltimore County Fixed Route Demand Response / Paratransit	0 0	0 0	0 0	0 0	0 0	0 0	1st year of service 39,614
Carroll Transit Fixed Route Demand Response	0 0	0 0	1 1	0.10 0.20	3 5	1.34 1.30	>170,000 >330,000
Charm City Circulator Fixed Route	0	0	<3	<0.5	<1	<0.22	>5,000
Harford Link Fixed Route Demand Response	0 0	0 0	<5 <3	<0.55 <0.85	<15 <10	<1.67 <3.33	>43,142 >26,404
Queen Anne's County Fixed Route Demand Response	0 0	0 0	0 0	0 0	0 0	0 0	0 0
RTA of Central MD Fixed Route Demand Response	0 0	0 0	20 3	1.5 0.25	20 5	1.5 0.40	6,000 6,000

Resilience 2050 prioritizes projects anticipated to improve transit safety through the project scoring process. Transit projects submitted for inclusion in *Resilience 2050* are eligible for a maximum of 55 technical points. Ten of these points, or nearly 20 percent, are devoted to projects anticipated to improve transit safety and security. Transit safety includes two criteria, each eligible for a maximum of 5 points. Points are awarded as follows:

Transit safety (5 points): The first criterion focuses on transit safety in the context of reducing crashes as well as the fatalities and injuries resulting from them. Points are awarded based on the degree to which the project includes features that improve transit safety, such as:

- Rehabilitation of facilities, infrastructure and vehicles to improve safety, including improving safety where pedestrians cross transit tracks such as the light rail in downtown Baltimore,
- Adding features that make transit stations and stops more accessible to persons with disabilities and
- Helping pedestrians and bicyclists to access transit more safely with features including new or improved sidewalks or protected bicycle lanes.

Projects specifically designed to improve transit safety received a maximum of 5 points while projects not anticipated to improve safety received 0 points. Projects in the middle received 3 points. Projects anticipated to improve transit safety for low-income and minority populations received an additional point.

Transit security (5 points): The second transit safety criterion focuses on the personal security of transit riders. Points are awarded based on the degree to which the project is anticipated to include features such as the installation of security features at stations and on vehicles, lighting improvements, and other design improvements focused on crime prevention on transit. Projects specifically designed to improve the security of transit riders received the maximum of 5 points while projects not anticipated to impact security received 0 points. Projects in the middle received 3 points.

By encouraging projects that incorporate features improving transit safety and security, these scoring criteria are anticipated to help the region to achieve the adopted transit safety performance targets.

Highway Safety

Driving is critical for many. However, motor vehicle crashes are also a leading cause of death in the U.S. Crashes between vehicles have become more severe due to riskier behaviors exhibited by drivers. Safety experts commonly believed that more cars on the roadway was a contributor to the number and severity of crashes. However, during the pandemic, when fewer cars were on the road, drivers exhibited significantly higher speeds, higher rates of impairment and other risky behaviors such as not using a seatbelt. The unfortunate result was an increase in fatalities from 2019 to 2020. The number and rate of fatalities decreased from 2020 to 2021, but were still above 2019 levels.

The FHWA's final rule established five performance measures for state DOTs and MPOs to use to carry out the Highway Safety Improvement Program (HSIP). We coordinated with MDOT on a methodology using crash data to develop regional targets. The source for all fatality data is the most recently available National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System data. Serious injury data were obtained through the state's crash data system. Compliant with the final rule, the methodology uses 5-year rolling averages for each of the measures.

We adopted the five required highway safety targets in January 2023. The five performance measures include:

1. The number of fatalities,
2. The number of serious injuries,
3. The fatality rate per 100 million VMT,
4. The serious injury rate per 100 million VMT and
5. The number of non-motorized fatalities and serious injuries.

Table 11 - Highway Safety Performance Measures and Targets

Performance Measure	2005-2009 Baseline	2019 Actual	2020 Actual	2021 Actual	% Change 2020-2021	2019-2023 Target	2030 Goal
Number of Fatalities	244	208	248	227	8.5% ↓	212	202
Number of Serious Injuries	2,094	1,509	1,409	1,638	16.3% ↑	1,269	1,060
Fatality Rate per 100 Million VMT	0.94	0.75	1.06	0.87	17.9% ↓	0.79	0.73
Serious Injury Rate per 100 Million VMT	8.06	5.42	6.04	6.30	4.3% ↑	4.66	3.75
Number of Non-motorized Fatalities and Serious Injuries*	290	342	331	365	10.3% ↑	338	281

** Increasing trend in five-year rolling averages, so two percent annual reduction applied to 2030*

Table 11 summarizes the five required highway safety performance measures and targets. While we and MDOT adopt short-term yearly highway safety targets in accordance with regulatory guidance and recommendations from FHWA, we nonetheless maintain our long-term commitment to achieving zero deaths on the state's and the region's roadways. We utilized the state methodology for developing regional targets by using an exponential trend to estimate a value for the 2028-2032 five-year average (2030 target year).

The target for non-motorized fatalities and serious injuries is an exception. The five-year rolling averages for this category have unfortunately exhibited an increasing trend over the past several years. Determination of whether a category displays an increasing or decreasing trend is based on five-year rolling averages rather than data from individual years. The five-year rolling average for non-motorized fatalities and serious injuries increased from 259 over the 2012-2016 period to 351 over the 2017-2021 period. As a result, a larger two percent annual reduction was applied when calculating the 2030 goal for this category.

Progress Toward Highway Safety Performance Targets and *Resilience 2050*

The 2024-2027 TIP includes $98.7 million in federal HSIP funds along with $25.7 million in matching funds for a total of $124.4 million. This investment represents 2.9 percent of the $4.24 billion programmed in the 2024-2027 TIP. While the FHWA-required highway safety performance measures and targets are focused specifically on implementation of the HSIP, the 2024-2027 TIP includes many other projects identified by project sponsors as supporting our highway safety goals. Examples include the provision of bicycle and pedestrian facilities along roadways as well as other cost effective safety countermeasures (e.g. rumble strips, signal phasing, etc.). These projects are funded by a variety of federal sources, state funds and local funds.

In addition to TIP investments, we have led or participated in the development and completion of several major projects related to safety throughout the Baltimore region in recent years. Most notably among these are the development and implementation of local Strategic Highway Safety Plans (SHSP), the adoption of Complete Streets policies and the staffing of pedestrian/bicycle coordinators in local Departments of Transportation or Public Works.

In addition, we recently updated a Congestion Management Process, encouraging traffic incident management training for all first responders through the Traffic Incident Management for the Baltimore Region committee, and promoting use of the MDOT SHA Transportation Systems Management and Operations (TSMO) Strategic Deployment Plan to ensure that safety is considered for all roadway projects. We are also supporting non-motorist safety projects including the *Look Alive* regional pedestrian and bicycle safety campaign and the promotion of Bike to Work Week, which helps to raise awareness of the rules of the road for drivers, pedestrians and cyclists and highlights the need for continued expansion of safe sidewalks, bike lanes and safe crossings.

Resilience 2050 demonstrates the high priority placed on safety through the project scoring methodology. Roadway projects submitted for inclusion in *Resilience 2050* are eligible for a maximum of 50 technical points. Safety accounts for 10 out of 50, or 20 percent, of those technical points. In prior LRTPs, safety received 5 out of 50, or 10 percent, of the technical points. We approved doubling the technical points for safety in *Resilience 2050* to reflect its importance as a regional goal.

The *Resilience 2050* project scoring criteria emphasize the inclusion of countermeasures addressing non-motorist safety, speeding and impaired or distracted driving.

The technical scoring criteria for safety focus on the top safety issues in the region as identified by the local SHSPs. Specifically, it emphasizes the inclusion of countermeasures addressing non-motorist safety, speeding and impaired or distracted driving. Projects are eligible for a maximum of 10 highway safety points:

- **SHSP Emphasis Areas (2 points):** Projects received two points for identifying the specific SHSP emphasis areas that the project is anticipated to address.
- **Safety Countermeasures (6 points):** The issues below are consistently among the top safety issues in Maryland and the Baltimore region. Projects received points for identifying countermeasures addressing the following emphasis areas (6 points maximum; not additive across emphasis areas):
    - Non-motorist safety: Projects anticipated to improve the safety of non-motorists such as bicyclists, pedestrians and wheelchair users received the maximum of 6 points.
    - Speeding: Projects anticipated to reduce excessive travel speeds to promote safer driving received 4 points.
    - Impaired or Distracted Driving: Projects anticipated to reduce the likelihood that a driver will leave their lane or the roadway received 2 points.
- **EJ Areas (2 points):** Projects anticipated to improve safety for low-income and minority populations received an additional 2 points.

CMAQ Traffic Congestion

Because the Baltimore region is not currently meeting federal air quality standards for ozone, we must show that the emissions resulting from transportation plans and programs are within emissions limits set by the State of Maryland's Baltimore Region Ozone State Implementation Plan (SIP). Projects in every transportation plan for the region, including *Resilience 2050*, are analyzed with regard to their air quality impacts. This process is called "transportation conformity", or just "conformity."

There are a number of air quality standards that MPOs must demonstrate conformity for including 8-hour ozone, carbon monoxide, small particulate matter and nitrogen dioxide. The Baltimore region is classified as a nonattainment area for the 8-hour ozone standard only. As such, the region must work to ensure it maintains conformity with the Baltimore Region SIP. The CMAQ program provides funding for transportation programs and projects that reduce air pollution and mitigate congestion in the transportation system in nonattainment areas.

The FHWA's final rule established three performance measures for state DOTs and MPOs to use to report on traffic congestion to carry out the CMAQ program. This final rule requires state DOTs and MPOs to coordinate and report on a single unified set of performance targets for each of the measures for the urbanized area. The three performance measures are:

1. Annual hours of peak-hour excessive delay (PHED): This measure represents the annual hours of PHED that occur within an urbanized area on the National Highway System (NHS). The threshold for excessive delay is based on the travel time at 20 miles per hour or 60 percent of the posted speed limit travel time, whichever is greater, and is measured in 15-minute intervals. Peak travel hours are defined as 6:00-10:00 a.m. local time on weekday mornings and 3:00-7:00 p.m. or 4:00-8:00 p.m. local time on weekday afternoons, providing flexibility to state DOTs and MPOs. MDOT calculated the PHED values by comparing travel times and posted speed limit data within a transportation analysis platform known as the Regional Integrated Transportation Information System (RITIS).
2. Percentage of non-single-occupancy (non-SOV) travel: This measure is the percentage of non-SOV vehicles traveling within an urbanized area, calculated using American Community Survey (ACS) commuting (journey to work) data from the U.S. Census Bureau.
3. On-road mobile source emissions reduction: This measure tracks the total emissions reduction attributed to projects funded through the CMAQ program. Total emission reduction is calculated by summing two- and four-year totals of emissions reduction of an applicable criteria pollutant and precursor, in kilograms per day, for all projects funded with CMAQ funds. The applicable

pollutants for 8-hour ozone are Volatile Organic Compounds (VOCs) and nitrogen oxides (NOx).

The PHED and non-SOV travel performance measures include the Baltimore and Aberdeen Urbanized Areas, shown in Map 1. The area for the on-road mobile source emissions reduction measure is the MPO planning area.

The following sections summarize performance thus far and updated performance targets for the PHED, non-SOV, and on-road mobile source emissions reduction measures. The updated targets were adopted in August 2022.

Annual Hours of Peak-Hour Excessive Delay

Table 12 summarizes information on annual per capita PHED, including the the previous two- and four-year performance targets for federal fiscal year (FFY) 2018-2021, the actual regional performance for FFY 2018-2021, and the updated performance targets for FFY 2022-2025. The previous FFY 2018-2021 targets were only developed for the Baltimore Urbanized Area while the updated FFY 2022-2025 performance targets were developed for both the Baltimore and Aberdeen Urbanized Areas. The targets are identical to the MDOT target for the metropolitan area. A two-year target for PHED was not required, but is included in the table.

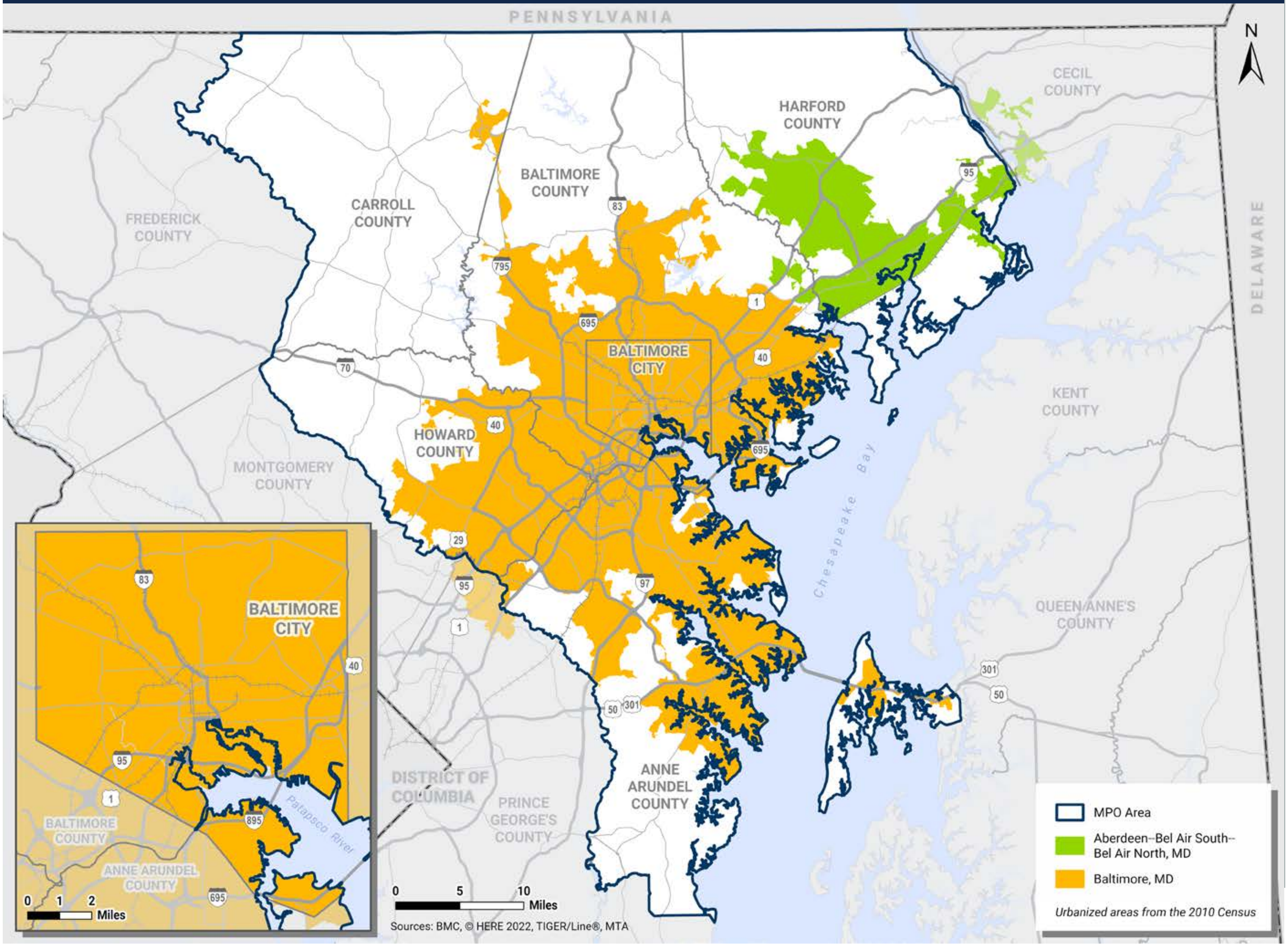
PHED in the Baltimore Urbanized Area remains below the 2019 target of 21.8 hours and was also below the 2021 target of 22.6 hours. This data shows that the region has been successful in controlling the increase in traffic delay.

The last two columns in Table 12 summarize the updated regional targets for PHED. The targets were developed by using the existing PHED, calculated through the RITIS tool, and then projecting future delay. The year 2020 was omitted from these calculations to account for atypical transportation patterns due to the COVID-19 pandemic. In developing the targets, we assumed that pre-pandemic trends will continue from the current performance level. For Baltimore, increasing

Table 12 - Annual Per Capita Hours of Peak-Hour Excessive Delay in the Baltimore and Aberdeen Urbanized Areas

Urbanized Area	Previous Regional Performance Targets		Actual Regional Performance					Updated Regional Performance Targets	
	2018-2019 2-year Target	2018-2021 4-year Target	Baseline (Year)	2018	2019	2020	2021	2022-2023 2-year Target	2022-2025 4-year Target
Baltimore	<21.8 hours	<22.6 hours	19.7 hours (2017)	21.5	20.6	8.4	13.9	<14.8 hours	<15.7 hours
Aberdeen	NA	NA	9.6 hours (2017)	9.4	7.8	NA	NA	<6.9 hours	<6.9 hours

Map 1 - Baltimore and Bel Air-Aberdeen Urbanized Areas



targets reflect the assumption that delay will likely increase into the near future, despite work we are planning to address it. For Aberdeen, the two- and four-year targets were kept the same to account for the downward trend prior to the pandemic but also to account for post-pandemic rebound.

Percentage of Non-Single-Occupancy Travel

Table 13 summarizes information on the percentage of non-SOV travel, including the previous two- and four-year performance targets for FFY 2018-2021, the actual regional performance for FFY 2018-2021, and the updated performance targets for FFY 2022-2025. The previous FFY 2018-2021 targets were only developed for the Baltimore Urbanized Area while the updated FFY 2022-2025 performance targets were developed for both the Baltimore and Aberdeen Urbanized Areas. The targets are identical to the MDOT target for the metropolitan area.

The previous two- and four-year targets for the Baltimore Urbanized Area were set at 24.8 percent. We would like to increase the share of non-SOV travel, so the goal is to exceed the non-SOV target of 24.8 percent. Since 2016, non-SOV travel performance remained relatively constant outside of effects from the COVID-19 pandemic. Performance in 2018, 2019 and 2020 exceeded the two- and four-year targets.

The last two columns in Table 13 summarize the updated regional targets for non-SOV travel. The targets were developed by using the existing non-SOV travel, calculated utilizing ACS five-year data, and forecasting trend lines for the second performance period. Performance data for 2020 was omitted to account for the atypical transportation patterns due to the COVID-19 pandemic. For the Baltimore Urbanized Area, two trend lines were forecast: (1) a long-term trend based on data ranging from 2010 to 2019 and (2) a near-term trend based on data ranging from 2015 to 2019. The average was then taken from the two- and four-year data points on these trend lines to develop the two- and four-year targets,

Table 13 - Percentage of non-SOV travel in the Baltimore and Aberdeen Urbanized Areas

Urbanized Area	Previous Regional Performance Targets		Actual Regional Performance					Updated Regional Performance Targets	
	2018-2019 2-year Target	2018-2021 4-year Target	Baseline (Year)	2018	2019	2020	2021	2022-2023 2-year Target	2022-2025 4-year Target
Baltimore	24.8%	24.8%	25.1% (2016)	25.2%	25.4%	27.1%	NA	25.3%	25.5%
Aberdeen	NA	NA	16.9% (2017)	16.7%	16.1%	NA	NA	16.8%	16.8%

Table 14 - On-Road Mobile Source Emissions Reduction

Pollutant	Previous Regional Performance Targets		Actual Regional Performance			Updated Regional Performance Targets	
	2018-2019 2-year Target	2018-2021 4-year Target	2014-2017 Baseline	2018-2019	2018-2021	2022-2023 2-year Target	2022-2025 4-year Target
Reduction of NOx (kg/day)	88.571	123.39	139.478	198.25	274.33	6.64	43.27
Reduction of VOC (kg/day)	6.589	7.874	12.825	118.38	126.39	0.87	13.63

respectively. This was done because the near-term and long-term trends produced varying forecasts. For the four-year target, this average was adjusted to be 0.2 percent higher to reflect long-term regional goals to increase the share of non-SOV travel. For the Aberdeen Urbanized Area, the two- and four-year targets were derived from only a long-term trend based on data ranging from 2010 to 2019 because the same variance seen for Baltimore was not found for Aberdeen.

On-Road Mobile Source Emissions Reduction

The Baltimore region is in nonattainment for 8-hour ozone. The applicable pollutants for 8-hour ozone are Volatile Organic Compounds (VOCs) and nitrogen oxides (NOx). The BRTB has adopted two- and four-year targets for NOx and VOCs for FFY 2022-2025. Table 14 summarizes information for on-road mobile source emissions reduction targets, including the previous two- and four-year performance targets for FFY 2018-2021, the actual regional performance for FFY 2018-2021, and the updated performance targets for FFY 2022-2025. MDOT created the targets as part of its overall state emissions reduction target. We adopted the MDOT-developed targets for the Baltimore region.

Table 14 shows that projects implemented in the Baltimore region with CMAQ funding have been successful at reducing ozone-forming pollutant emissions in the past two years. As shown in Table 14, the funded projects have out-performed the two- and four-year reduction targets for NOx and VOC reductions.

The last two columns in Table 14 summarize the updated regional targets for on-road mobile source emission reductions. These targets were calculated using a combined approach of historic project selection and anticipated CMAQ projects programmed over the next four years during FFY 2022-2025. The targets were established using historic emissions reduction in the FFYs 2014-2017 and 2018-2021 performance periods. The targets omit outlier projects that will not be replicated and accounted for programs where utilization is depressed due to altered commute patterns and COVID rebound. The targets incorporate declines in average emission rates of light-duty vehicles over time due to the federal vehicle and fuel standards, as well as the fleet turnover of older vehicles. MDOT developed the appropriate calculations. We worked with MDOT and MDOT SHA staff throughout the process, and received information about the assumptions and methodology of calculation. Both the Maryland Air Quality Off-Network Estimator (MAQONE) model and the CMAQ online emission reduction calculator were used to assess the benefits of different projects.

Progress Toward CMAQ Traffic Congestion Performance Targets and *Resilience 2050*

There are numerous projects in the TIP intended to help the region to meet the two- and four-year targets for traffic congestion and on-road mobile source emission reductions. We report on these projects through the BRTB's federally required CMAQ Performance Plan, approved in August 2022. Projects funded through the CMAQ program anticipated to help the region to achieve these targets include battery electric bus charging infrastructure, battery electric bus procurement, ridesharing and Guaranteed Ride Home programming.

The 2024-2027 TIP includes $191.8 million in federal CMAQ funds along with $47.3 million in matching funds for a total of $239.1 million. This investment represents 5.6 percent of the $4.24 billion programmed in the 2024-2027 TIP. MDOT MTA accounts for nearly 92 percent of CMAQ funds programmed in the TIP, with MDOT SHA accounting for the remainder. MDOT MTA sponsored projects include two projects focused on the overhaul and replacement of bus, metro and light rail vehicles as well as funding for ridesharing in the Baltimore region. MDOT SHA sponsored projects include two areawide projects focused on congestion management and safety and spot improvements.

Resilience 2050 includes several technical scoring criteria related to improving traffic congestion and reducing mobile source emissions. These include criteria for complete streets, highway mobility, transit mobility and environmental conservation:

- **Complete Streets:** Highway and transit projects incorporating complete streets features are eligible for a maximum of 5 points. These projects include features ensuring the safety, security, comfort, access and convenience of all users of the street including pedestrians, bicyclists, transit riders and shared mobility users. In turn, these projects can encourage people to use modes other than driving alone, thus reducing congestion and emissions.
- **Highway Mobility:** Highway projects are eligible for a maximum of 10 points related to mobility. Mobility is calculated based on anticipated congestion levels for

passenger, commercial and truck vehicle hours of delay. Projects on more congested facilities receive more points.

- **Transit Mobility:** Transit projects are eligible for a maximum of 10 points related to mobility. Transit projects receive more points if they increase high quality transit options (defined as transit trips of 45 minutes or less), transit ridership (via walk and drive access to transit) and transit connectivity (defined as projects that most reduce the number of transfers required).
- **Environmental Conservation - Potential for Greenhouse Gas Emissions Reduction:** Highway and transit projects are evaluated for their potential for Greenhouse Gas (GHG) emissions reduction and are eligible for a maximum of 5 points. Projects receive more points if they include features such as new sidewalks, trails, bicycle lanes, new transit lines and increasing the fuel efficiency of vehicles. These features, in turn, can encourage people to bike, walk and use transit, thus reducing congestion and emissions.

The 2024-2027 TIP includes $191.8 million in federal CMAQ funds along with $47.3 million in matching funds for a total of **$239.1 million**.

Pavement and Bridge Condition

The FHWA's final rule established six performance measures for state DOTs and MPOs to use to assess the performance of the NHS under the National Highway Performance Program (NHPP). These include four measures of pavement condition and two measures of bridge condition. We coordinated with MDOT on a methodology for developing two- and four-year targets for the Baltimore region.

The required targets were adopted in March 2023. The six performance measures for these targets are:

1. Share of pavement on the interstate system in good condition,
2. Share of pavement on the interstate system in poor condition,
3. Share of pavement on the NHS (excluding the interstate system) in good condition,
4. Share of pavement on the NHS (excluding the interstate system) in poor condition,
5. Share of NHS bridges by deck area classified as in good condition and
6. Share of NHS bridges by deck area classified as in poor condition.

Pavement condition is based on a calculation using measures of international roughness index, cracking and rutting or faulting. Bridge condition is based on National Bridge Inventory condition ratings for the bridge deck, superstructure, substructure and culvert. Pavement sections and bridges are assigned a rating of good, fair or poor based on the worst score among the rated elements. For example, if the bridge deck is rated poor while the other elements are rated fair, the bridge condition will be rated poor.

The adopted pavement and bridge condition targets are based on projecting current conditions out to the target years, considering planned and programmed maintenance. The results of this target setting may be considered as a factor in redirecting funds in the future if deemed appropriate.

Table 15 summarizes the six required performance measures and targets for pavement and bridge condition.

Comparing the 2022 four-year targets to the 2022 baseline data in Table 15 shows mixed progress in achieving the 2022 four-year targets. The region fell short of the targets for the share of NHS Interstate pavement in good condition, the share of NHS non-Interstate pavement in good condition and the share of NHS bridges in good condition. The region also had a larger share of NHS non-Interstate pavement in poor condition as compared to the 2022 four-year target. However, the region did achieve a lower share of NHS Interstate pavement in poor condition and NHS bridges in poor condition when comparing the 2022 four-year targets and baseline data.

Table 15 - Pavement and Bridge Condition Performance Measures and Targets

Measure	Previous Performance Targets	Actual Regional Performance	Updated Regional Performance Targets	
	2022 4-Year Target	2022 Baseline*	2024 2-Year Target	2026 4-Year Target
Share of NHS Interstate Pavement in Good Condition	60.0%	52.3%	45.3%	42.5%
Share of NHS Interstate Pavement in Poor Condition	2.0%	1.2%	1.7%	1.7%
Share of NHS Non-Interstate Pavement in Good Condition	30.0%	23.6%	22.5%	21.7%
Share of NHS Non-Interstate Pavement in Poor Condition	8.0%	10.6%	13.7%	15.4%
Share of NHS Bridges in Good Condition	20.0%	18.2%	18.3%	18.6%
Share of NHS Bridges in Poor Condition	5.0%	4.8%	4.6%	4.1%

** 2022 Baseline for Pavement Condition uses 2021 data because 2022 data are not yet available*

Progress Toward Pavement and Bridge Condition Performance Targets and *Resilience 2050*

The financial plan for *Resilience 2050* includes nearly $21 billion for system preservation from 2028-2050. Since *Resilience 2050* is a long-range planning document, specific details are not yet available for many system preservation projects, including many that will improve the condition of

Bridge condition is based on National Bridge Inventory condition ratings for the bridge deck, superstructure, substructure and culvert.

pavement and bridges on the NHS. However, *Resilience 2050* does detail several large-scale system preservation investments related to pavement and bridge condition. Example projects include (implementation timeframe; Year of Expenditure estimated cost):

- **Keith Avenue / Broening Highway Improvements:** Upgrade roadway conditions, including ramp bridges on Keith Avenue and Colgate Creek (2028-2039; $84 million),
- **Russell Street Complete Streets Improvements:** Improve asset conditions and multimodal Complete Streets infrastructure for automobile traffic, pedestrians, bicyclists, transit and freight movement (2028-2039; $54 million) and

- **Vietnam Veterans Memorial Bridge and Hanover/Potee Street Corridor Improvements:** Rehabilitate or replace the Vietnam Veterans Memorial Bridge and improve multimodal Complete Streets infrastructure along Hanover/Potee streets (2028-2039; $339 million).

Resilience 2050 includes numerous other roadway projects that will likely include pavement and bridge reconstruction, though full details are not yet available for most of these long-term projects.

As projects in the LRTP move from the conceptual stage to the implementation phase, they enter the TIP. The 2024-2027 TIP includes numerous projects related to pavement condition on the Interstate and non-Interstate NHS. These projects program a total of $203.6 million, though only a small portion of the funds may be utilized to improve pavement condition due to varying project scopes. The TIP also includes $776.7 million in federal and state funds programmed by MDOT SHA for areawide expenditures on resurfacing and rehabilitation, safety and spot improvements and urban reconstruction. Some of this funding will be used to improve pavement condition, though specific project details are not available for most areawide expenditures. The 2024-2027 TIP also includes $373.3 million in programmed funds for bridge projects on the NHS.

Travel Time Reliability

Many drivers are used to congestion and can plan for this by either leaving earlier or avoiding travel during peak travel times. However, travel times can vary from what travelers expect. Travel time reliability measures the extent of this variability in travel times, with more variability indicating a less reliable trip. The FHWA's final rule established three performance measures for state DOTs and MPOs to use to assess the performance of the NHS under the NHPP. These include two measures related to Level of Travel Time Reliability (LOTTR) as well as a Truck Travel Time Reliability (TTTR) Index. We coordinated with MDOT on a methodology for developing two- and four-year targets for the Baltimore region.

We adopted the required targets in March 2023. The three performance measures are:

1. Share of person-miles traveled on the Interstate System that are reliable,
2. Share of person-miles traveled on the non-Interstate NHS that are reliable and
3. TTTR Index: Ratio of Interstate System mileage indicating reliable truck travel times.

LOTTR compares the time it takes to travel segments of the NHS in congested conditions (as shown by the 80th percentile time) relative to the time it takes to make a trip in "normal" conditions (as shown by the 50th percentile time). If the 80th percentile travel time divided by the 50th percentile travel time is less than 1.5, then travel time is considered to be reliable. As an example, traffic that takes 45 minutes to travel a segment that in normal conditions takes 30 minutes results in a ratio of 1.5. This measure uses data from FHWA's National Performance Management Research Data Set or equivalent. Data are collected in 15-minute segments during all time periods between 6:00 a.m. and 8:00 p.m. local time.

The TTTR index compares the time it takes trucks to travel segments of the NHS in congested conditions (as shown by the 95th percentile time) relative to the time it takes to make a trip in "normal" conditions (as shown by the 50th percentile time). The TTTR ratio is generated by dividing the 95th percentile time by the 50th percentile time for each segment. For example, say a truck takes 56 minutes to travel a segment of the NHS that normally takes 30 minutes. This translates into a ratio of 1.87 (56 minutes / 30 minutes).

For purposes of calculating the TTTR index, travel time is divided into five periods: morning peak (6:00–10:00 a.m.), midday (10:00 a.m.–4:00 p.m.) and afternoon peak (4:00–8:00 p.m.) Mondays through Fridays; weekends (6:00 a.m.–8:00 p.m.); and overnights for all days (8:00 p.m.–6:00 a.m.). The TTTR index is generated by multiplying each segment's largest ratio of the five periods by its length, then dividing the sum of all length-weighted segments by the total length of Interstate.

Table 16 summarizes the travel time reliability performance measures and targets.

Comparing previous targets with regional performance shows mixed results for travel time reliability. Ideally, the region would have a higher share of person-miles that are reliable and a lower TTTR Index as compared to the targets. For the 2018-2019 period, the region performed worse than the regional targets while the region performed better than the regional targets for the 2018-2021 period. However, it is important to note that regional performance for the 2018-2021 period was influenced by changing travel patterns associated with the COVID-19 pandemic.

Progress Toward Travel Time Reliability Performance Targets and *Resilience 2050*

The regional Congestion Management Process (CMP) is a vital tool for improving travel time reliability in the Baltimore region. A CMP is a systematic approach to address congestion in order to reduce its impacts on the movement of people and goods. A CMP provides the region with a process to:

- Identify the location, extent, duration and causes of recurring and non-recurring congestion,
- Evaluate the impacts of congestion,
- Identify strategies to reduce congestion and
- Evaluate implemented strategies.

Table 16 - Travel Time Reliability Performance Measures and Targets

Measure	Previous Performance Targets		Actual Regional Performance		Updated Regional Performance Targets	
	2018-2019 2-year Target	2018-2021 4-year Target	2018-2019	2018-2021	2023 2-Year Target	2025 4-Year Target
LOTTR (Interstate) Measure: Share of Person-miles Traveled on the Interstate System that are Reliable	72.1%	72.1%	71.6%	88.4%	72.9%	72.9%
LOTTR (Non-Interstate) measure: Share of Person-miles Traveled on the Non-Interstate NHS that are Reliable	NA*	81.7%	78.9%	91.3%	79.4%	79.4%
TTTR Index: Ratio of Interstate System Mileage Indicating Reliable Truck Travel Times	1.87	1.88	2.03	1.64	2.06	2.06

** For the first performance period only, FHWA does not require state DOTs and MPOs to set a 2-year target for the LOTTR non-Interstate measure.*

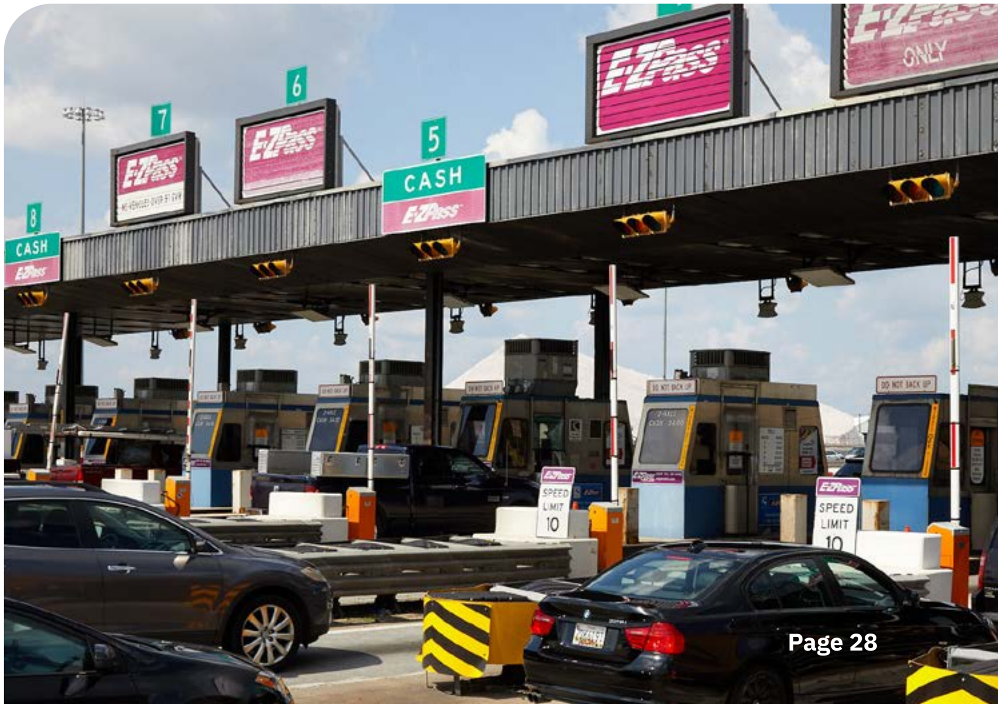
Federal law requires metropolitan areas with a population exceeding 200,000 (such as the Baltimore region) to develop a CMP. We work with transportation professionals and decision makers to implement the CMP.

In major metropolitan regions it is not possible, or even desired, to eliminate all traffic congestion. Some congestion is the result of vibrant social, business and community activity, so a region would likely not want to eliminate all congestion because doing so would likely adversely affect the region. The overall goal of the CMP, then, is to take a broad approach to reduce excessive recurring and non-recurring congestion, use existing system capacity as efficiently as possible, increase system reliability, and always seek to improve safety.

We do this through a variety of CMP projects and programs. The [CMP Analysis Tool] is an interactive map that visually displays transportation project data in addition to multiple performance metrics including travel time reliability and truck travel time reliability. This tool helps identify the top corridors for more in-depth analysis and serves as input into the project prioritization process. We also conduct before/after studies on specific projects to analyze the impacts of projects intended to improve travel time reliability.

The CMP includes a number of strategies that could be considered for implementation in the region to address identified congestion and reliability problems. These include:

- **Demand Management and Regional Strategies,** including:
  - Commuter-related programs (employer outreach, commuter benefits policies, etc.) and
  - Promoting regional coordination (intra-jurisdictional projects/strategies),
- **Transportation System Management and Operations (TSMO) Strategies,** including:
  - Intersection control (traffic signal coordination, ramp metering, etc.),
  - Real-time monitoring (active traffic management, real time parking info, traveler information systems, etc.) and
  - Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, etc.),



- **Public Transportation Strategies,** including:
  - Operational improvements (transit signal priority, optimizing transit service, etc.),
  - New infrastructure (bus rapid transit, network expansion, etc.) and
  - User-oriented improvements (trip-planner application, real-time data, etc.),
- **Bicycle/Pedestrian and Micromobility Strategies,** including:
  - Infrastructure addition (new bike lanes, streetscape elements, etc.),
  - Infrastructure improvements (traffic calming, etc.) and
  - Sharing programs (bikeshare programs, micromobility, etc.) and
- **Road Capacity Strategies,** including:
  - Roadway changes (new lanes, spot improvements, etc.),
  - Intersection changes (grade separated intersections, intersection improvements, etc.) and
  - Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.).

We track planned implementation of these CMP strategies for projects submitted for inclusion in *Resilience 2050*. Tracking planned implementation of these strategies provides a useful baseline for projects while they are in their early stages. Knowing the CMP strategies associated with LRTP projects will allow us to track and encourage implementation of these strategies over time as projects progress from the LRTP to the TIP.

Resilience 2050 includes 36 transit projects and 56 roadway projects, for a total of 92. Project sponsors identified the CMP strategies these projects are anticipated to include during the call for projects for the LRTP.

- **Demand Management Strategies:** 33 percent of all projects are anticipated to incorporate demand management strategies, including seven percent of roadway projects and 72 percent of transit projects,
- **Transportation System Management and Operations (TSMO) Strategies:** 50 percent of all projects are anticipated to incorporate TSMO strategies, including 41 percent of roadway projects and 64 percent of transit projects,
- **Public Transportation Strategies:** 46 percent of all projects are anticipated to incorporate public transportation strategies, including 13 percent of roadway projects and 97 percent of transit projects (the lone transit project which does not incorporate one of these CMP strategies focuses solely on overhauling light rail vehicles),
- **Bicycle/Pedestrian and Micromobility Strategies:** 68% of all projects are anticipated to incorporate bicycle/pedestrian and micromobility strategies, including 77% of roadway projects and 56% of transit projects and

- **Road Capacity Strategies:** 80% of all projects are anticipated to incorporate road capacity strategies, including 96% of roadway projects and 56% of transit projects.

We are also beginning to track these CMP strategies across TIP projects. While there are no federal funding sources tied directly to travel time reliability on Interstate and non-Interstate NHS facilities, the TIP does include a number of projects that have the potential to improve travel time reliability. These projects include traffic signals and Intelligent Transportation Systems (ITS) projects in Baltimore City, two projects involving part-time shoulder use and small-scale congestion management projects on state roadways.

Future Performance Monitoring

In cooperation with MDOT and its modal agencies, as well as its other state agency partners, we will continue to monitor the performance of the region's transportation systems throughout the life of this plan.

We will use the established targets to help in identifying strategies and in making investment decisions about programs and projects.

Chapter 6

Financial Plan

The core of *Resilience 2050* is a list of planned federally funded major capital expansion projects. *Resilience 2050* also includes large-scale system preservation projects. But how do we determine which projects are included in *Resilience 2050*? How do we determine how many projects can be included, and why can't all projects submitted be included?

In short, only some projects can be included because *Resilience 2050* is not a wish list. Federal law requires that plans must be financially constrained by the amount of revenue anticipated to be available to a region within the timeframe of the plan. This means that the anticipated costs of transportation projects and programs in *Resilience 2050* cannot exceed anticipated revenues.

Each metropolitan transportation plan must include a financial plan. This financial plan demonstrates consistency between (1) revenues reasonably expected to be available and (2) the estimated costs of implementing proposed transportation system improvements. This consistency is referred to as "fiscal constraint." To satisfy this requirement, we worked with the Maryland Department of Transportation (MDOT) and local members to forecast the amount of federal, state and local revenues the region anticipates will be available.

The anticipated costs of transportation projects and programs in ***Resilience 2050*** cannot exceed anticipated revenues.

The financial forecast extends from 2028 through 2050. The planning horizon for *Resilience 2050* begins immediately after the final year for the short-range Transportation Improvement Program (TIP). The TIP includes all projects anticipated to use federal funds over the next four fiscal years. We will consider the 2024-2027 TIP in conjunction with *Resilience 2050*. As a result, the planning horizon for *Resilience 2050* begins in 2028 and covers the 20+ years from 2028 through 2050.

The financial forecast includes anticipated revenues and costs associated with operating the transportation system and system preservation through 2050. The remaining funds will be available to fund expansion projects such as new or expanded transit service or roadway capacity. This chapter provides details on the financial forecast and the methodology used to produce it.

Definitions

The financial forecast covers three main categories of spending. These include expenditures for operating the transportation system, system preservation and expanding the transportation system. These definitions differ slightly for transit and roadway projects:

Operating

- **Roadways:** Covers the salaries and wages of personnel who maintain and operate roadway systems and vehicles.
- **Transit:** Covers routine maintenance, employee wages, spare parts and consumables. Note that while routine maintenance is considered a function of system operations, some maintenance activities may be paid for with federal capital funds.

System Preservation

- **Roadways:** Covers capital costs for routine asset management and maintenance activities. These activities include repaving roadways, repairing bridges, clearing snow and ice and maintaining roadside lighting, guardrails and signs.
- **Transit:** Covers planning, design, acquisition/construction and major asset rehabilitation activities necessary to keep the existing transit system in a state of good repair.

Expansion

- Examples include major new or expanded transit service and new or widened roadways.

State and Federal Forecast

MDOT forecast state and federal revenues anticipated to be available for the 23-year period from 2028-2050. MDOT begins by calculating total program revenues for operating and capital. Program expenditures rely on projecting historical state and federal revenues forward based on historical annual average growth rates. In the most recent forecast, 2028 to 2050 projections of state funds use an historical annual average growth rate of 5.0%. Federal fund projections are based on an average growth rate of 3.0% for roadway and 2.33% for transit program funds. Federal funding in the forecast comes from either the Federal Highway Administration or the Federal Transit Administration.

MDOT then calculates anticipated needs for operating and system preservation for the period extending from 2028 to 2050. Operating budget projections for 2022 to 2027 are drawn from the FY 2022-2027 financial plan of the Transportation Trust Fund (TTF). Projections for operating expenditures from 2028 to 2050 were derived by inflating the previous year with an estimate for the percentage change in the Consumer Price Index for All Urban Consumers (CPI-U) plus 2%. The CPI-U is a generally accepted measure of inflation. The projected annual change in index figure is based on information from two econometric forecasting firms. Two percent

is added to this index to account for the additional operating costs associated with new capital expansions.

System preservation budget projections for 2022 to 2027 were drawn from the final FY 2022-2027 MDOT Consolidated Transportation Program. Projections for system preservation expenditures from 2028 through 2050 assumed an annual average growth rate of 2.5%.

Expenditures for expansion were derived by subtracting both operating and system preservation expenditures from the total program expenditures for each year. In other words, the amount available for expansion is determined by what is left over from total revenues after accounting for anticipated needs for system operations and system preservation. Table 1 depicts anticipated statewide revenue forecasts for operating, system preservation and expansion from 2028 to 2050.

The statewide forecasts in Table 1 form the basis of forecasts for the Baltimore region. Table 2 details the calculation of the expansion revenue forecast for the

The Transportation Trust Fund (TTF) was created in 1971 to establish a dedicated fund to support the Maryland Department of Transportation. Revenue sources for the TTF include motor fuel taxes, vehicle excise (titling) taxes, motor vehicle fees (registrations, licenses and other fees), a portion of the State's tax on corporate income, a portion of the State's sales and use taxes on short-term vehicle rentals, operating revenues and bond proceeds.

Table 1 - MDOT Statewide Operating, System Preservation and Expansion Revenue Forecast: 2028-2050 (Millions of Dollars)

Year	Operating	System Preservation	Expansion	Statewide Total
2028	$2,734	$1,637	$701	$5,072
2029	$2,849	$1,715	$735	$5,299
2030	$2,968	$1,799	$771	$5,538
2031	$3,091	$1,890	$810	$5,791
2032	$3,217	$1,985	$851	$6,053
2033	$3,350	$2,084	$893	$6,327
2034	$3,488	$2,188	$938	$6,614
2035	$3,633	$2,297	$985	$6,915
2036	$3,787	$2,357	$1,087	$7,231
2037	$3,946	$2,416	$1,200	$7,562
2038	$4,112	$2,476	$1,320	$7,908
2039	$4,286	$2,538	$1,446	$8,270
2040	$4,467	$2,601	$1,581	$8,649
2041	$4,656	$2,666	$1,725	$9,047
2042	$4,853	$2,733	$1,877	$9,463
2043	$5,060	$2,801	$2,039	$9,900
2044	$5,275	$2,871	$2,212	$10,358
2045	$5,500	$2,943	$2,392	$10,835
2046	$5,735	$3,017	$2,585	$11,337
2047	$5,981	$3,092	$2,789	$11,862
2048	$6,238	$3,169	$3,006	$12,413
2049	$6,504	$3,249	$3,237	$12,990
2050	$6,783	$3,330	$3,483	$13,596
Total 2028 – 2050	**$102,513**	**$57,854**	**$38,663**	**$199,030**

Table 2 - Baltimore Region Expansion Revenue Forecast: 2028-2050 (Millions of Dollars)

Percent of Statewide Expansion Funds for Surface Expansion, 1981-2021: 84.9%

Percent of Statewide Surface Expansion Funds for the Baltimore region, 1981-2021: 36.1%

Year	Statewide Expansion Funds	Statewide Surface Percentage (84.9%)	Statewide Private Funds	Total Statewide Surface Expansion Funds	Baltimore Region Expansion Funds (36.1%)
2028	$701	$595	$24	$619	$224
2029	$735	$624	$24	$648	$234
2030	$771	$655	$24	$679	$245
2031	$810	$688	$25	$713	$257
2032	$851	$722	$25	$747	$270
2033	$893	$758	$25	$783	$283
2034	$938	$796	$25	$821	$297
2035	$985	$836	$25	$861	$311
2036	$1,087	$923	$25	$948	$342
2037	$1,200	$1,019	$25	$1,044	$377
2038	$1,320	$1,121	$25	$1,146	$414
2039	$1,446	$1,228	$25	$1,253	$452
2040	$1,581	$1,342	$25	$1,367	$494
2041	$1,725	$1,464	$25	$1,489	$538
2042	$1,877	$1,593	$25	$1,618	$585
2043	$2,039	$1,731	$25	$1,756	$634
2044	$2,212	$1,878	$25	$1,903	$687
2045	$2,392	$2,031	$25	$2,056	$742
2046	$2,585	$2,194	$25	$2,219	$802
2047	$2,789	$2,368	$25	$2,393	$864
2048	$3,006	$2,552	$25	$2,577	$931
2049	$3,237	$2,748	$25	$2,773	$1,002
2050	$3,483	$2,957	$25	$2,982	$1,077
Total 2028-2050	**$38,663**	**$32,823**	**$572**	**$33,395**	**$12,062**

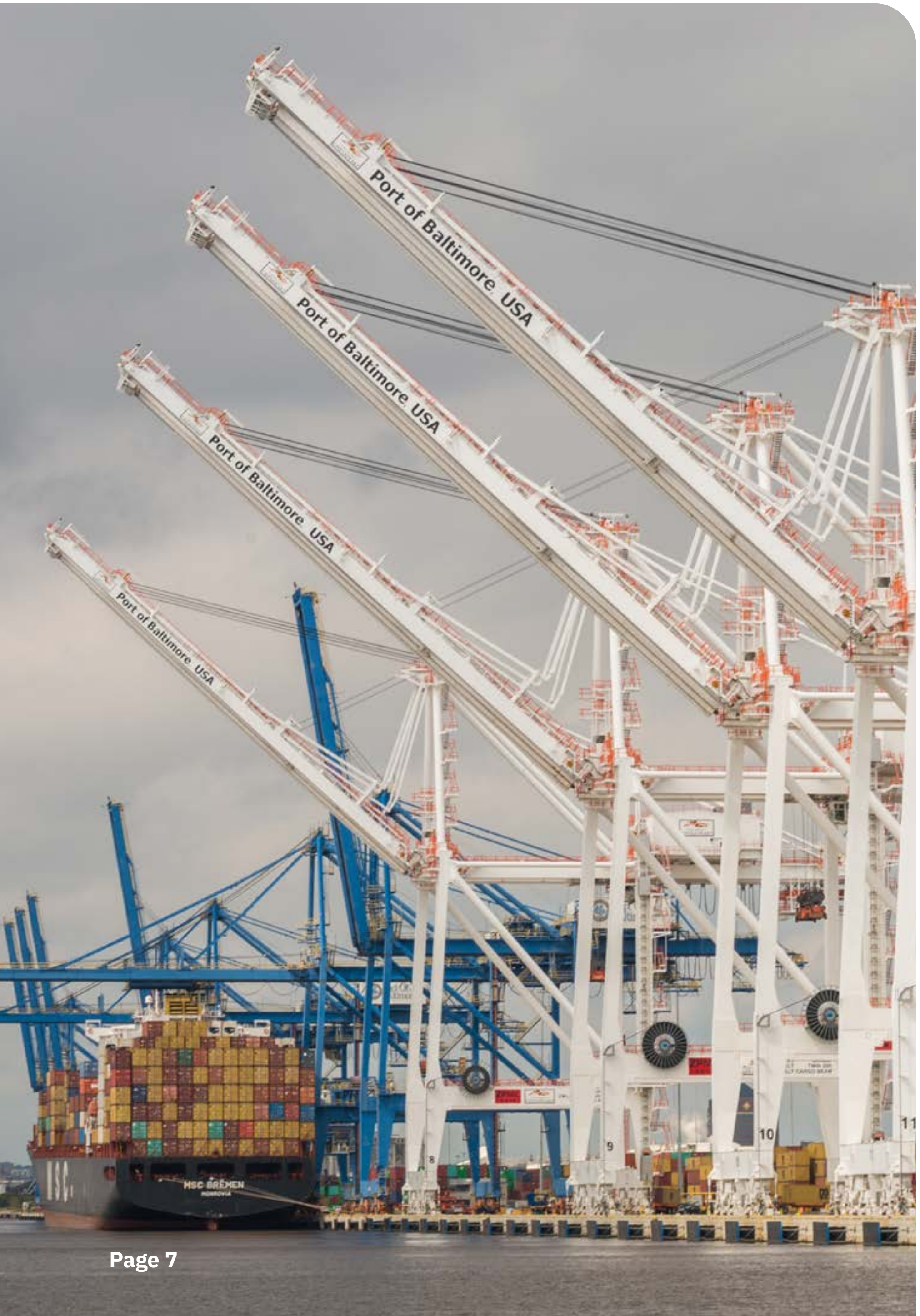
Baltimore region. Table 3 details the full state and federal financial forecast for operating, system preservation and expansion for the Baltimore region.

Table 2 contains details on the calculation of expansion funds for the Baltimore region. This calculation starts with statewide expansion funds, the second column of Table 2. Note that this column is identical to the expansion column of Table 1. MDOT spends expansion funds on both surface and non-surface transportation. Surface transportation includes roadway and transit expenditures, while non-surface includes expenditures on ports, aviation and the Motor Vehicle Administration. *Resilience 2050* includes roadway and transit projects, and thus is only concerned with the portion of funds dedicated to surface transportation.

MDOT analyzed historical expenditure data to produce an estimate of the percentage of Maryland expansion funds associated with surface transportation from 2028 to 2050. For this financial forecast, MDOT estimated that approximately 84.9% of statewide expansion funds from 1981 to 2021 were spent on surface expansion. In Table 2, this percentage was multiplied by statewide expansion funds

Table 3 - Baltimore Region State and Federal Operating, System Preservation and Expansion Revenue Forecast: 2028-2050 (Millions of Dollars)

Year	Operating	System Preservation	Expansion	Totals
2028	$987	$591	$224	$1,802
2029	$1,028	$619	$234	$1,881
2030	$1,071	$649	$245	$1,965
2031	$1,116	$682	$257	$2,055
2032	$1,161	$717	$270	$2,148
2033	$1,209	$752	$283	$2,244
2034	$1,259	$790	$297	$2,346
2035	$1,312	$829	$311	$2,452
2036	$1,367	$851	$342	$2,560
2037	$1,425	$872	$377	$2,674
2038	$1,484	$894	$414	$2,792
2039	$1,547	$916	$452	$2,915
2040	$1,613	$939	$494	$3,046
2041	$1,681	$962	$538	$3,181
2042	$1,752	$987	$585	$3,324
2043	$1,827	$1,011	$634	$3,472
2044	$1,904	$1,036	$687	$3,627
2045	$1,986	$1,062	$742	$3,790
2046	$2,070	$1,089	$802	$3,961
2047	$2,159	$1,116	$864	$4,139
2048	$2,252	$1,144	$931	$4,327
2049	$2,348	$1,173	$1,002	$4,523
2050	$2,449	$1,202	$1,077	$4,728
Total 2028-2050	**$37,007**	**$20,883**	**$12,062**	**$69,952**



(column 2) to reach the statewide surface percentage (column 3). Statewide private funds are listed in column 4. Private funds are generally from public-private partnerships, with funding spread out as opposed to picking one year that it would arrive. Private funds could also be from a private entity contributing to a project, such as Ports America Chesapeake contributing to a Maryland Port Administration project or a developer contributing to an adjacent roadway project. Statewide private funds were added to the statewide surface percentage to yield total statewide surface expansion funds (column 5). MDOT then used historical expenditure data to derive the Baltimore region's share of statewide expansion funds from 1981 to 2021 (36.1%). Baltimore region expansion funds (column 6) were calculated by multiplying total statewide surface expansion funds by 36.1%. This yields a total of $12.062 billion available for expansion projects in the Baltimore region from 2028 to 2050.

Table 3 adds the operating and system preservation components of the Baltimore region financial forecast. These are calculated by multiplying the statewide totals for operating and system preservation from Table 1 by 36.1%.

The financial forecast includes a total of $69.952 billion in state and federal revenue available for operating, system preservation and expansion in the Baltimore region from 2028 to 2050. Individual totals for operating, system preservation and expansion are $37.007 billion, $20.883 billion and

$12.062 billion, respectively. Figures 1 and 2 provide a comparison of the financial forecast for *Resilience 2050* to those for the three previous BRTB long-range transportation plans (LRTPs).

Figure 1 shows that anticipated revenues have increased from one LRTP to the next. However, it is important to note that each subsequent LRTP after 2011 included one additional year in its planning horizon. Funding within categories has also increased from one LRTP to the next. The lone exception is the decrease in expansion funding from the 2015 LRTP to the 2019 LRTP and *Resilience 2050*. There was also a large jump in system preservation funding from the 2019 LRTP to *Resilience 2050*.

Economic circumstances at the time of each forecast influence the amount available. In addition, part of the reason for these shifts is a change in methodology at MDOT. Prior financial forecasts were based on a different categorization of projects. Candidate projects for the LRTP were previously "major capital" projects, which could include large-scale projects that didn't expand roadway or transit capacity. Examples include major overhauls of transit vehicles or large roadway reconstruction or interchange projects that

Figure 1 - LRTP State and Federal Financial Forecast Comparison: Funds by Category

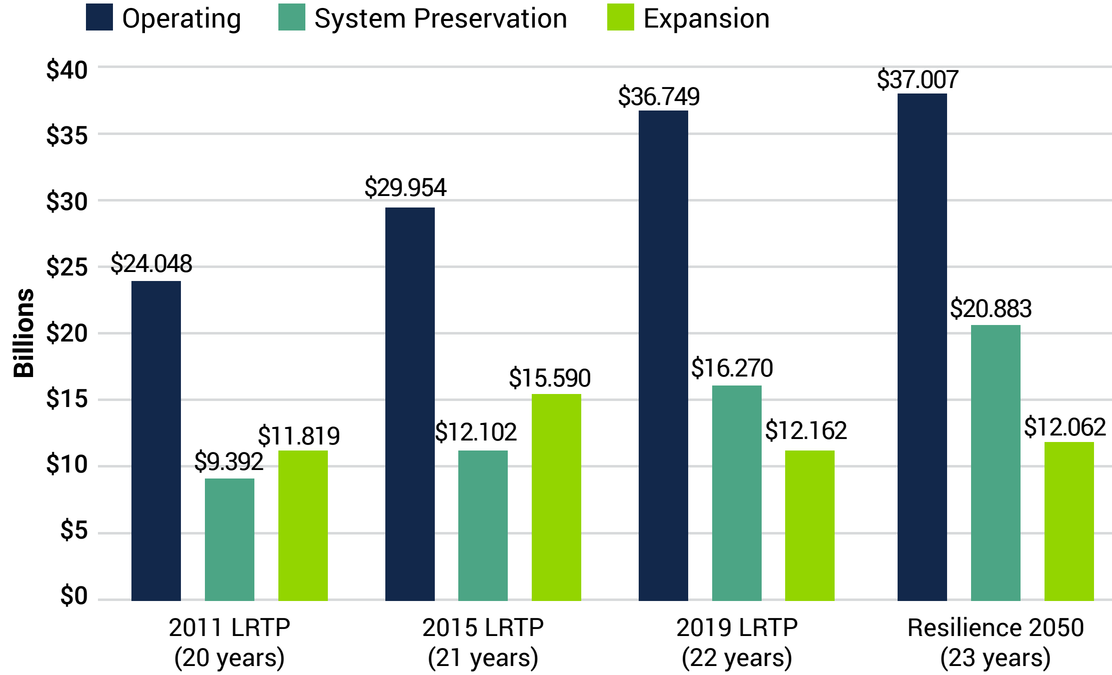
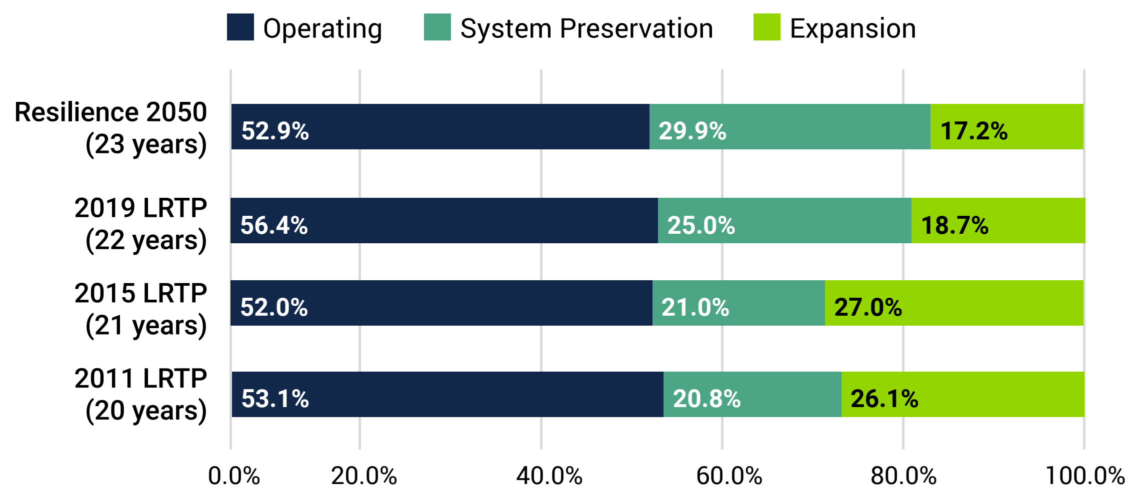


Figure 2 - LRTP State and Federal Financial Forecast Comparison: Share of Funds by Category



The financial forecast for *Resilience 2050* includes a total of $69.952 billion in state and federal revenue for operating, system preservation, and expansion in the Baltimore region from 2028 to 2050.

don't add lanes. Starting with the *Resilience 2050* financial forecast, the major capital category is now considered to be exclusively expansion. This means that projects that MDOT had previously categorized as major capital that don't include additional capacity are now categorized as system preservation. This results in an increase in system preservation funds in the financial forecast (and an associated decrease in expansion funds).

Figure 2 compares the share of funds by category for *Resilience 2050* and the three prior LRTPs. Operating revenues comprise the majority of the financial forecast, with the share remaining relatively consistent from one LRTP to the next. The share dedicated to system preservation has gradually increased while the share dedicated to expansion has decreased. This shows the increasing demands associated with maintaining the Baltimore region's transportation system in a state of good repair.

Local Financial Forecast

While MDOT provides state and federal funding forecasts for the LRTP, federal regulations require a financial plan to identify "all necessary financial resources from public and private sources that are reasonably expected to be available," which includes forecasting of local sources of revenue. In 2022, we worked with a consultant and local jurisdiction staff to develop a local funding projection tool for use in *Resilience 2050*. This tool can also be adapted to generate local funding forecasts for future LRTPs.

The local financial forecast was based on baseline funding information for FY 2022. Baseline funding information was gathered through (1) the review of relevant funding documentation for each jurisdiction, and (2) interviews held with relevant representatives of each jurisdiction. Local funds come from a variety of sources including Highway User Revenues (HUR), general funds, bonds and other sources such as usage fees. HUR funds come from a portion of the gasoline tax.

Funding sources were allocated to either operating or capital sources based on the review of local documents and staff interviews. Capital was further divided into system preservation and expansion categories to mimic the state and federal financial forecast. Baseline funds for operating and capital were projected forward by source (HUR, general funds, bonds, etc.) using growth rates estimated from interviews with budget staff and reasonable economic principles.

Table 4 summarizes local revenues projected to be available to the Baltimore region from 2028 to 2050. These totals were calculated by summing the individual county-by-county values for operating, system preservation and expansion for each time period listed. We summarized the local financial forecast in 5-year bands due to methodological limitations since this is the first year we developed a region-wide local financial forecast for the LRTP. Future LRTPs will continue to refine and include a local financial forecast to provide a clearer picture of the resources available for transportation in the Baltimore region.

Table 4 - Baltimore Region Local Operating, System Preservation and Expansion Revenue Forecast: 2028-2050 (Millions of Dollars)

Time Period	Operating	System Preservation	Expansion	Total
2028-2032	$2,829	$1,223	$185	$4,237
2033-2037	$3,193	$1,304	$199	$4,696
2038-2042	$3,614	$1,397	$215	$5,226
2043-2047	$4,104	$1,506	$233	$5,843
2048-2050	$2,731	$963	$150	$3,844
Total 2028-2050	**$16,471**	**$6,393**	**$982**	**$23,846**

Forecast Federal Revenues by Funding Program: 2028-2050

During the 2016 federal certification review, FHWA and FTA recommended including a breakdown of forecast federal revenues by funding program in the LRTP. To satisfy this requirement, we applied MDOT's FY 2022 apportionment shares for major FHWA and FTA federal funding programs, accounting for the *Resilience 2050* financial forecast and the estimated share of federal funds as documented in MDOT's CTP. These federal programs primarily provide capital funds for system preservation and expansion. Therefore, the federal funding program estimates are constrained by Baltimore region revenues for expansion and system preservation only. Table 5 shows the resulting estimate of how these federal revenues might break down from 2028-2050. There is no guarantee that these funding programs will be available in their present forms throughout the next 25+ years. There also is no guarantee that these same percentages will apply in the future, or that MDOT will continue to provide the same level of state funding for projects. However, this approach was deemed the best way to provide a possible scenario for how federal funding might be apportioned within the region in the future.

Table 5 - *Resilience 2050* Regional Revenue Forecasts by Federal Funding Program (Millions of Dollars)

	FHWA - Highways*							FTA - Transit*			Totals		Baltimore Region Expansion and System Preservation Revenues
	NHPP	STBG	HSIP	CMAQ	NHFP	CRP	PROTECT	S5307	S5337	S5339	Highways	Transit	
2028	$203	$99	$22	$28	$10	$9	$10	$89	$38	$6	$381	$133	$815
2029	$212	$103	$23	$30	$11	$9	$10	$94	$40	$6	$398	$140	$853
2030	$223	$108	$24	$31	$11	$10	$11	$98	$42	$6	$418	$146	$894
2031	$234	$114	$25	$33	$12	$10	$12	$103	$44	$7	$440	$154	$939
2032	$246	$120	$26	$34	$12	$11	$12	$108	$46	$7	$461	$161	$987
2033	$258	$125	$28	$36	$13	$11	$13	$114	$49	$7	$484	$170	$1,035
2034	$271	$132	$29	$38	$13	$12	$13	$119	$51	$8	$508	$178	$1,087
2035	$284	$138	$30	$40	$14	$12	$14	$125	$53	$8	$532	$186	$1,140
2036	$297	$145	$32	$42	$15	$13	$15	$131	$56	$8	$559	$195	$1,193
2037	$311	$151	$33	$44	$16	$13	$15	$137	$59	$9	$583	$205	$1,249
2038	$326	$159	$35	$46	$16	$14	$16	$144	$61	$9	$612	$214	$1,308
2039	$341	$166	$37	$48	$17	$15	$17	$150	$64	$10	$641	$224	$1,368
2040	$357	$174	$38	$50	$18	$15	$18	$157	$67	$10	$670	$234	$1,433
2041	$374	$182	$40	$52	$19	$16	$18	$165	$70	$11	$701	$246	$1,500
2042	$392	$191	$42	$55	$20	$17	$19	$172	$74	$11	$736	$257	$1,572
2043	$410	$199	$44	$57	$20	$18	$20	$180	$77	$12	$768	$269	$1,645
2044	$429	$209	$46	$60	$21	$19	$21	$189	$81	$12	$805	$282	$1,723
2045	$449	$219	$48	$63	$22	$19	$22	$198	$85	$13	$842	$296	$1,804
2046	$471	$229	$51	$66	$23	$20	$23	$207	$89	$13	$883	$309	$1,891
2047	$493	$240	$53	$69	$25	$21	$24	$217	$93	$14	$925	$324	$1,980
2048	$517	$251	$56	$72	$26	$22	$25	$228	$97	$15	$969	$340	$2,075
2049	$542	$264	$58	$76	$27	$24	$27	$239	$102	$15	$1,018	$356	$2,175
2050	$568	$276	$61	$79	$28	$25	$28	$250	$107	$16	$1,065	$373	$2,279
Total 2028-2050	**$8,208**	**$3,994**	**$881**	**$1,149**	**$409**	**$355**	**$403**	**$3,614**	**$1,545**	**$233**	**$15,399**	**$5,392**	**$32,945**

*see endnote for definitions of FHWA and FTA funding programs[1]

FY 2028-2050 Estimated Federal Revenues $20,791

Fiscal Constraint: Project Costs vs Forecast Revenues

This section compares forecast revenues with anticipated year of expenditure project costs, demonstrating that the region anticipates to have sufficient funds to pay for the projects included in *Resilience 2050*. See Chapter 7 for specific project details.

LRTP Candidate Projects, Scoring and Cost Estimation

Before comparing forecast revenues with project costs, it is necessary to understand how the BRTB decides what projects to include in the LRTP. Local jurisdictions and state agencies submit candidate projects for consideration. There are always more projects submitted than the region can afford to include in the LRTP. Deciding which projects to include requires a method of prioritizing candidate projects. Projects are scored based on the approved scoring methodology for projects. The number of projects included also depends on estimated project costs and the financial forecast for the region. Projects are selected for the preferred alternative based on their project score until the sum of project costs is just below revenues anticipated to be available. A portion of funds is also set aside for programs anticipated to reduce emissions and improve air quality in the Baltimore region. See Chapter 7 for additional details on these set-aside funds.

Candidate Projects

The following jurisdictions and agencies submitted candidate projects during the call for projects, held from April through June of 2022:

- City of Annapolis
- Anne Arundel County
- Baltimore City
- Baltimore County
- Carroll County
- Harford County
- Howard County
- Queen Anne’s County
- MDOT Maryland Transit Administration

These jurisdictions and agencies, in consultation with MDOT MTA and MDOT SHA, submitted 98 projects for consideration for *Resilience 2050*. These included 36 transit and 62 roadway projects. Projects submitted for inclusion in *Resilience 2050* are major capital projects focused on expanding the transportation system. Examples of expansion projects include building new or widening existing roadways and expanding transit lines or building new transit stations. Eighty-five of the candidate projects fell into this expansion category. Thirteen of the projects submitted for *Resilience 2050* did not expand roadway or transit capacity and were classified as system preservation projects. This is important as the financial forecast includes different categories of funding for expansion and system preservation projects.

Project Scoring

Candidate projects are given both a policy and a technical score. The policy score is worth a maximum of 40 points. It is based on how high of a priority the project is for the submitting jurisdiction and if it has existing financial support. Technical scores are based on project consistency with criteria drawn directly from the regional goals and strategies. Table 6 lists the criteria along with the points devoted to each for transit and roadway projects.

Resilience 2050 includes an enhanced focus on equity and environmental justice (EJ) in the project scoring methodology. Note that while equity is not a stand-alone criteria, a subset of the points for most criteria are devoted to the anticipated impacts of each project on EJ populations. EJ populations include low-income and minority persons in the Baltimore region. Embedding points for EJ populations within individual criteria allows us to consider the potential effects of candidate projects on EJ populations from multiple perspectives (safety, accessibility, environmental impacts, etc.). Criteria marked with an asterisk (*) include points related to project impacts on EJ populations.

Both roadway and transit projects are scored for these criteria, though the methodology differs in some cases since the tools for evaluating roadway projects may not be appropriate for transit projects and vice versa. For example, the types of features used to improve safety for transit riders on Light Rail and MARC may be different from the features used to improve safety along roadways for bicyclists, pedestrians and drivers. Transit projects are eligible for 5 more technical scoring points than roadway projects in an effort to respond to public comments recommending improving transit accessibility, reliability and frequency. This results in a slight advantage for transit projects in the technical scoring process.

Table 6 - Technical Scoring Goals, Criteria, and Points

Goal/Criteria	Technical Scoring Points: Transit Projects	Technical Scoring Points: Roadway Projects
Safety*	10	10
Accessibility – Complete Streets*	5	5
Accessibility – Access to Jobs*	10	5
Mobility	10	10
Environmental – Effects on ecologically sensitive lands and culturally significant resources*	5	5
Environmental – Potential for Greenhouse Gas Emissions Reductions	5	5
Security*	5	5
Economic Prosperity	5	5
Total Technical Points	**55**	**50**

**includes points related to project impacts on EJ populations*

Total scores were calculated by adding the policy and technical scores together for each project. Roadway projects were eligible for a maximum of 90 points (40 policy + 50 technical) and transit projects were eligible for a maximum of 95 points (40 policy + 55 technical). The total score was used to prioritize projects for inclusion in *Resilience 2050*. See Appendix B for a summary of the scoring methodology and the policy and technical scores for the projects included in *Resilience 2050*.

Project Costs

Estimating project costs for *Resilience 2050* was a joint effort that included the assistance of state agencies, local jurisdictions and transportation consultants. MDOT SHA provided cost estimates for all roadway projects, regardless of whether the facility was a state or locally maintained roadway. Local jurisdictions provided necessary information to MDOT SHA for projects on local roadways. MDOT MTA developed capital cost estimates for the transit projects it would operate. MDOT MTA, through an existing contract with a consultant, provided cost estimates for locally sponsored transit projects. See Appendix B for further details on cost estimation methodologies.

Project cost estimates were initially provided in current dollars, or today's dollars. However, the cost of constructing a project today is significantly less than the cost to construct that project in 10 or 20 years. An inflation adjustment is applied to projects selected for *Resilience 2050* due to the long-term planning horizon of the LRTP. This requires translating current dollar cost estimates into Year of Expenditure (YOE) cost estimates using an inflation factor consistent with MDOT expectations and reasonable financial principles. In all cases, we applied a 2.5% annual inflation rate to account for capital cost escalation and to determine year of expenditure cost estimates as federally required. This rate is consistent with the rate that MDOT uses to determine system preservation funding needs through 2050.

Financial Forecast

Not all funding in the financial forecast is considered to be available for candidate projects. Projects submitted for *Resilience 2050* represent federally funded major capital expenditures for expanding and preserving the transportation system. This chapter includes a forecast of federal, state and local funds anticipated to be available for surface transportation through 2050. However, projects submitted for *Resilience 2050* are federally funded projects anticipated to use the revenues identified in the state and federal forecast from MDOT. As a result, funds in the local financial forecast are not considered to be available for the expansion and system preservation projects submitted for *Resilience 2050*. This more conservative assumption helps to ensure that *Resilience 2050* remains fiscally constrained.

Fiscal constraint is demonstrated by showing that the YOE costs of projects in *Resilience 2050* do not exceed the state and federal revenues anticipated to be available for expansion and system preservation. The financial forecast includes a total of $12.062 billion and $20.883 billion in anticipated state and federal revenues for expansion and system preservation, respectively, in the Baltimore region.

Fiscal Constraint for Expansion Projects

Most candidate projects are expansion projects that compete for the $12.062 billion in state and federal expansion funds anticipated to be available from 2028 to 2050. Table 7 shows a breakdown of forecast revenues versus total estimated YOE costs for expansion projects in *Resilience 2050*. Included in this breakdown are set-aside funds for small programs intended to improve air quality and for Locally Operated Transit Systems (LOTS). See Chapter 7 for further details on these programs. This breakdown demonstrates that the region expects to have sufficient funds to pay for expansion projects in *Resilience 2050* in the time periods in which the region expects these projects to be implemented.

Table 7 - Fiscal Constraint for Expansion Projects (Millions of Dollars)

	Category	2028-2039	2040-2050	2028-2050
Estimated Expansion YOE Costs	Projects	$3,607	$8,084	$11,691
	Small Program Set-Asides	$45	$205	$250
	LOTS	$30		$30
	Total	**$3,682**	**$8,289**	**$11,971**
Forecast Expansion Revenues		**$3,706**	**$8,356**	**$12,062**

Fiscal Constraint for System Preservation Projects

Resilience 2050 also details several large-scale system preservation projects along with an estimated breakdown of future system preservation expenditures by category provided by MDOT MTA and MDOT SHA. Including further details on anticipated system preservation needs in *Resilience 2050* reflects the increasing importance of system preservation at the national, state and regional level. As our transportation infrastructure ages, system preservation expenditures comprise an increasing share of transportation budgets. System preservation becomes even more important in light of a changing climate, as detailed in Chapter 3 and in our Climate Change and Resilience white paper.

The financial forecast for *Resilience 2050* includes estimated revenues of $20.883 billion in state and federal system preservation funds available from 2028 to 2050. Table 8 contains a breakdown of estimated YOE system preservation expenditures versus forecast revenues by project type. This breakdown includes YOE costs for 13 system preservation projects submitted for inclusion in *Resilience 2050*. A full project list is available in Chapter 7.

Table 8 - Fiscal Constraint for System Preservation Projects (Millions of Dollars)

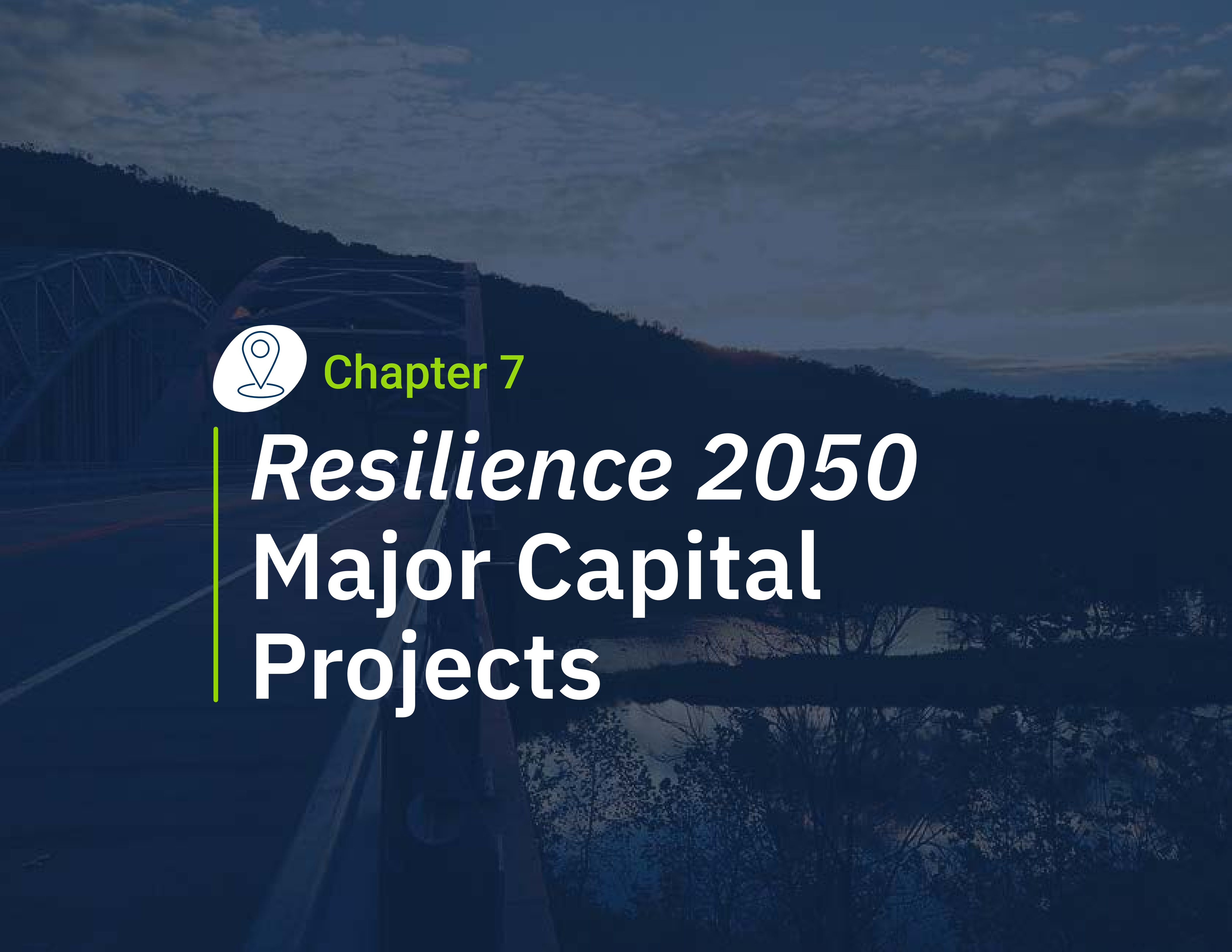
		2028-2039	2040-2050	2028-2050
Roadway Estimated System Preservation YOE Costs	Transportation Alternatives	$127	$155	$282
	Environmental	$453	$552	$1,005
	Congestion Management	$457	$557	$1,014
	Bridge Replacement and Rehabilitation	$1,525	$1,444	$2,969
	Resurfacing and Rehabilitation	$1,758	$2,139	$3,897
	Safety and Spot	$1,043	$1,270	$2,313
	Urban Reconstruction	$429	$72	$501
	Roadway Subtotal	**$5,792**	**$6,189**	**$11,981**
Transit Estimated System Preservation YOE Costs	Guideway	$296	$541	$837
	Facilities	$464	$102	$566
	Systems	$291	$501	$792
	Stations	$515	$833	$1,348
	Vehicles	$1,804	$3,555	$5,359
	Transit Subtotal	**$3,370**	**$5,532**	**$8,902**
Total Estimated System Preservation YOE Costs		**$9,162**	**$11,721**	**$20,883**
Forecast System Preservation Revenues		**$9,162**	**$11,721**	**$20,883**

Endnotes

1 Definitions of Major Federal Funding Programs from Table 5

FHWA - Highways
- *NHPP: National Highway Performance Program*
- *STBG: Surface Transportation Block Grant Program*
- *HSIP: Highway Safety Improvement Program*
- *CMAQ: Congestion Mitigation and Air Quality Improvement Program*
- *NHFP: National Highway Freight Program*
- *CRP: Carbon Reduction Program*
- *PROTECT: Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation*

FTA - Transit
- *S5307: Section 5307 Urbanized Area Formula Grants*
- *S5337: Section 5337 State of Good Repair Grants*
- *S5339: Section 5339 Bus and Bus Facilities Grants*



Chapter 7

Resilience 2050 Major Capital Projects

Anticipated Projects: 2028-2050

The Transportation Improvement Program (TIP) consists of near-term projects with defined scopes, established schedules and committed funding. In contrast, *Resilience 2050* consists of long-term commitments to system operations and system preservation, along with details on specific expansion projects. While prior LRTPs have not detailed specific system preservation projects, *Resilience 2050* includes several large-scale system preservation projects.

These long-term projects generally have only conceptual scopes, potential schedules and anticipated funding. The TIP covers the period from FY 2024 to 2027. The planning horizon for *Resilience 2050* begins immediately after and must cover a minimum of 20 years per federal requirements. *Resilience 2050* covers the period from FY 2028 to 2050.

Local jurisdictions and state agencies submitted 98 candidate projects for consideration, including 62 roadway projects and 36 transit projects. There are always more projects submitted than the region can afford to include in the LRTP. Working with local jurisdictions and state agencies, we selected a list of projects for *Resilience 2050* from among the 98 candidate projects. The projects were selected by applying the adopted evaluation and scoring criteria, consistent with federal laws and policies and the region's adopted transportation goals. The number of projects included depends on estimated year of expenditure (YOE) costs of projects and the financial forecast for the region. Chapter 6 summarizes each of these elements in more detail. Cost estimation methodologies, project evaluation criteria and project scores are available in Appendix B.

The fiscally constrained list of projects included in *Resilience 2050* is known as the preferred alternative. Ninety-two of the 98 projects were selected, including all of the transit projects and 56 of the roadway projects. In addition to the specific expansion and system preservation projects, the preferred alternative also consists of funding allocated for operation and maintenance of existing systems. For the projects and programs in the preferred alternative, we coordinated with the Maryland Department of Transportation (MDOT) to identify future funding sources the region reasonably anticipates will be available. This is to comply with the requirement for a financially constrained plan.

The major capital expansion and system preservation projects in the *Resilience 2050* preferred alternative have only generally defined scopes. Similarly, funds to cover the design, right-of-way and construction phases of these projects for the most part have not been committed yet. Such funds would come from forecasted revenues the region reasonably expects to be available for major projects throughout the life of the plan. Project sponsors may or may not be able to commit these anticipated funds to specific projects during the life of the plan. Rather, the projects included in the preferred alternative represent our best judgment about what is desirable and what meets the federal requirement for fiscal constraint, all while considering existing conditions and future expectations.

Analysis of the Potential Effects of Major Capital Projects

We included major capital projects in the master network of programmed and planned system improvements. We analyzed this master network using a travel demand model. The travel demand model combines socioeconomic forecasts of future households, population and employment along with anticipated changes to the transportation network to model future effects on air quality and travel demand. The travel demand model is also used to evaluate potential effects of the projects in *Resilience 2050* on Environmental Justice populations. Appendix C shows the results of these analyses.

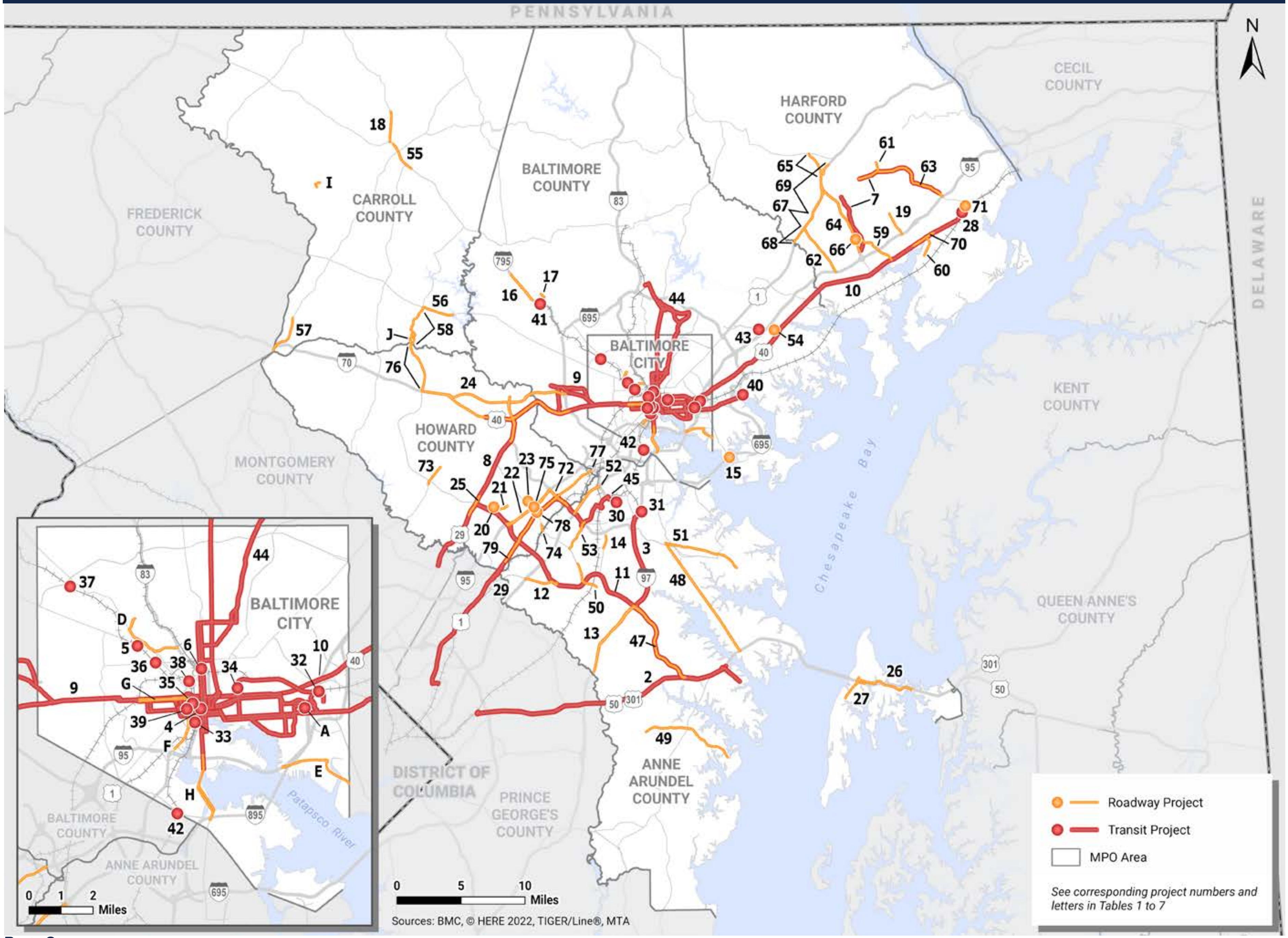
Other Projects and Programs

This chapter also lists other categories of programs and projects. These include funding set-aside from the financial forecast to fund programs and initiatives that will improve air quality in the Baltimore region. Set-aside funds are part of the financially constrained LRTP.

The federally funded projects in the *Resilience 2050* preferred alternative are anticipated to use funds from the Federal Highway Administration (FHWA) or the Federal Transit Administration (FTA). However, *Resilience 2050* must also account for projects funded by other sources that affect air quality and travel demand. These include projects funded by Maryland Transportation Authority (MDTA) toll revenues and rail projects using Federal Railroad Administration (FRA) funding. Each of these categories of programs and projects is summarized at the end of this chapter.

The fiscally constrained list of projects in *Resilience 2050* is known as the preferred alternative.

Map 1 - Locations of Major Capital Expansion and System Preservation Projects: 2028-2050
(See corresponding project numbers and letters in Tables 1-7)



**Projects marked with an asterisk in the following tables are not location specific and do not appear in this map*

Preferred Alternative – Expansion and System Preservation Projects: 2028-2050

The tables beginning on the next page show major capital expansion and system preservation projects in the timeframes within which we anticipate they might be implemented. Sponsors, in coordination with MDOT SHA and MDOT MTA, provided current year cost estimates. We then applied an inflation factor, consistent with MDOT expectations, out to the expected year of operation to arrive at estimated YOE cost estimates.

Current assumptions about project scopes, future inflation rates and future conditions could change over the next four years by the time of the next update of the regional plan. For this reason, these cost estimates should be considered conceptual in nature, based on the best available knowledge and expectations.

Expansion Projects

Figure 1 shows a breakdown of anticipated expansion investments by type and time period. Tables 1-4 beginning on the next page provide details on these expansion projects. The ID corresponds to the project numbers on Map 1.

Figure 1 - Breakdown of Anticipated Expansion Investments by Project Type and Time Period

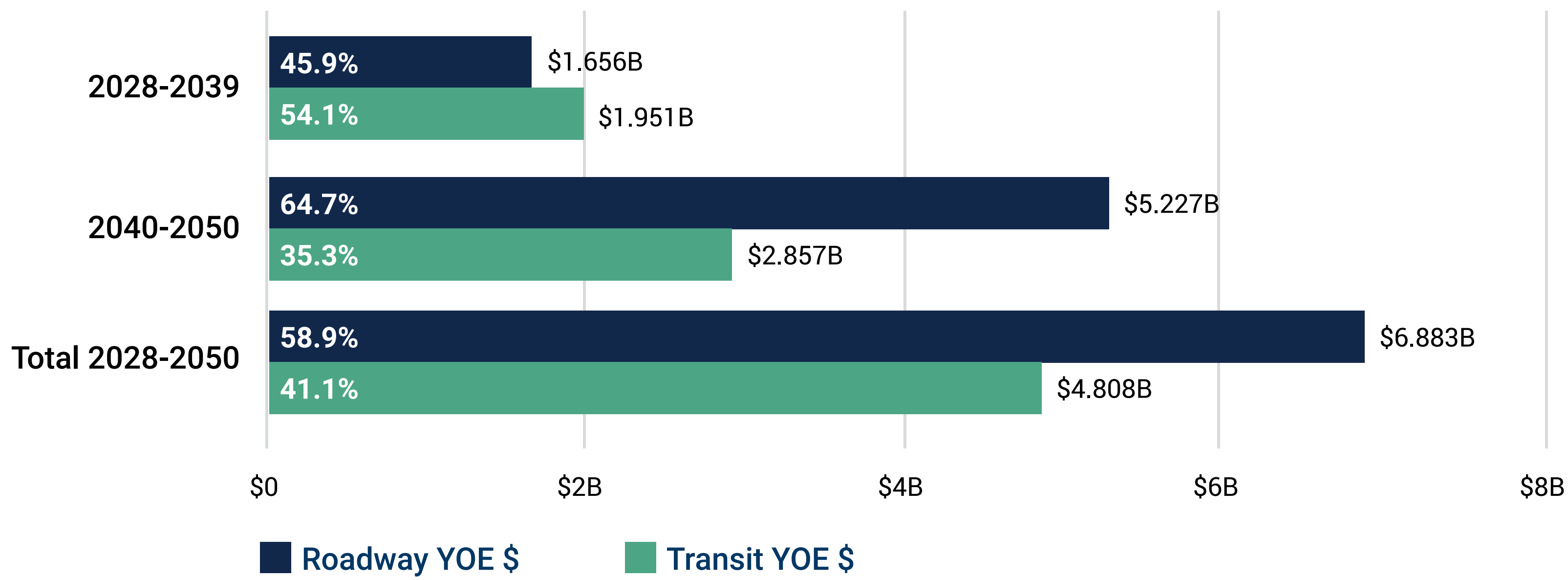


Table 1 - Transit Expansion Projects: 2028-2039

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
1*	Anne Arundel County	Anne Arundel Countywide Microtransit	Countywide	Expand microtransit service in Anne Arundel County from 1 zone in the south to 7 zones, providing on-demand transit services to connect to existing fixed route services across the entire county.	A countywide microtransit system would address many of the first / last mile issues with existing passenger rail, light rail and regional / local bus services in the County, increasing the ability of residents to take advantage of existing services that might otherwise not be available to them.	$3,000,000
2	TBD Anne Arundel County	Annapolis to New Carrollton Transit	New Carrollton to Parole 21.0 miles	New Express Bus service between Parole and New Carrollton with stops at major communities along the way.	Limited transit alternatives exist between the Annapolis and Prince George's County / Washington D.C. areas. Providing a new high-quality transit service would expand economic opportunity and increase regional mobility and accessibility for vulnerable populations in both communities.	$3,000,000
3	TBD Anne Arundel County	Glen Burnie to Annapolis Transit	Cromwell / Glen Burnie to Annapolis / Parole 16.0 miles	New Express Bus service between Annapolis / Parole and Glen Burnie along I-97.	Frequent, high-quality service connecting the state capital area with the Glen Burnie / BWI areas and to the City of Baltimore via the existing light rail service connection. This will increase economic opportunities for both areas. It will also help reduce demand on MD 2 and I-97, thus reducing the environmental impacts of SOV travel.	$7,000,000
• 4 • 5 • 6	MDOT MTA 3 Locations in Baltimore City	MDOT MTA Transit Hubs: • Charles Center • Mondawmin • Penn Station	Jurisdiction: • Baltimore City • Baltimore City • Baltimore City	MDOT MTA has identified transit hub locations as part of the Regional Transit Plan. Typically, a transit hub includes enhanced amenities (shelters, benches, information). The Penn Station project has received $5M in Congressionally Designated Funding for multimodal access improvements to the station and a Federal RAISE discretionary grant to further fund investments around the station.	Transit hubs are important for both passengers and operators. Well-situated and well-designed transit hubs can significantly improve transferring from one system, mode or vehicle to another. At a minimum, a transit hub should include amenities like shelters, benches, real-time information, and CCTV for security. Comfort stations will be considered to support bus operators, particularly at terminal stops and stations. Coordinated signage and wayfinding enables customers to make their transfer quickly and easily. Bicycle parking and shared mobility options, and in some cases park-and-ride, help with first mile/last mile access at hubs. Transit Oriented Development (TOD) is often centered around a transit hub, though not all transit hubs are appropriate for TOD.	• $14,000,000 • $7,000,000 • $19,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
7	MDOT SHA Harford County	Transit Signal Priority	MD 22 corridor from MD 543 to Long Drive / Technology Drive 7.4 miles MD 924 corridor from MacPhail Road to Woodsdale Road 4.7 miles	Construct queue jump lanes along MD 22 and MD 924 and install equipment on buses that syncs with traffic signals along these corridors.	Improve service and mobility for current and future riders by addressing capacity, frequency and reliability.	$2,000,000
8	TBD Howard County	US 29 Bus Rapid Transit	US 40 to MD 198 (Burtonsville, MD) 16.0 miles	Connect Ellicott City to Columbia, Maple Lawn and Burtonsville at MD 198 in Montgomery County, including separated facilities on US 29 to integrate with Montgomery County improvements and the development of a transit center in Downtown Columbia.	Strengthen and support transit as well as economic connections between the Baltimore and Washington, DC regions, with a focus on connecting state and local investment in Downtown Columbia, Maple Lawn, Applied Physics Laboratory, Burtonsville, White Oak and Silver Spring. Provide greater access to housing, educational, cultural and recreational opportunities in each region. Service and road improvements will address peak hour congestion to enhance mobility, including partnering with other improvements on US 29 to enhance capacity and safety such as reducing bottlenecks at Rivers Edge Road and other proposed projects in Montgomery County.	$20,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
9	MDOT MTA Regional	East-West Transit Corridor	Ellicott City to Essex 17.0 miles	New east-west transit service to connect major Baltimore region destinations like West Baltimore, Downtown, East Baltimore and the western suburbs as identified in the RTP.	Corridor represents a major area of transit infrastructure need. Specific transit routes and/or stations, modes, alignments, or service levels have not been determined. Careful study is required to assess demand and local context before investing in specific transit assets. This corridor is an Early Opportunity Corridor selected for its potential to benefit the highest number of people, jobs and households in the region in the short term. Corridor exhibits strong market demand and represents a critical link in the regional transit system. Corridor serves areas with a high density of jobs and population as well as high concentrations of vulnerable populations.	$1,829,000,000
10	MDOT MTA Regional	MDOT MTA Commuter Service	Harford County to Downtown Baltimore and Harbor East	Additional MDOT MTA commuter bus service from Harford County to Downtown Baltimore and Harbor East.	Improve service and mobility for current and future riders by addressing capacity, frequency and reliability.	$2,000,000
11	TBD Regional	Annapolis to Fort Meade / Columbia Transit	Annapolis / Parole to Fort Meade to Columbia 25.0 miles	New Express Bus service between Parole and Columbia with primary service to Fort Meade and stops at major communities along the way.	Fort Meade / NSA is one of the primary job hubs of the state. Express bus service to and from Columbia and Annapolis will expand economic opportunities for residents and reduce vehicular demands on those corridors.	$45,000,000

**Project does not appear in map*

Table 2 - Roadway Expansion Projects: 2028-2039

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
12	MDOT SHA Anne Arundel County	MD 198	MD 295 to MD 32 2.7 miles	Widen from 2 to 4 lanes and construct a continuous center median. Widen ramp at MD 295. Provide bicycle and pedestrian facilities within project limits.	Support economic growth at and around Fort Meade by constructing additional travel lanes to reduce congestion and a median that will improve safety. Improvements will enhance access to this major employment hub.	$275,000,000
13	MDOT SHA Anne Arundel County	MD 3	MD 450 to MD 32 6.2 miles	Targeted widening from 4 to 5 lanes, including intersection improvements, access controls to address safety, TSMO[1] strategies to address congestion, as well as bicycle and pedestrian improvements.	Address capacity issues along MD 3, improve operations at intersections, improve roadway safety, and enhance pedestrian and bicycle accessibility.	$95,000,000
14	MDOT SHA Anne Arundel County	MD 170	Norcross Lane to Wieker Road 0.83 miles	Widen from 2 to 4 lanes, resurface, and restripe along MD 170 and along MD 174 to create new turn lanes and increased capacity at the MD 170 / MD 174 intersection, including sidewalks and bicycle compatible shoulders.	Improve safety and operations along MD 170 from Norcross Lane to Wieker Road, including the intersection of MD 170 and MD 174.	$23,000,000
15	MDOT Baltimore County	I-695 at Broening Highway Interchange		Construct a partial interchange at Exit 44 of I-695 to support redevelopment at Sparrows Point.	Maximize the potential redevelopment activities at TradePoint Atlantic and improve access to this major activity center. Allow for truck avoidance of the toll plaza and reduce truck traffic affecting residential communities on Dundalk Avenue and Holabird Avenue.	$147,000,000
16	MDOT SHA Baltimore County	I-795	Owings Mills Boulevard to Franklin Boulevard 2.63 miles	Widen from 4 to 6 lanes and construct a full interchange at Dolfield Boulevard, including TSMO strategies.	Improve access to the planned growth corridor along Red Run Boulevard in Owings Mills.	$155,000,000
17	MDOT SHA Baltimore County	MD 140	Painters Mill Road to Owings Mills Boulevard 0.4 miles	Widen from 4 to 6 lanes, including a raised median, bicycle accommodations and pedestrian facilities.	Accommodate ongoing development in the area by adding capacity. Addition of a median will manage turning movements and increase safety.	$33,000,000

1 Transportation System Management and Operations (TSMO) includes a set of strategies that focus on operational improvements that can maintain and even restore the performance of the existing transportation system before extra capacity is needed.

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
18	MDOT SHA Carroll County	MD 97	Bachmans Valley Road to MD 140 in Westminster 2.4 miles	Widen from 3 to 5 lanes, with a full interchange at Meadow Branch Road and bicycle and pedestrian facilities.	Support economic vitality of the community by reducing congestion and improving operations through widening MD 97 and constructing an interchange at Meadow Branch Road. Improve multimodal mobility with pedestrian and bicycle facilities.	$202,000,000
19	MDOT SHA Harford County	MD 543	MD 136 to I-95 1.9 miles	Widen from 2 to 4 lanes, including intersection upgrades at MD 136, turn lanes, capacity upgrades to the MD 543 / I-95 interchange, and bicycle and pedestrian access. Improvement will fix queuing problems on MD 543 through the intersection with MD 7.	Relieve congestion and improve access, capacity, mobility and safety for passenger and freight traffic as well as bicyclists, pedestrians and transit riders. Address extreme queuing issues at I-95 interchange.	$140,000,000
20	Howard County	Broken Land Parkway at Snowden River Parkway	Broken Land Parkway from south of MD 32 to north of Snowden River Parkway; Snowden River Parkway from east of Minstrel Way to Patuxent Woods Drive 0.25 miles	Capacity, operational and safety improvements at this signalized intersection as well as access improvements to the MD 32 / Broken Land Parkway interchange ramps.	This major East Columbia intersection is a "gateway" to West and Downtown Columbia and is integral to the operations and community and economic health of Columbia. Existing peak period congestion and safety problems to / from MD 32 create significant traffic safety problems and impede economic vitality of Snowden River Parkway corridor. Broken Land Parkway, a major arterial connection to Downtown Columbia, also is impeded with congestion and crashes. Improvements will include ADA-compliant pedestrian access as well as bicycle and transit access / mobility improvements. Project will reduce pedestrian and bicycle vulnerability and sideswipe, angle, and rear end collisions, improve freight access and mobility and reduce congestion in this complex intersection. Reduced delay will result in reduced emissions.	$63,000,000
21	Howard County	Snowden River Parkway Widening	Broken Land Parkway to Oakland Mills Road 1.1 miles	Widen from 4 to 6 lanes, including auxiliary lanes and pedestrian, bicycle and transit improvements on both sides of the road.	Enhance capacity and safety, including significant pedestrian, bicycle and transit improvements. Reduce diverted traffic using the local road network. Improve commuting, freight operations and alternate modal choices for travel. Augment prior Federal, State and County investment and mitigate traffic demand on parallel routes MD 175 and MD 32.	$21,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
22	MDOT SHA Howard County	I-95	MD 32 to MD 100 6.0 miles	Create peak hour part-time shoulder use lanes.	Relieve congestion and improve freight movement by adding one outside lane in both directions during peak hours. Creating additional merge area at entrance ramps will increase safety.	$45,000,000
23	MDOT SHA Howard County	MD 175 / MD 108 Interchange	0.25 miles in all directions from the current intersection as well as a direct connection of MD 108 to Columbia Gateway Drive. 0.25 miles	This T-intersection experiences significant congestion and an even worse collision experience. Existing intersection exhibits a collision rate higher than almost all intersections in Howard County. A partial grade-separation with direct access into Columbia Gateway will improve intersection capacity and alleviate the high collision rate.	Mitigate and reduce impacts at this congested intersection within the I-95 corridor, which currently experiences very high rates of rear-end and sideswipe collisions. Improve access to I-95 and direct access to Columbia Gateway, a Regional Activity Center. Improve commuter access to / from I-95, US 1 and US 29 as well as access for nearby communities, commercial uses (retail, offices) and schools. Facilitate access to the Columbia Association Gateway pathway system.	$102,000,000
24	MDOT SHA Howard County	TSMO System 1	I-70 from I-695 to MD 32 (11.0 miles) US 29 from MD 99 to MD 100 (4.0 miles) US 40 from I-695 to I-70 (10.0 miles)	Implement a combination of information technology and geometric improvements to address safety and operations within TSMO System 1 including I-70, US 29, and US 40.	Improve safety and operations along I-70, US 29, and US 40	$48,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
25	MDOT SHA Howard County	US 29	Patuxent River Bridge to Seneca Drive 1.7 miles	Widen northbound US 29 from 2 to 3 lanes, including improvements at intersection with Rivers Edge Road.	Reduce congestion by adding one lane in the northbound direction to match the southbound typical section. Improve safety at the Rivers Edge Road intersection.	$103,000,000
26	MDOT SHA Queen Anne's County	MD 18	Kent Narrows to Bay Bridge – MD 18 and MD 835 on east side of Kent Narrows to MD 18 5.0 miles	Widen from 2 to 4 lanes, including right-of-way acquisition, utility relocation, new pedestrian improvements, and reconstruction of intersections to improve capacity, safety and mobility on the only alternative route to US 50/301 on the island.	More than 26 million vehicles travel US 50/301 and cross the William Preston Jr. Memorial Bridge annually, making this a vital transportation corridor in the mid-Atlantic region. MD 18 is the only alternate route to US 50/301 for 10 miles from the US 50/301 split in Queenstown to the Bay Bridge. MD 18 is vital to mobility in the area, access to services, and emergency service response and transport. Widening MD 18 to add capacity, improve safety and maintain mobility as volumes and congestion on US 50/301 increase is vital to the transportation system while MDOT is planning for additional capacity for crossing the Chesapeake Bay.	$114,000,000
27	MDOT SHA Queen Anne's County	MD 8 / US 50/301 Interchange and Service Roads	Skip Jack Parkway south to Davidson Drive; east to Thompson Creek service road 2.0 miles	Widen from 2 to 4 lanes, convert MD 8 overpass to full divergent diamond interchange with US 50/301, and add Thompson Creek and Cox Creek service roads to improve traffic flow, add capacity and allow for alternative routes to services and residential areas. Provide for bike and pedestrian improvements along existing and new routes.	MD 8 is predominantly a 2-lane road that serves as the only access to a 10-mile residential peninsula on southern Kent Island. Widening northern sections of MD 8 and reconstructing existing overpass will add capacity, improve safety, reduce congestion, and allow for pedestrian and bike access in corridor. Reconstructing MD 8 overpass into a divergent diamond will improve mobility and access of daily commuters to Chesapeake Bay Bridge. Project allows for safe bike and pedestrian access across US 50/301, connecting existing improvements north and south of US 50/301. Thompson Creek service road will allow access to business and allow some traffic to bypass more congested sections of MD 8. Shoulder use on MD 8 North is permitted in limited circumstances at times of severe congestion.	$90,000,000

Table 3 - Transit Expansion Projects: 2040-2050

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
28	MDOT MTA Harford County	Aberdeen MARC Station	US 40 at MD 132 (Bel Air Ave)	TOD, new train station, additional parking, US 40 “Green Boulevard,” and remove pedestrian overpass and replace with Station Square Plaza - a new pedestrian underpass and green, terraced plaza / amphitheater.	Improve service and mobility for current and future riders by addressing capacity, frequency and reliability.	$126,000,000
29	TBD Howard County	US 1 Corridor Bus Rapid Transit	Dorsey MARC Station to College Park Purple Line Station 19.5 miles	Bus Rapid Transit will emulate light rail operation at a lower cost, and is designed to link Howard County commuters from the Dorsey MARC to the Laurel MARC Station and the City of Laurel as well as to College Park and the Purple Line Light Rail.	More closely link the Baltimore and Washington regions to foster greater economic, educational, housing, cultural and recreational opportunities without peak hour and other congestion. Provide increased mobility to the University of Maryland, enhancing educational opportunities and resulting in stronger state investment in the University.	$281,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
• 30 • 31 • 32 • 33 • 34 • 35 • 36 • 37 • 38 • 39 • 40 • 41 • 42 • 43	MDOT MTA 14 Locations throughout the region	MDOT MTA Transit Hubs: • BWI Airport • Glen Burnie • Bayview Medical Center • Camden Station • Johns Hopkins Hospital • Lexington Market • Penn-North • Rogers Avenue • State / Cultural Center • UM Medical Center • Essex • Owings Mills • Patapsco • White Marsh	Jurisdiction: • Anne Arundel • Anne Arundel • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore Co • Baltimore Co • Baltimore Co • Baltimore Co	MDOT MTA has identified transit hub locations as part of the Regional Transit Plan. Typically, a transit hub includes enhanced amenities (shelters, benches, information).	Transit hubs are important for both passengers and operators. Well-situated and well-designed transit hubs can significantly improve transferring from one system, mode or vehicle to another. At a minimum, a transit hub should include amenities such as shelters, benches, real-time information and CCTV for security. Comfort stations will be considered to support bus operators, particularly at terminal stops and stations. Coordinated signage and wayfinding enables customers to make their transfer quickly and easily. Bicycle parking and shared mobility options, and in some cases park-and-ride, help with first mile/last mile access at hubs. TOD is often centered around a transit hub, though not all transit hubs are appropriate for TOD.	• $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000 • $9,000,000
44	MDOT MTA Regional	North-South Transit Corridor	Towson to Downtown Baltimore (potentially Lutherville to Port Covington) 14.0 miles	New North-South transit service to connect Towson to Downtown Baltimore, with associated investments to significantly improve the speed and reliability of transit service in this busy corridor.	Corridor represents a major area of transit infrastructure need. Specific transit routes and/or stations, modes, alignments, or service levels have not been determined. Careful study is required to assess demand and local context before investing in specific transit assets. Corridor is an Early Opportunity Corridor selected for its potential to benefit the highest number of people, jobs and households in the region in the short term. Corridor exhibits strong market demand and represents a critical link in the regional transit system. Corridor serves areas with a high density of jobs and population as well as high concentrations of vulnerable populations.	$2,025,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
45	TBD Regional	Bus Rapid Transit to BWI	Dorsey MARC Station to BWI Light Rail Station 9.7 miles	New bus rapid transit service from the Dorsey MARC station to Arundel Mills to BWI consolidated rental car facility to the BWI light rail station.	Benefit the region by more closely linking the Baltimore and Washington regions via connectivity to the MARC Camden Line, jurisdictions within the Baltimore region, and BWI airport, a major transportation facility. Reduce commuter traffic congestion on major arterials and automobile emissions.	$240,000,000
46*	TBD Regional	Chesapeake Bay Ferry Service		Establish a passenger ferry between numerous ports along the Chesapeake Bay.	Support goal addressing community vitality and economic prosperity by establishing an alternative mode of transportation that supports tourism and economic development.	$59,000,000

**Project does not appear in map*

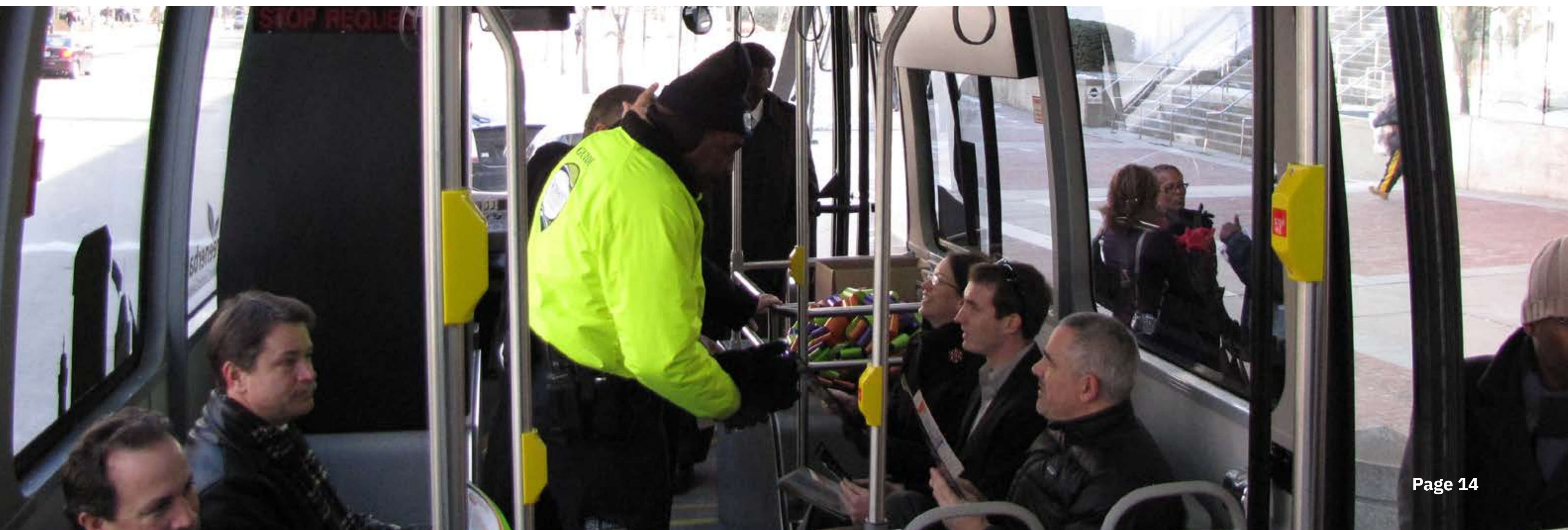


Table 4 - Roadway Expansion Projects: 2040-2050

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
47	MDOT SHA Anne Arundel County	I-97	MD 32 to US 50/301 6.5 miles	Widen from 4 to 6 lanes, adding managed lanes (HOV lanes) to address capacity needs. Investigate need for additional interchange access in Crownsville.	I-97 provides a gateway to the City of Annapolis and the Eastern Shore. Bottlenecks occur on roadway year round. The project will support the US 50/301 improvements (Bay Bridge).	$450,000,000
48	MDOT SHA Anne Arundel County	MD 2	US 50 to MD 100 10.0 miles	Widen existing 4-lane sections to 6 lanes to create a continuous typical section throughout corridor, including intersection improvements and pedestrian facilities throughout to connect MD 2 to the B&A Trail at various locations.	Address existing congestion, improve lane utilization and accommodate high volumes of MD 2 traffic utilizing TSMO strategies.	$205,000,000
49	MDOT SHA Anne Arundel County	MD 214	MD 424 to Shoreham Beach Road 7.5 miles	Project includes travel lane extensions from 2 to 4 lanes east of MD 2, bicycle improvements throughout most of the corridor and pedestrian improvements in segments. Traffic signal warrant assessments recommended at MD 214 / Riva Road and MD 214 / Stepneys Lane intersections.	MD 214 provides an essential link between the Edgewater area to the rest of the County and the Washington D.C. region. It serves local traffic in Edgewater as well as commuters traveling to job centers in Washington D.C., Fort Meade, the NSA and Annapolis. Proposed improvements include bicycle and pedestrian infrastructure for improved safety as well as intersection improvements and some segments of additional through lanes for congestion relief.	$236,000,000
50	MDOT SHA Anne Arundel County	MD 175	Reece Road to MD 170 2.7 miles	Widen from 4 to 6 lanes, including improvements at the MD 32 interchange, and bicycle and pedestrian facilities.	Support the growth of cyber-security activities at Fort Meade by relieving congestion with added travel lanes, improving traffic operations with access controls in the form of a center median, and supporting multimodal access to this major employment hub with extensive bicycle and pedestrian facilities.	$277,000,000
51	MDOT SHA Anne Arundel County	MD 177	MD 2 to Lake Shore Drive 6.1 miles	Widen from 2 to 4 lanes, including intersection improvements and improved bicycle and pedestrian infrastructure in accordance with the County Study and MDOT SHA MD 177 Operational Analysis.	Reduce vehicle crashes by installing a median island, improve capacity at various intersections, widen segments of MD 177, and provide bicycle and pedestrian infrastructure where none currently exists.	$223,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
52	MDOT SHA Anne Arundel County	MD 295	MD 100 to I-195 3.27 miles	Widen from 4 to 6 lanes, including a new full interchange at Hanover Road and an extension of Hanover Road from the CSX railroad tracks to MD 170.	Support economic growth at BWI. Relieve congestion and improve freight movement by adding one lane to MD 295 in both directions. Develop a key component of the local network with the Hanover Road interchange and extension.	$393,000,000
53	MDOT SHA Anne Arundel County	MD 713	MD 175 to MD 176 2.6 miles	Construct corridorwide improvements including reconstruction and widening, intersection improvements and bicycle and pedestrian accommodations. Primary widening is from 2 to 4 lanes between MD 175 and Stoney Run Drive.	Widen the roadway and improve intersections to address congestion. Reconstruct the roadway to include sidewalk and shared use paths to improve bicycle and pedestrian safety and facilitate existing transit along the corridor. MD 713 connects Fort Meade and NSA to Arundel Mills and by connecting to MD 176, improves access for all modes to BWI Airport.	$68,000,000
54	MDOT SHA Baltimore County	MD 7 at MD 43 Interchange		Upgrade interchange from partial to full, including two new ramps to accommodate full movements at interchange.	Improve mobility through the corridor and provide another important link between the MD 43 corridor and White Marsh Town Center in the White Marsh growth area.	$82,000,000
55	MDOT SHA Carroll County	MD 140	Market Street to Sullivan Road 2.5 miles	Widen from 6 to 8 lanes, with a full interchange at MD 97, continuous flow intersections at Center Street and Englar Road, and bicycle and pedestrian facilities.	Improve mobility and provide additional capacity for planned growth and economic development within Westminster.	$474,000,000
56	MDOT SHA Carroll County	MD 26	MD 32 to the Liberty Reservoir 2.5 miles	Widen from 4 to 6 lanes, including a raised median, intersection improvements, and pedestrian facilities.	Addition of a median and partial access controls will improve safety along the corridor. Continuous pedestrian facilities will improve multimodal access to employment and service centers.	$120,000,000
57	MDOT SHA Carroll County	MD 27 Corridor Improvements	Carroll County line to Leishear Road 3.2 miles	Widen to a consistent four lanes, including dedicated turn lanes, signalized traffic control, boulevard separation of lanes, and controlled intersections to allow pedestrian crossings.	The MD 27 corridor serves the needs of Frederick and Carroll Counties, and is a vital link between I-70 and northern Carroll County. Several large undeveloped parcels in this area are targeted for significant employment and residential uses.	$78,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
58	MDOT SHA Carroll County	MD 32	Howard County Line to MD 26 3.36 miles	Widen from 2 to 4 lanes with pedestrian and bicycle facilities.	Addition of two lanes addresses anticipated traffic growth. Construction of a median and access controls will increase safety in the corridor. Pedestrian and bicycle facilities will improve multimodal connections.	$66,000,000
59	Harford County	Abingdon Road	MD 924 to US 40 3.0 miles	Capacity improvements including turn lanes, bicycle lanes and sidewalks.	Improve safety and pedestrian access from commercial areas along MD 924 to residential communities to the east.	$87,000,000
60	Harford County	Perryman Access - Mitchell Lane	US 40 in the vicinity of Mitchell Lane to Canning House Road 2.0 miles	Construct a new 2-lane road and bridge over Cranberry Run in Perryman, including turn lanes and bicycle and pedestrian access.	Improve access, mobility and safety into and out of the Perryman Peninsula for passenger and freight traffic as well as bicyclists, pedestrians and transit users. Roadway will be the primary access for residential developments in the western part of the peninsula and to the north of the Amtrak railroad tracks.	$62,000,000
61	Harford County	Thomas Run Road	MD 22 to West Medical Hall Road 0.8 miles	Streetscape and capacity improvements, including center turn lane, sidewalks, bicycle accessibility, pedestrian-scale lighting with banners, crosswalks and street furniture.	Partnership between Harford Community College and Towson University will bring expected growth and planned expansion. Project will improve safety, mobility and access for passenger traffic, bicyclists and pedestrians on and around these campuses.	$21,000,000
62	MDOT SHA Harford County	MD 152	US 1 to I-95 4.3 miles	Capacity improvements including turn lanes and bicycle and pedestrian access where applicable.	Improve access, mobility and safety for passenger and freight traffic as well as bicyclists, pedestrians and transit users.	$103,000,000
63	MDOT SHA Harford County	MD 22	MD 543 to I-95 7.9 miles	Widen existing 2 and 3 lane sections to 4 and 5 lanes, including an HOV lane from Old Post Road to the Aberdeen Proving Ground (APG) gate, bicycle and pedestrian access, and transit queue jump lanes and transit priority system where applicable.	MD 22 corridor is a major east west arterial in Harford County connecting the municipalities of Bel Air and Aberdeen with direct access to the main APG gate. The road has interchanges with I-95 and US 40. A segment of the roadway is designated as part of the East Coast Greenway.	$221,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
64	MDOT SHA Harford County	MD 24	US 1 Bypass to south of Singer Road 5.0 miles	Widen from 4 to 6 lanes, including sidewalks and bicycle accommodations where appropriate.	Increased traffic volumes continue to stress the roadway network in and around the town of Bel Air. The MD 24 corridor links Bel Air, Forest Hill and communities in the northern part of Harford County with I-95 and the US 40 corridor.	$128,000,000
65	MDOT SHA Harford County	MD 24 (Rock Spring Road)	US 1 Bypass to MD 23 1.8 miles	Add travel lane in each direction (widen from 2 to 4 lanes), including turn lanes and completion of shared use path adjacent to the roadway from Forest Valley Road to Red Pump Road.	Increased traffic volumes continue to stress the roadway network in and around the Town of Bel Air. This section of roadway is a gateway into the County's growth area from rural northern Harford County communities.	$44,000,000
66	MDOT SHA Harford County	MD 24 at Singer Road Interchange		Elevate grade of cross street through movement as well as left turn movements from all directions while allowing MD 24 through and right turn movements as well as side street right turn movements to operate with free-flowing movements as described in MD 924 study.	Reduce congestion and improve safety and operations by transforming an at grade intersection into a full grade separated intersection.	$182,000,000
67	MDOT SHA Harford County	US 1	MD 152 to MD 147 / US 1 Business 1.3 miles	Widen from 4 to 6 lanes, including bicycle and pedestrian accommodations.	Increased traffic volumes continue to stress the roadway network in and around the Town of Bel Air. US 1 is a major transportation corridor linking Bel Air with northeast Baltimore County.	$212,000,000
68	MDOT SHA Harford County	US 1	Baltimore County Line to MD 152 1.4 miles	Add travel lane in each direction (widen from 4 to 6 lanes), including turn lanes and bicycle and pedestrian access where applicable.	Improve the safety and operational characteristics of US 1.	$35,000,000
69	MDOT SHA Harford County	US 1 Bypass	MD 147 / US 1 Business to Hickory Bypass 4.6 miles	Widen from 2 to 4 lanes and improve US 1 / MD 24 and US 1 / MD 924 interchanges.	Reduce congestion with added roadway capacity. Interchange improvements will improve safety and operations. Support economic development and improve quality of life in Harford County communities.	$354,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
70	MDOT SHA Harford County	US 40	MD 543 to Loflin Road 1.7 miles	Widen from 4 to 6 lanes, including turn lanes, a partial interchange reconstruction at MD 543 and bicycle and pedestrian access.	Project can relieve some of the congestion on I-95 by providing local travelers an alternate route. Includes bicycle and pedestrian improvements.	$93,000,000
71	MDOT SHA Harford County	US 40 at MD 22 Interchange		Make capacity improvements, reconfigure the existing interchange, restrict all left turn movements (allowing room for designated bike lanes), and relocate the existing signal from MD 22 to US 40.	Improve capacity and safety at this interchange for passenger, freight and transit traffic as well as bicyclists and pedestrians.	$48,000,000
72	MDOT SHA Howard County	MD 100 Widening	I-95 to Anne Arundel County line 2.0 miles	Widen from 4 to 6 lanes with additional merge/diverge lanes.	MD 100 experiences daily capacity and safety issues (merging/weaving), especially during peak periods that negatively impact commuting, freight / commercial and regional traffic as well as air quality and energy use. Local traffic diverts to local road networks, overloading the capacity and operational capability of these roadways. Widening MD 100 east of I-95 will relieve these problems as well as accommodate increasing demand for MD 100. Prior investment for initial MD 100 construction will be positively augmented by further investment.	$47,000,000
73	MDOT SHA Howard County	MD 108	Trotter Road to Guilford Road 1.67 miles	Improvements as articulated in the 2014 Clarksville Pike Streetscape Plan & Design Guidelines / Traffic Study. Includes selected road capacity enhancements, sidewalks, shared use paths and traffic signal upgrades.	Current road design negatively impacts existing and newly developing commercial land uses. In coordination with private sector development, project will deliver operational and safety improvements. Project will improve mobility to MD 32 and provide for safe access for pedestrians and cyclists along the corridor.	$64,000,000
74	MDOT SHA Howard County	MD 175	Oceano to Anne Arundel County Line 0.54 miles	Widen from 2 to 4 lanes, including bicycle, transit and pedestrian improvements consistent with Anne Arundel County widening proposals.	Improve multimodal inter-jurisdictional traffic. Improve housing, commuting and freight options (to / from the Baltimore region). Provide benefits to new and existing communities and commercial land uses through access for all travel modes. Facilitate freight access to / from Dorsey Run Road and MD 295 and access to the MARC Camden and Penn lines.	$24,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
75	MDOT SHA Howard County	MD 175 at I-95 Interchange	1.0 miles	Improve existing full interchange consistent with preferred options in the MDOT SHA MD 175 Improvement Study.	Reduce congestion and improve mobility at this critical point on the regional and national highway network and support freight movement to and from distribution centers in the area.	$196,000,000
76	MDOT SHA Howard County	MD 32	North of I-70 to Carroll County Line 4.0 miles	Widen from 2 to 4 lanes to provide safety, capacity, operational and access improvements on MD 32.	MD 32 connects high growth area of Carroll County with growing job markets in Howard County.	$79,000,000
77	MDOT SHA Howard County	US 1	Baltimore County Line to MD 175 5.5 miles	Widen from 4 to 6 lanes and construct the revised typical section in the State / County MOU for US 1 revitalization, including connecting community destinations in the US 1 corridor to support safety and access as per the US 1 safety evaluation, functional plans and the regional active transportation priority project.	Improve access, mobility, safety and enhance economic activity and opportunity on the corridor by: (a) Enhancing safe and secure access from communities to US 1 and providing safe passage for drivers, pedestrians and cyclists along US 1, which is also supported as a regional active transportation project. (b) Enhancing freight movement by providing sufficient capacity and operations improvements for the corridor's freight and distribution sector. (c) Addressing documented safety hot-spots. (d) Supporting land use and planning efforts to residential and commercial areas. (e) Supporting local and state efforts to support freight mobility in the county and region.	$205,000,000
78	MDOT SHA Howard County	US 1 at MD 175 Interchange	0.5 miles	Construct a new grade-separated Single Point Urban Interchange, with MD 175 passing over US 1.	Support commercial revitalization of the US 1 corridor by relieving congestion with a grade separated interchange. Improve safety by removing at grade turning movements.	$184,000,000
79	MDOT SHA Howard County	US 1 Revitalization Breakout Projects	MD 175 to Whiskey Bottom Road 4.5 miles	Widen from 4 to 6 lanes along with bicycle, pedestrian, transit, streetscape and access improvements consistent with the US 1 Design Manual. Involve the private sector development community under the auspices of the US 1 State / County MOU and the US 1 Design Manual.	Enable active transportation modes and improve access to affordable housing and commuting options for households and employees in the region. Improve access, safety, and active transportation options for existing and new communities and businesses. Eliminate bottleneck locations such as the skewed intersection at Guilford Road. Improve freight movements. Enhance prior investment in this Priority Funding Area.	$166,000,000

System Preservation Projects

Including further details on large-scale system preservation projects in *Resilience 2050* demonstrates the increasing importance of system preservation, also observed at the national and state level. As our transportation infrastructure ages, system preservation expenditures comprise an increasing share of transportation budgets. This section details only the thirteen specific system preservation projects submitted for *Resilience 2050* and is not reflective of all anticipated system preservation investments from 2028-2050. A summary of estimated system preservation expenditures by category from MDOT MTA and MDOT SHA is included in Chapter 6.

Tables 5-7 beginning on the next page provide details on system preservation projects. The ID corresponds to the project letters on Map 1 on page 3.

As our transportation infrastructure ages, system preservation expenditures comprise an increasing share of transportation budgets.

Table 5 - Transit System Preservation Projects: 2028-2039

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
A	MDOT MTA Baltimore City	Eastern Bus Division		Reconstruct the Eastern Bus Division as an electric bus facility.	Allow for an expanded fleet and enhance MDOT MTA's ability to transition to a zero emission fleet. Reduce noise pollution, improving the work environment for operators, mechanics and residents who live in the surrounding area.	$464,000,000
B*	MDOT MTA Regional	Zero Emission Bus Transition Phase 1	MDOT MTA's core service area in the Baltimore region	Transition 50% of MDOT MTA's 760-bus fleet to zero-emission by 2030. Includes procurement of over 350 Battery Electric Buses by 2030, training the transit workforce, and retrofitting Kirk and Northwest bus divisions with charging infrastructure. Beyond 2030, the MDOT MTA is preparing to have a 95% zero-emission fleet by 2045.	Improve the region's overall air quality while providing passengers with a comfortable ride. MDOT MTA projects that about 500 million pounds of carbon dioxide emissions will be avoided through use of electric buses instead of diesel buses between 2025 and 2030. Reduce noise pollution, improving the work environment for operators and mechanics, as well as residents who live in the surrounding area. Transition plan updates and ongoing studies will seek to build on those benefits beyond 2030.	$1,594,000,000
C*	MDOT MTA Regional	Light Rail Fleet Mid-life Overhaul	Hunt Valley to BWI/Glen Burnie	Overhaul the entire Light Rail fleet, extending the fleet's life by approximately 15 years, improving safety and reliability, providing a more comfortable and secure ride, and lowering maintenance costs.	Ensure safe operation, reduce ongoing maintenance costs, increase vehicle reliability and availability, and increase passenger comfort and security.	$210,000,000

**Projects do not appear in map*

Table 6 - Roadway System Preservation Projects: 2028-2039

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
D	Baltimore City	Druid Park Lake Drive Complete Streets	Greenspring Ave in the northeast to I-83 in the southeast along Druid Hill Park 2.17 miles	Redesign Druid Park Lake Drive to implement guidelines and recommendations in the City's Complete Streets Manual. Reduce automobile traffic by removing travel lanes and adding or improving infrastructure and accessible connections for pedestrians, the handicapped, bicyclists, transit users, and e-scooters.	Baltimore residents indicated overwhelming support for a redesign of Druid Park Lake Drive during public engagement. The 15% design concepts are a starting point for the transformation of the corridor that would make it safe and easy for residents to utilize all of the modes of transportation available to them, enable them to access the excellent park in their backyards, rebuild property values, improve public health, and raise the quality of life for thousands of residents.	$43,000,000
E	Baltimore City	Keith Avenue / Broening Highway Improvements	Clinton Street to the Baltimore City Line Southeast of Ralls Avenue 2.5 miles	Keith Avenue and Broening Highway are part of Baltimore City's critical freight route network, connecting I-95 and the Seagirt and Dundalk Terminal Port facilities. Improvements are needed to upgrade roadway conditions, improve wayfinding, and integrate complete street amenities to better accommodate safety for transit, pedestrians and bicyclists.	Both Keith Avenue and Broening Highway are concrete roadways including a prestressed concrete girder bridge. Concrete slabs in the roadway are deteriorated with joints spalling and the roadways are structurally deficient and functionally obsolete. The ramp bridges on Keith Ave and Colgate Creek are currently weight restricted due to its state of disrepair. As a result, weight restricted trucks have to travel through existing neighborhoods, increasing noise and environmental pollution.	$84,000,000
F	Baltimore City	Russell Street Complete Streets Improvements	Annapolis Road to South Greene & South Paca Streets 1.0 mile	Russell Street (MD 295) in south Baltimore is in need of investments to improve asset conditions and multimodal Complete Streets infrastructure for automobile traffic as well as pedestrian, transit and freight movement. Transportation improvements will support safe mobility and economic development in the city's growing southern edge and Camden Yards.	Russell Street is the gateway to the city of Baltimore and to downtown and south Baltimore for travelers from Washington and the central Maryland suburbs. This corridor serves as an endpoint of the BW Parkway, and as a link to MD 295, I-95, and several MDOT MTA CityLink and CommuterLink bus routes. This corridor also serves as an important connection for the historically disadvantaged, low-income, and minority communities to job centers in the Carroll-Camden industrial area, BWI Airport, Downtown Baltimore, Anne Arundel County, and points south. The road is in poor condition and difficult to use for walking or biking given the excessive speeding of vehicles and freight traffic. Corridor improvements with multimodal accommodations and traffic calming will ensure this corridor offers a safe, reliable, and accessible Complete Streets connection to leverage economic development and community revitalization.	$54,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
G	Baltimore City	US 40 Highway Deconstruction	Smallwood Street to Greene Street 1.5 miles	US 40 is a depressed expressway built in the 1970s cutting through neighborhoods in West Baltimore. It was intended to connect with I-70, but that connection was never made. Building this fragment of an expressway has caused irreparable damage to community cohesion and economic stability. Deconstructing the highway will offer over 60 acres for redevelopment and improvements to adjacent streets.	When this highway was built in the 1970s, it obliterated 16 blocks of an established community, causing damage to the community fabric, cohesion and economic opportunities. The expressway never connected to its intended destination of I-70, and is a fragment that provides no real value to the transportation network. Instead, it serves as an omnipresent scar of a time when urban, low-income, black communities were impacted at the expense of highways for suburban and more affluent drivers. The space this expressway occupies offers over 60 acres of redevelopment opportunities that could benefit the community impacted by the construction 50 years ago. The area today is a low-income, black community with limited car ownership, educational attainment, jobs, and amenities. Deconstructing US 40 provides new opportunities for complete street retrofits and new economic development that can repair what had been lost to improve quality of life.	$157,000,000
H	Baltimore City	Vietnam Veterans Memorial Bridge and Hanover / Potee Street Corridor Improvements	Patapsco Avenue to Wells Street 2.2 miles	Rehabilitate or replace the Vietnam Veterans Memorial Bridge and improve multimodal Complete Streets infrastructure along the Hanover / Potee Streets (MD 2) corridor in south Baltimore. Transportation improvements will improve accommodations for pedestrians, bicycles, transit, freight, and auto traffic to support safe mobility and economic development.	The Vietnam Veterans Memorial Bridge, built in 1916, is past its service life and is not suited to today's transportation needs. This corridor serves as a freight connection between MDOT MPA's Port of Baltimore and I-95 and as a transit connection for several MDOT MTA CityLink bus routes. Furthermore, this corridor serves an important connection for the historically disadvantaged, low-income, and minority Cherry Hill, Brooklyn, and Greater Baybrook communities to job centers in Port Covington, Downtown Baltimore, the Port of Baltimore, and points south in Anne Arundel County. The bridge cannot safely accommodate bicycles, sidewalks are not ADA compliant, and the roadway is a one-way pair with excessive speeding. Corridor improvements with multimodal accommodations and traffic calming will ensure this corridor offers a safe, reliable, and accessible Complete Street connection to leverage economic development and community revitalization.	$339,000,000

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
I	MDOT SHA Carroll County	MD 31 Corridor Improvements	MD 31 from Church Street to High Street and High Street from Main Street to Coe Drive 0.67 miles	Improve sidewalks, enhance bicycle and pedestrian accessibility, and improve the roadway.	Stabilize roadway infrastructure and improve bicycle and pedestrian access to an existing commercial center.	$16,000,000
J	MDOT SHA Carroll County	MD 851 Urban Reconstruction	Cooper Drive to South Branch of the Patapsco River 1.04 miles	Roadway reconstruction and improvements to pedestrian and bicycle facilities, as well as streetscape amenities.	Project will help restore Sykesville's historic Main Street to an attractive and pedestrian-friendly urban local roadway.	$16,000,000

Table 7 - Transit System Preservation Projects: 2040-2050

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Justification	Estimated Cost (YOE)
K*	MDOT MTA Regional	Fleet Replacement with Low-Floor Rail Vehicle		Transition to low-floor Light Rail Vehicles when replacement is needed. This will require significant station retrofits, modifying maintenance facilities, and amending standard operating practices.	Light Rail systems are increasingly moving toward vehicles and platforms providing "level boarding," in which customers can move from the station platform to the main level of the train without steps or grade changes. This design better accommodates individuals with mobility issues requiring walking aids or wheelchairs or those with strollers or other large items without necessitating "high blocks" or ramps to the wheel-chair accessible door on the Light Rail vehicle.	$757,000,000
L*	MDOT MTA Regional	Zero Emission Bus Transition Phase 2	MDOT MTA's core service area in the Baltimore region	Transition to a 95% zero-emission fleet by 2045. Capital costs for phase 2 are rough estimates and include retrofitting for Washington Boulevard, a 5th Division, and Battery Electric Buses.	Improve the region's overall air quality while providing passengers with a comfortable ride. Reduce noise pollution, improving the work environment for operators and mechanics, as well as residents who live in the surrounding area. Transition plan updates and ongoing studies will seek to build on those benefits.	$2,228,000,000
M*	MDOT MTA Regional	MARC Rolling Stock Overhauls and Replacements	All three MARC lines (Penn, Camden, Brunswick)	Short-term, medium-term, and long-term plans to replace and overhaul MARC locomotives and train sets, including: • GP39H-2 Locomotive Mid-Life Overhaul • MP36PH-3C Mid-Life Overhaul • MARC III and MARC IV Railcar Overhaul • Railcar Fleet Replacement • Locomotive Fleet Replacement	Enhance the rider experience, providing safer and pleasant train service. Improve operational efficiency, with more system reliability and on-time train arrivals and departures. New train sets and locomotives will be environmentally friendly, resulting in lower carbon emissions.	$570,000,000**

**Projects do not appear in map*

***Project benefits multiple MPO regions. Cost listed is 50% of total project cost of $1.14 billion.*

Small Program Set-Asides: 2028-2050

We have set aside funds to support various strategies intended to improve air quality due to the Baltimore region's nonattainment status in regards to the National Ambient Air Quality Standards (NAAQS). These strategies can increase transportation system efficiency or employ Transportation Demand Management (TDM) approaches to reduce travel demand of single-occupancy vehicles (SOV). Transportation system efficiency strategies rely primarily on managing existing transportation facilities, rather than building new capacity. TDM refers to various strategies that change travel behavior (how, when, and where people travel) to increase transportation system efficiency. Together, these types of strategies contribute to cleaner air and a safer transportation system. Although most individual strategies only affect a small portion of total travel, the cumulative impacts of a wide range of strategies can be significant. Objectives that can be addressed through this funding include managing congestion, reducing emissions, promoting equity and improving safety.

We approved a total of $250 million for these set-asides from the $12.062 billion in anticipated expansion revenues from federal and state sources detailed in the financial forecast (see Chapter 6). Examples of the kinds of programs and strategies the region can consider implementing during the life of the plan include:

> **Transportation System Management and Operations (TSMO) Strategies:** TSMO includes a set of strategies intended to optimize the performance of existing infrastructure through the implementation of systems, services and projects designed to preserve capacity and improve security, safety and reliability of the transportation system. This means using technology and enhanced agency coordination to operate the existing transportation system as safely, reliably and efficiently as possible. Typically, TSMO projects cost less than projects that add capacity, such as construction of a new lane, and they take significantly less time to implement.

Example strategies drawn from MDOT's 2018 TSMO Strategic Plan include:

- Incorporate TSMO in MDOT SHA policies, programs and standard practices
- Implement and institutionalize a TSMO Master Plan
- Promote a culture to mainstream TSMO within and outside MDOT SHA at all levels
- Develop and implement Advanced Traffic Management Systems with Active Traffic Management capabilities
- Develop Integrated Corridor Management capabilities for multimodal passenger and freight movement

- Develop and apply technological foundations for Connected and Automated Vehicles (CAV)
- Implement a comprehensive data-driven performance management program to support TSMO
- Advance data governance, analysis and modeling capabilities to inform planning, operational and TSMO decisions
- Provide reliable and accessible real-time modal choice information to customers
- Raise awareness of TSMO and its general understanding by the traveling public

> Complete Streets Strategies:

The increased awareness of the needs of all transportation system users, including active transportation users, is the basis of Complete Streets. Complete Streets focuses on creating roadways that are safe and comfortable for all users and that increase equity and access to destinations. Recognizing the importance of active transportation and Complete Streets, many jurisdictions in the Baltimore region have drafted and adopted Complete Streets policies and plans.

The Complete Streets concept focuses not only on individual roadways but also on changing the decision making and design processes to consider the needs of all users during the planning, design, construction and operation of all roadways. If done in advance as an integrated best practice and not as an afterthought, a Complete Streets approach can reduce the need for retrofitting and making safety and accessibility improvements after projects are built.

The following list presents some potential investments that follow a Complete Streets approach:

- Improve sidewalks, crosswalks, paths and bike lanes
- Correct specific roadway hazards to non-motorized transport
- Accommodate people with disabilities and other special needs
- Develop pedestrian oriented land use and building design
- Provide street furniture and design features
- Implement traffic calming, traffic speed reductions and road space reallocation
- Integrate biking and walking facilities with transit
- Provide bicycle parking

> Transportation Emission Reduction Measures (TERMS):

The Baltimore region is an EPA-designated nonattainment area for the ground level ozone standard. As the metropolitan planning organization for the Baltimore region, we are required to ensure that transportation planning takes into account air quality through the transportation conformity process (described in Chapter 1).

There are a variety of TERMs that can help mitigate the effects of pollution from automobiles, trucks, and other mobile sources on air quality. The following list of TERMs includes examples of promising measures that, when implemented together, can reduce emissions of criteria pollutants and greenhouse gases in a meaningful way:

- **Technologies:** Fleet bus replacement, truck replacement incentives, incentives/technologies to improve truck fleet efficiency and reduce idling, retrofit highway construction and maintenance equipment, electric vehicle charging infrastructure and promotion of electric vehicles.
- **Capital Improvements:** Park-and-ride lots and virtual truck weigh stations.
- **Land Use:** TOD and mixed-use land use practices.
- **Behavioral Strategies:** Promotion of eco-driving, clean commuting, reduced idling and teleworking as well as incentivizing changed behavior through programs such as Commuter Choice, Guaranteed Ride Home and rideshare coordination.

> **Active Transportation:** Active transportation is critical to the Baltimore region's transportation system and includes bicycling, walking and use of electric scooters, electric bicycles and wheelchairs. A connected and safe active transportation network benefits the entire region by improving equitable access to destinations that meet the daily needs of a diverse group of users. This can include connections to transit systems, schools, jobs, core services, parks and more. Broadening transportation choices and potentially increasing active transportation use can increase job opportunities, increase physical activity, reduce motor vehicle traffic congestion on roadways, provide tourism opportunities and increase economic competitiveness.

Our Bicycle and Pedestrian Advisory Group worked with local jurisdictions, state agencies and other stakeholders in 2022 to identify the top active transportation priorities in the Baltimore region. We elected to include the full list of active transportation priorities as part of the set-aside funding. Table 8 lists these active transportation priorities, with the corresponding locations shown in Map 2.

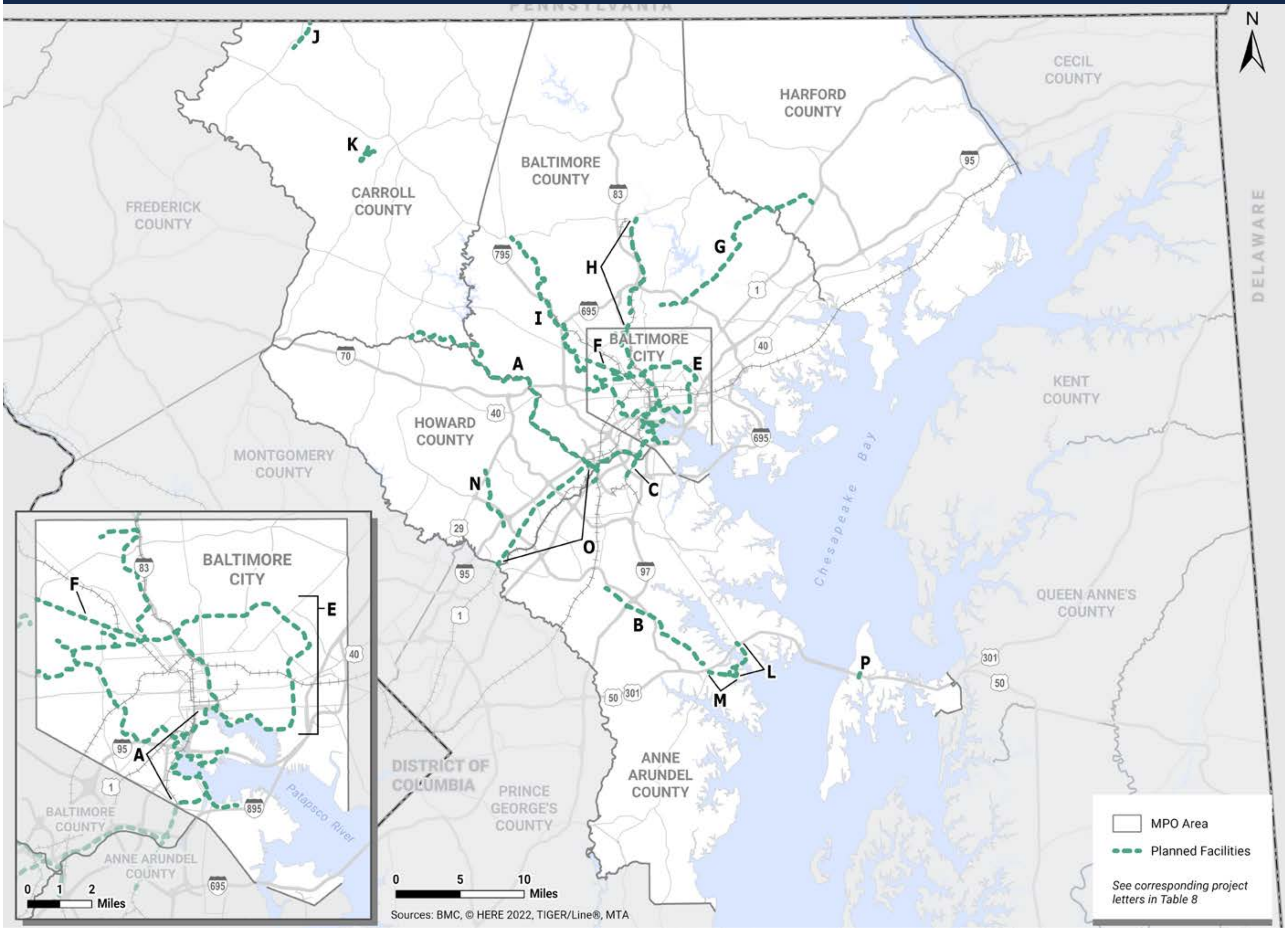
A connected and safe active transportation network benefits the entire region by improving equitable access to destinations that meet the daily needs of a diverse group of users.

Table 8 - Top Regional Active Transportation Priorities (see corresponding letters in Map 2 on the next page)

Map ID	Priority Project	Location	Length
A	Complete the Patapsco Regional Greenway	Region-wide	40 miles
B	Complete the South Shore Trail Missing Segments	Anne Arundel County	13.14 miles
C	Connect BWI Trail Loop to the Gwynns Falls Trail	Anne Arundel County	1.3 miles
D*	Citywide ADA Infrastructure Improvements	Baltimore City	N/A
E	Complete the Baltimore Greenway Trail Network	Baltimore City	35 miles
F	Separated Bicycle Facilities along Liberty Heights	Baltimore City	3.5 miles
G	Connection through Baltimore County to Ma & Pa Trail in Harford County	Baltimore County and Harford County	17.3 miles
H	Torrey C. Brown/NCR Trail Connections	Baltimore County	7 miles
I	Gwynns Falls Trail Connection	Baltimore County	18 miles
J	Northwest Trail	Carroll County	5.6 miles
K	Wakefield Valley Park Bicycle & Pedestrian Trail System	Carroll County	8 miles
L	B&A Trail - Annapolis Extension	City of Annapolis and Anne Arundel County	4.3 miles
M	Shared Use Path and Sidepath along West East Express	City of Annapolis	2.2 miles
N	Patuxent Branch Trail Completion	Howard County	6 miles
O	Shared Use Path and Sidewalk along US 1 Corridor	Howard County	10.9 miles
P	Connect the Cross Island Trail and South Island Trail	Queen Anne’s County	3 miles

**Project does not appear in map*

Map 2 - Top Regional Active Transportation Priorities
(See corresponding project letters in Table 8)



Set-Aside Funding for Locally Operated Transit Systems

We have also elected to set aside $30 million for Locally Operated Transit Systems (LOTS) in the Baltimore region. LOTS in the Baltimore region include Annapolis Transit, Anne Arundel County Transit, Baltimore City's Charm City Circulator, Baltimore County CountyRide and Towson Loop, Carroll County Trailblazer, Harford TransitLINK, Queen Anne's County Ride and the Regional Transportation Agency of Central Maryland.

Potential uses of these funds include capital expenses such as the purchase of vehicles, equipment and facilities or operating expenses such as utilities, miscellaneous equipment, fuel and oil and driver, maintenance staff and administrator salaries.

Resilience 2050 must also account for projects funded by other sources such as MDTA toll revenues that affect air quality and travel demand.

Projects and Programs from Other Funding Sources: 2028-2050

The federally funded projects in the *Resilience 2050* preferred alternative are anticipated to use funds from FHWA and FTA. However, *Resilience 2050* must also account for projects funded by other sources that affect air quality and travel demand. These include projects funded by MDTA toll revenues and the FRA, as well as one former LRTP project that is now included in a neighboring MPO's LRTP.

Maryland Transportation Authority Projects

The MDTA is an independent agency responsible for managing, operating and improving the state's toll facilities. Because MDTA projects are funded by tolls, they are not included in the listing of projects to be supported with federal funds. *Resilience 2050*, however, must account for these projects because of their effects on air quality conformity and travel demand.

Table 9 shows the projects MDTA expects to implement by 2050. We included these projects in the master network of programmed and planned system improvements. We analyzed this master network to determine air quality conformity and to predict system-wide travel demand effects. Appendix C shows the results of these analyses.

Table 9 - MDTA Projects: 2028-2050

Year	Jurisdiction	Name	Limits/Length	Description
2028	Baltimore City	I-895/Baltimore Harbor Tunnel Toll Plaza and Interchange Improvements	K-Truss Bridge to Baltimore Harbor Tunnel 0.7 miles	Remove toll booths and install an overhead gantry at the I-895/Baltimore Harbor Tunnel Toll Plaza, providing two lanes of barrier-separated mainline through-traffic in each direction along I-895 between the K-Truss bridge and the Baltimore Harbor Tunnel. In addition, install a separated collector distributor road in each direction adjacent to the mainline traffic lane between the I-895 interchanges with Frankfurst Avenue and Childs Street. Mainline I-895 modifications include replacing and raising the I-895 bridge over Frankfurst Avenue, replacing the I-895 bridge over Childs Street, and removing the I-895 bridge over the toll facility campus storage area.
2029	Baltimore City	I-95: Port Covington Access Improvements	Caton Avenue to Fort McHenry Tunnel 7.0 miles	Improve I-95 ramps along approximately 7 miles of I-95 and sections of Hanover Street, McComas Street, and Key Highway. Improvements include: 1. I-95 Northbound Off-Ramps: (a) Exit 52, new ramp from Russell Street off-ramp; (b) Exit 53 interchange, new spur from I-395 southbound ramp; (c) Exit 54, remove ramp from I-95 northbound to Hanover Street southbound; and (d) Exit 55, reconstruct ramp from I-95 northbound to McComas Street 2. I-95 Northbound On-Ramps: new ramp from McComas Street to I-95 northbound 3. I-95 Southbound Off-Ramps: new ramp from I-95 southbound to McComas Street westbound 4. I-95 Southbound On-Ramps: realign ramp from McComas Street westbound to I-95 southbound 5. Hanover Street: reconstruction from CSX Bridge to McComas Street westbound to I-95 southbound 6. McComas Street and Key Highway: (a) realign McComas Street; and (b) widen Key Highway between McHenry Row and McComas Street 7. Pedestrian and Bicycle Connections: (a) new sidewalks along Hanover Street and realigned McComas Street; (b) shared use path along Key Highway; and (c) shared use path linking South Baltimore to Port Covington peninsula.

Federal Railroad Administration Projects

MDOT MTA submitted several large-scale projects that are anticipated to use funds from the FRA. The regional LRTP over which we have jurisdiction does not cover FRA-funded projects. These projects are listed in Table 10.

Table 10 - FRA Projects: 2028-2050

Year	Operating Agency / Jurisdiction	Name	Limits	Description
2028-2039	MDOT MTA Regional	Penn Camden Connector		Increase efficiency by consolidating vehicle maintenance and repair for the Penn and Camden lines, leverage the capital investment in the Riverside Heavy Maintenance Building and facilitate access to a new MARC storage and maintenance facility for Penn Line MARC trains. A new storage and maintenance facility is required as Amtrak's Baltimore Penn Station redevelopment plans do not accommodate the current storage and maintenance at Penn Station.
2028-2039	Amtrak Regional	Frederick Douglass Tunnel/B&P Tunnel Replacement Program	Along the Northeast Corridor and surrounding neighborhoods between Penn Station and Amtrak's Gwynns Falls Bridge	Transform a four mile section of the Northeast Corridor including two new high-capacity electrified tubes, new roadway and railroad bridges, new rail systems and track, and a new ADA-accessible West Baltimore MARC station. Design efforts began in 2020. Amtrak has worked closely with MDOT MTA and other partners to conduct public outreach.
2040-2050	MDOT MTA Regional	BWI Fourth Track from Odenton MARC to Halethorpe MARC	Odenton MARC Station to Halethorpe MARC Station	Construct a new platform and improvements to the current station with possible multi-level TOD and addition of 9 miles of fourth track along the Northeast Corridor Line.
TBD	Amtrak Regional	Susquehanna River Rail Bridge Replacement	Havre de Grace (Harford County) to Perryville (Cecil County)	Replace the existing two-track bridge with 2 new 2-track bridges; realign and reconstruct five route miles of track; and modernize and improve track, catenary and signals for higher speeds. The existing bridge, built in 1906, is owned by Amtrak and is used by Amtrak, Maryland's MARC Commuter Rail and Norfolk Southern Railway to carry passenger and freight trains across the Susquehanna River. The FRA issued a Finding of No Significant Impact (FONSI), for the Susquehanna River Rail Bridge Project. The FONSI completes the National Environmental Policy Act (NEPA) process.

MARC Service Project in WILMAPCO LRTP

Our previous LRTP, *Maximize 2045*, included a project to fill the commuter rail gap in the Northeast rail corridor between Perryville, Maryland and Newark, Delaware. This project is included in the LRTP for the Wilmington Area Planning Council (WILMAPCO) MPO, which includes Cecil County, Maryland. We continue to support this project and its benefits to the Baltimore region, but it is not included in the *Resilience 2050* preferred alternative to avoid double counting the project.

Committed Funding: 2024-2027

As noted, *Resilience 2050* covers the timeframe from 2028 through 2050. To present a complete picture of planned future transportation investments, Table 11 shows the major committed projects within the 2024-2027 period of the current adopted TIP. "Committed" means that a schedule is in place and sponsors have identified fund sources and have committed funds to build these projects by 2027.

Table 11 - Committed Projects: 2024-2027

Year	Operating Agency / Jurisdiction	Name	Limits	Description
2024 / 2027	Maryland Transportation Authority Baltimore and Harford Counties	I-95 Northbound	North of MD 43 to North of MD 24	• Add 2 northbound Express Toll Lanes to MD 152 (2024) and to north of MD 24 (2027) • Reconstruct interchanges at MD 152 and MD 24 along with a 1.7 mile auxiliary lane between the interchanges • Widen MD 24 from 2 to 3 lanes from MD 924 to north of Singer Road • Reconstruct overpasses at Raphel, Bradshaw, Old Joppa, Clayton, and Abingdon Roads • Widen I-95 northbound bridges over the Big and Little Gunpowder Falls and Winters Run
2024	MDOT MTA Baltimore City	Baltimore Arena Transit Hub	Baltimore Street from Howard Street to Hopkins Place	Design and construct a transit transfer facility in downtown Baltimore as outlined in the Regional Transit Plan. Concept facility includes sidewalk expansion to add bus bays, lighting, ADA access, and bus stop amenities on Baltimore Street near CFG Bank Arena.
2024	MDOT SHA Baltimore County	I-695	I-70 to MD 43	Add 1 lane in each direction during am and pm peak using inside shoulder (western and northern portion of I-695).
2025	Anne Arundel County	Odenton MARC TOD Improvements	Odenton MARC Station	Construct a structured parking garage on the state owned surface parking lot to set up the station for future TOD and expanded transportation services

Year	Operating Agency / Jurisdiction	Name	Limits	Description
2025	Howard County	Dorsey Run Road	CSX Railroad to Old Dorsey Run Road	Widen from 2 to 3 lanes (with center turn lane)
2025	Howard County	Marriottsville Road and I-70 Bridge Improvements	South of US 40 to MD 99	Widen from 2 to 4 lanes, improve ramp for I-70 and replace bridge over I-70
2025	Howard County	US 29 / Broken Land Parkway Interchange	3.1 miles of new lanes on ramps and new roadways	Construct new direct connections from westbound US 29 / Broken Land Parkway interchange ramp to new road (Merriweather Drive) and to Little Patuxent Parkway. Construct direct connection from Merriweather Drive to Broken Land Parkway, including configuring north and southbound US 29 ramps at Broken Land Parkway into signalized intersection. Remove existing ramp from Broken Land Parkway to US 29 southbound.
2025	Maryland Port Administration Baltimore City	Howard Street Tunnel		Reconstruct the 125-year-old tunnel to provide double-stack rail access to and from the Port of Baltimore
2025	MDOT SHA Anne Arundel County	MD 175	Sellner Road / Race Road to McCarron Court	Widen from 2 to 6 lanes and reconfigure ramps in the NE and SW quadrants of the MD 295 interchange to create signalized left turns at MD 175. Add a shared use path on the south side of the road and bicycle compatible shoulders.
2026	Anne Arundel County	Parole Transportation Center	Westfield Annapolis Mall	Construct a multimodal transportation center at the Westfield Annapolis Mall to serve existing local and regional bus service. Project design will incorporate possible future connectivity to bikeshare, carshare, and ridehailing services.
2026	Baltimore County	Mohrs Lane Bridge	Bridge over CSX Railroad	Reconstruct bridge closed in 2011 to accommodate 3 lanes of traffic on future Campbell Boulevard
2026	Harford County	Woodley Road Extension to MD 715 (Perryman East - aka Road A)	MD 715 to Michaelsville Road	Construct new 2-lane road in Perryman
2026	MDOT SHA Carroll County	MD 32	2nd Street to Main Street	Improve intersection geometry, extend turn lanes, and modify access along MD 32 from 2nd Street to Main Street
2026	MDOT SHA Harford County	MD 24 (Section G)	900 feet south of Sharon Road to 1,700 feet north of Ferncliff Lane	Resurface and reconstruct roadway, including slope repair and guardrail replacement

Year	Operating Agency / Jurisdiction	Name	Limits	Description
2027	Maryland Transportation Authority Anne Arundel and Queen Anne's Counties	Chesapeake Bay Crossing, Phase II NEPA	Corridor containing the existing Bay Bridge	Conduct Phase II NEPA study on the selected bay crossing location. The Phase II NEPA will evaluate potential impacts of the selected bay crossing location. Phase II NEPA is vital to moving forward with adding additional capacity to cross the Chesapeake Bay.
2027	Maryland Transportation Authority Harford County	I-95 Southbound	Maryland House Travel Plaza to north of the MD 24 overpass	Restripe southbound lanes and improve left shoulder lane to provide part-time left shoulder use, including ITS devices to allow dynamic opening and closing of the left shoulder based on traffic conditions
2027	MDOT SHA Anne Arundel County	I-97 TSMO	US 50 to MD 32	Implement TSMO improvements including peak period hard shoulder running from US 50 to MD 32.
2027	MDOT SHA Baltimore County	I-695	at I-70	Reconstruct interchange and replace existing bridges within the interchange

Illustrative Projects

Federal regulations for metropolitan transportation planning identify the concept of “illustrative projects” as an element of the planning process. These are projects included in a metropolitan transportation plan for illustrative purposes only, meaning that they could be included in the adopted transportation plan if additional funds beyond the reasonably anticipated financial resources identified in the plan were to become available.

There is no requirement to select any project from an illustrative list of projects in a metropolitan plan at some future date, when funding might become available. Nonetheless, illustrative projects can be helpful in guiding transportation and land use planning efforts at both the regional and local levels because they provide a resource from which we can select regional priorities should additional funding become available. Any project amended into the LRTP must show financial resources and air quality impacts.

Table 12 shows the list of illustrative projects for the Baltimore region.

Table 12 - Illustrative Projects – Could be amended into *Resilience 2050* should future funds become available

Operating Agency / Jurisdiction	Name	Limits / Length	Description	Estimated Cost (YOE)
MDTA Anne Arundel County	Chesapeake Bay Bridge	MD 2 to US 50/US 301 Split 21.0 miles	Construct new crossing of the Chesapeake Bay Bridge and widen approach roadways.	Not available
MDOT SHA Anne Arundel County	MD 3	US 50 to MD 32 8.9 miles	Widen from 4 to 6 lanes to provide continuous through lanes throughout the corridor, including intersection improvements, access controls to address safety and bicycle and pedestrian improvements.	$1,422,000,000
MDOT SHA Anne Arundel County	US 50	I-97 to MD 2 5.5 miles	Reconstruct freeway and widen from 6 to 8 lanes including possible managed lanes connecting to I-97 managed lanes and improvements associated with the Bay Bridge on the other side of the project limits, and possible interchange modifications at I-97.	$368,000,000
MDOT SHA Anne Arundel County	MD 32	I-97 to Howard County line 11.0 miles	Widen from 6 to 8 lanes between I-95 and MD-295. Add additional HOV-2 lanes.	$524,000,000
MDOT SHA Anne Arundel County	MD 100	Howard County line to I-97 6.5 miles	Widen from 4 to 6 lanes and possible inclusion of managed lanes.	$299,000,000
MDOT SHA Harford County	MD 24 at Wheel Road		Elevate grade of cross street through movement as well as left turn movements from all directions while allowing MD 24 through and right turn movements as well as side street right turn movements to operate with free-flowing movements (as described in MD 924 study).	$182,000,000
MDOT SHA Howard County	I-70	US 29 to MD 32 6.0 miles	Widen from 4 to 6 lanes, including reconstruction of Marriottsville Road interchange and upgrades to US 29 interchange.	$838,000,000
MDOT SHA Howard County	MD 32	Cedar Lane to Anne Arundel County Line 8.0 miles	Widen from 4 to 6 lanes (Feasibility and Needs Study required), increase capacity at grade-separations, study feasibility of HOV and/or HOT lanes, and improve freight operations and access to Regional Activity Centers.	$1,153,000,000

Operating Agency / Jurisdiction	Name	Limits / Length	Description	Estimated Cost (YOE)
MDOT SHA Howard County	US 29 Widening	MD 100 to I-70 3.2 miles	Widen from 6 to 8 lanes, including a cross-section accommodating US 29 peak traffic volumes and ITS features facilitating movement and safety.	$771,000,000
MDOT MTA Regional	Intercity Connection from Western Maryland to Baltimore and Washington, D.C.		Improve accessibility to Western Maryland, helping to create links to essential services and generate economic development and tourism. Provide a missing commuter link between Baltimore and Frederick.	Not available
MDOT MTA Regional	Intercity Connection from the Eastern Shore to Baltimore and Washington, D.C.		Improve connections to the Eastern Shore to help residents and visitors travel to and from the state's major metro areas.	Not available
MDOT MTA 7 Corridors throughout the region	Early Opportunity Regional Transit Plan (RTP) Corridors: • Morgan State University to South Baltimore • Rogers Ave to City Hall • State Center to Hopkins Bayview • Walbrook Junction to Berea • Ellicott City to Silver Spring • Glen Burnie to South Baltimore • Sparrows Point to Hopkins Bayview	Jurisdiction: • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Regional • Regional • Regional	Early Opportunity Corridors in the RTP are selected for their potential to benefit the highest number of people, jobs, and households in the region in the short term. They include major travel corridors within Baltimore City, and commuter bus links from the suburbs to the region's job centers. All these corridors currently exhibit strong market demand and represent critical links in the regional transit system. The RTP does not specify transit routes and/or stations and does not prescribe modes, alignments, or service levels. Careful study is required to assess demand and local context before investing in specific transit assets.	• $753,000,000 • $861,000,000 • $538,000,000 • $538,000,000 • $1,291,000,000 • $753,000,000 • $646,000,000

Operating Agency / Jurisdiction	Name	Limits / Length	Description	Estimated Cost (YOE)
MDOT MTA 11 Corridors throughout the region	Mid-Term Opportunity Regional Transit Plan Corridors: • Mondawmin to Hopkins Bayview • Mondawmin to South Baltimore • BWI to Columbia Town Center • BWI to Greenbelt • Convention Center to Middle River • Halethorpe to UM Transit Center • Mondawmin to Northwest Hospital • Mondawmin to Reisterstown • North Plaza to UM Transit Center • Towson to South Baltimore • White Marsh to Johns Hopkins Hospital	Jurisdiction: • Baltimore City • Baltimore City • Regional • Regional • Regional • Regional • Regional • Regional • Regional • Regional • Regional	Mid-Term Opportunity Corridors in the RTP are selected for their potential to benefit a high number of people, jobs, and households in the region. These tend to score lower in certain evaluation measures than Early Corridors. Mid-Term Corridors are concentrated in Baltimore City and County, except for two that connect BWI Airport with important population and job centers in Howard and Anne Arundel counties. The RTP does not specify transit routes and/or stations and does not prescribe modes, alignments, or service levels. Careful study is required to assess demand and local context before investing in specific transit assets.	• $1,553,000,000 • $988,000,000 • $2,118,000,000 • $1,835,000,000 • $1,553,000,000 • $847,000,000 • $1,129,000,000 • $1,412,000,000 • $1,553,000,000 • $1,835,000,000 • $1,412,000,000
MDOT MTA 9 Corridors throughout the region	Long-Term Opportunity Regional Transit Plan Corridors: • Glen Burnie to Annapolis • Towson to Hunt Valley • Bel Air to Edgewood • Fallston to APG • Annapolis to Union Station • Ellicott City to BWI • Glen Burnie to Bowie • Laurel to Halethorpe • Odenton to Clarksville	Jurisdiction: • Anne Arundel • Baltimore Co • Harford • Harford • Regional • Regional • Regional • Regional • Regional	Long-Term Opportunity Corridors in the RTP are selected for their potential to benefit areas where transit demand is expected to increase over the next 25 years. These corridors are concentrated on the region's peripheries and tend to connect areas with low existing densities of residents, jobs, and vulnerable populations relative to the region's urban core. However, much of the region's long-term growth is projected to occur in these peripheral areas, and transit markets along these corridors are expected to grow accordingly. The RTP does not specify transit routes and/or stations and does not prescribe modes, alignments, or service levels. Careful study is required to assess demand and local context before investing in specific transit assets.	• $2,400,000,000 • $988,000,000 • $1,271,000,000 • $2,259,000,000 • $1,694,000,000 • $1,976,000,000 • $2,118,000,000 • $1,835,000,000 • $2,400,000,000

“Mega-Regional” Projects

The projects listed below are outside the scope of this regional transportation plan. Currently, these projects are under study, but most have not progressed to the point where their sponsors have identified funds reasonably anticipated to be available during the 2028-2050 period. Even if these projects were to be funded some time in the future, at least some of the funding would need to come from sources outside of the fiscally constrained LRTP such as the FRA or MDTA toll revenues. Additionally, projects may be funded by the private sector and are not considered with our analysis of fiscal constraint. Partly for this fiscal constraint reason, the preferred alternative does not include these projects. As projects move forward in the future, we will assess their impact on air quality in the region.

It is good policy for the region to be aware of these projects and to be prepared to determine their potential effects on regional travel demand and regional travel patterns. Below is a list of projects and a brief description.

Amtrak / Freight Rail Bridge over the Susquehanna River

The Susquehanna River Rail Bridge is a two-track bridge located in the City of Havre de Grace in Harford County, Maryland and the Town of Perryville in Cecil County, Maryland. The nearly 120-year-old bridge is owned by Amtrak and is used by Amtrak, MARC Commuter Rail and Norfolk Southern Railway to carry passenger and freight trains across the Susquehanna River. The project would replace the existing two-track bridge with two new 2-track bridges; realign and reconstruct five route miles of track; and modernize and improve track, catenary and signals for higher speeds.

The FRA issued a Finding of No Significant Impact (FONSI) for the Susquehanna River Rail Bridge Project in 2017. The FONSI completes the National Environmental Policy Act (NEPA) process and this phase of the project. The project was placed on hiatus due to COVID in March 2020 but was restarted in October 2021.

Chesapeake Bay Bridge

MDTA owns, finances, operates, and maintains the William Preston Lane, Jr. Memorial (Bay) Bridge and is conducting the Tier 2 NEPA Study for the project. Previously, MDTA completed the Chesapeake Bay Crossing Study: Tier 1 NEPA in April 2022, when the FHWA issued a Final Environmental Impact Statement/Record of Decision (FEIS/ROD). The FEIS/ROD identifies the corridor containing the existing Bay Bridge as the selected corridor alternative.

In June 2022, MDTA launched the four- to five-year Chesapeake Bay Crossing Study Tier 2 NEPA. This Tier 2 study will evaluate the environmental and socioeconomic impacts of a range of alternative alignments and

transportation issues from the Severn River Bridge in Anne Arundel County to the US 50/US 301 split in Queen Anne's County. The range of alternatives includes a No Build alternative and a range of build alternatives including various alignments, crossing types and modal and operational alternatives.

A potential Chesapeake Bay crossing project is included in the list of illustrative projects in this chapter.

Northeast Corridor (NEC)

In response to strong and continued demand for rail travel in the NEC, Amtrak has developed a vision for Next Generation high-speed rail service on the NEC. Amtrak is upgrading its infrastructure to increase track capacity, improve ride quality and offer greater reliability along the NEC. Amtrak is taking steps to improve its infrastructure for all users in preparation for the introduction of the new, next generation Acela Express fleet.

Among the many improvements, Amtrak will be constructing a new side high-level platform at New Carrollton Station and increasing the number of high-level platforms at Baltimore Penn Station to allow for greater operational flexibility and expansion of train service. Amtrak is also working to upgrade the last of three tracks between Washington Union Station and Baltimore Penn Station to operate at speeds up to 125 mph and improve ride quality for a more comfortable journey.

Appendix A

Glossary

This appendix provides definitions and examples of concepts and terms related to the transportation planning process.

American Community Survey (ACS): A nationwide survey conducted by the U.S. Census Bureau that collects and produces information on social, economic, housing and demographic characteristics about our nation's population every year. This information provides an important tool for communities to use to see how they are changing.

Americans with Disabilities Act (ADA): Legislation enacted in 1991 to address the needs of disabled individuals in public settings. Sets standards and provides guidelines for accessibility with regard to public facilities (such as buildings and transit vehicles) and public rights-of-way (such as sidewalks, crosswalks and curb ramps).

Average Daily Traffic (ADT): The average number of vehicles passing a fixed point in a 24-hour time frame. Can be used as a performance metric to evaluate capital projects.

Baltimore Metropolitan Council (BMC): Non-profit organization established to identify regional interests and to develop collaborative strategies, plans and programs to improve the quality of life and economic vitality of the Baltimore region. BMC employs a paid, professional planning staff, which serves as technical staff to the Baltimore Regional Transportation Board (BRTB). Included in the functions of BMC staff are transportation planning and modeling, air quality conformity analysis, demographic analysis, GIS mapping, maintenance of the regional building permit database, administration of a rideshare program, coordination of the local cooperative purchasing program, regional emergency preparedness, regional fair housing planning and regional workforce development data analysis and initiatives.

Baltimore Regional Transportation Board (BRTB): The federally designated Metropolitan Planning Organization (MPO) for the Baltimore region. The BRTB is a 13-member policy board consisting of Annapolis and Baltimore cities, Anne Arundel, Baltimore, Carroll, Harford, Howard, and Queen Anne's counties, the Maryland Department of Transportation (MDOT), the Maryland Department of the Environment (MDE), the Maryland Department of Planning (MDP), the Maryland Transit Administration (MDOT MTA) and a representative of public transportation. As the region's MPO, the BRTB is responsible for the planning and coordination of federally funded transportation programs in the region and related short- and long-range planning.

Bus Rapid Transit (BRT): Enhanced bus system that generally operates in dedicated bus lanes or other transitways. Intent is to combine the flexibility of buses with the efficiency of rail.

Complete Streets: An approach to planning, designing and operating roadways so they are safe and comfortable to use and support the access and mobility of users of all ages and abilities, regardless of whether they are travelling as drivers, pedestrians, bicyclists or public transportation riders.

Conformity: Refers to the region's conformity to air quality standards. Conformity means that the projects in the regional transportation plan and the Transportation Improvement Program (TIP) will not cause or contribute to new air quality violations, worsen existing violations or delay timely attainment of air quality standards.

Congestion Management Process (CMP): Federal transportation legislation (IIJA) requires each urbanized area with a population of more than 200,000 (known as a Transportation Management Area or TMA; see definition) to manage traffic congestion through a process. This process uses a number of analytic tools to define and identify congestion within a region, corridor, activity center or project area. The process also involves developing and selecting appropriate operational and travel demand reduction strategies to reduce congestion or to mitigate the effects of congestion.

Connected and Automated Vehicles (CV/AV/CAV): CVs incorporate communications technology that enables them to share data with other vehicles and roadside infrastructure or obtain data from the cloud. AVs are vehicles in which at least some aspect of a safety-critical control function (such as steering, throttle, or braking) occurs without direct driver input. CAVs combine the two technologies to wirelessly communicate with each other and with vehicles around them, traffic infrastructure and other travelers and/or automate some or all of the driving functions.

Consolidated Transportation Program (CTP): The six-year capital budget for transportation projects in the state of Maryland. Includes projects for the Maryland Department of Transportation and its modal agencies (Maryland Aviation Administration, Maryland Port Administration, Maryland State Highway Administration, Maryland Transit Administration, and Motor Vehicle Administration), as well as related authorities within the department (Maryland Transportation Authority, Washington Metropolitan Area Transit Authority).

Environmental Justice (EJ): Concept established in 1994 through Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." Intent is to ascertain that federally funded transportation projects do not adversely affect minority and low-income populations.

Environmental Protection Agency, U.S. (EPA): Federal agency charged with protecting natural and human environmental resources. Responsible for developing and enforcing standards and regulations to maintain air and water quality, including relevant standards and regulations affecting transportation facilities and programs.

Fixing America's Surface Transportation (FAST) Act: Legislation enacted by the U.S. Congress reauthorizing funding and planning for highway and transit programs. The

FAST Act preserved the commitment to the metropolitan transportation planning process established in previous federal legislation. It was signed into law on December 4, 2015. Superseded by the IIJA.

Federal Highway Administration (FHWA): Division of the U.S. Department of Transportation that administers and funds highway planning and programs.

Federal Highway Trust Fund: Federal funding for highway and transit systems and facilities is available through this fund (the fund includes a separate Mass Transit Account). Consists of revenues from federal motor fuel taxes and federal excise taxes on such items as tires. In the past, Congress has supplemented the Highway Trust Fund with general funds as needed to meet obligations.

Federal Transit Administration (FTA): Division of the U.S. Department of Transportation that administers and funds transit planning and programs.

Fiscal Constraint: A requirement for both the Regional Long-Range Transportation Plan (LRTP) and the Transportation Improvement Program (TIP). For the LRTP, fiscal constraint means the total estimated year of expenditure costs of projects and programs cannot exceed forecasted funding levels. For the TIP, fiscal constraint means providing (1) budgets showing committed funding and funding sources for each project and (2) realistic implementation schedules based on when these funds will be available.

Fiscal Year (FY), Federal: Begins October 1 of the preceding year and ends September 30 of the next calendar year. For example, federal FY 2024 begins on October 1, 2023 and ends September 30, 2024.

Fiscal Year (FY), State: Begins July 1 of the preceding year and ends June 30 of the next calendar year. For example, state FY 2024 begins on July 1, 2023 and ends June 30, 2024.

Goal: Broad aspiration or guiding principle for the region (such as “Improve system safety”).

Greenhouse Gas (GHG) Emissions: GHG emissions trap heat in the atmosphere. A surplus of these emissions resulting from human activity contributes to an observed increase in average global temperature. Global warming is a result of an enhanced greenhouse effect, which is a naturally occurring process by which heat from the sun is radiated off the Earth’s surface and is then trapped in the earth’s atmosphere by greenhouse gases, whereby the Earth’s surface temperature increases. Carbon dioxide is a key greenhouse gas.

Highway: Term applies to roads, streets and parkways, and also includes rights-of-way, bridges, railroad crossings, tunnels, drainage structures, signs, guard rails and protective structures in connection with highways.

High-Occupancy Vehicle (HOV) Lanes: HOV lanes are one or more lanes of a roadway that have restrictions on use to encourage ridesharing and can reduce vehicle miles traveled (VMT).

Illustrative Projects: Projects included in a metropolitan transportation plan for illustrative purposes, as specified by MAP-21 and federal regulations. These are projects that could be included in the adopted transportation plan if additional financial resources beyond those identified in the plan were to become available. There is no requirement to select any project from an illustrative list of projects in an adopted plan at some future date, when funding might become available.

Infrastructure Investment and Jobs Act (IIJA): The most recent federal transportation legislation, signed into law on November 15, 2021. The IIJA authorizes the largest federal investment in public transportation in the nation's history, providing $550 billion over fiscal years 2022 through 2026 in new Federal investment in infrastructure, including roads, bridges and mass transit, as well as water infrastructure, resilience and broadband. Creates more than a dozen new highway programs and also creates more opportunities for local governments and other entities. It is the primary source of funding for federal surface transportation projects. Establishes requirements for projects receiving such funding.

Intelligent Transportation System (ITS): A system that enables the transfer of information relating to traffic and transit system operations and conditions to state and local operations staff and to roadway and transit users. Elements can include dynamic message signs to alert users to changing conditions, closed-circuit television systems that alert state or local operations staff to changing conditions, incident detection and management systems, transit security-related systems and state or local transportation management centers.

Level of Traffic Stress (LTS): An approach that quantifies the amount of discomfort that people feel when they bicycle close to traffic based on attributes such as traffic speed, traffic volume, number of lanes, frequency of parking turnover and ease of intersection crossings.

Locally Operated Transit Systems (LOTS): Transit service from a local provider, offered by some of the jurisdictions in the region. Supplements service provided by the Maryland Transit Administration.

Maryland Rail Commuter (MARC) Service: Maryland's commuter rail operation, managed by the Maryland Transit Administration. MARC provides service on three lines, all of which have a terminus at Union Station in Washington, DC. The Camden Line runs to Camden Station in Baltimore City. The Penn Line runs to Penn Station in Baltimore City and on to Perryville in Cecil County. The Brunswick Line runs to Brunswick in Frederick County and on to Martinsburg, West Virginia, with a spur serving Frederick, Maryland.

Maryland Department of Transportation (MDOT): The department charged by Maryland state law with the responsibility for various transportation-related functions. These include construction, operation and maintenance of highway facilities (through the Maryland State Highway

Administration), transit facilities (through the Maryland Transit Administration), port facilities (through the Maryland Port Administration) and aviation facilities (through the Maryland Aviation Administration). The Motor Vehicle Administration, the state agency responsible for administering vehicle licensing and registration, is also under the jurisdiction of MDOT.

Maryland Department of the Environment (MDE): The state environmental protection agency that monitors and enforces the regulations pertaining to air and water quality. Also responsible for developing the State Implementation Plan and motor vehicle air pollutant budgets and for monitoring how transportation affects air quality.

Maryland Department of Planning (MDP): The state agency charged with developing and coordinating implementation of statewide growth management policies.

Maryland Port Administration (MDOT MPA): The agency in the Maryland Department of Transportation responsible for increasing waterborne commerce through Maryland ports for the benefit of the citizens of the state.

Maryland State Highway Administration (MDOT SHA): The agency in the Maryland Department of Transportation responsible for construction, operation and maintenance of most federal and state highway facilities. Primary recipient of surface transportation funds through the Federal Highway Administration.

Maryland Transit Administration (MDOT MTA): The agency in the Maryland Department of Transportation responsible for construction, operation and maintenance of transit facilities. Federally designated recipient of Federal Transit Administration funds for the Baltimore region.

Maryland Transportation Authority (MDTA): The agency responsible for constructing, operating and maintaining the State's toll facilities, as well as for financing new revenue producing transportation projects. The MDTA owns eight toll facilities, two turnpikes, two tunnels and four bridges. All of the MDTA's projects and services are funded through tolls paid by the customers who use the MDTA's facilities.

Maryland Transportation Trust Fund (TTF): Provides the state's portion of funding for constructing, operating and maintaining state highway, transit, aviation and port systems and facilities. Consists of revenues from motor fuel taxes, titling taxes and fees, operating revenues, bond proceeds, fund transfers and funding from the Federal Highway Trust Fund.

Metropolitan Planning Organization (MPO): An organization designated by law with lead responsibility for developing transportation plans and programs in urbanized areas of 50,000 or more in population. The Baltimore Regional Transportation Board (BRTB) is the MPO for the Baltimore region.

Metropolitan Transportation Plan (MTP): Also referred to as the Long-Range Transportation Plan (LRTP), the MTP is one of the documents an MPO is legally mandated to produce. *Resilience 2050* is the current MTP for the Baltimore region. The plan establishes the region's broad transportation goals and strategies and contains a list of the major surface transportation projects the region expects to implement over the next 20-25 years. Another major component is the financial plan, which shows the revenues (federal, state, local, other) the region expects to have available for these projects and the estimated costs of these projects. By law, this document must be air quality constrained as well as fiscally constrained.

Moving Ahead for Progress in the 21st Century (MAP-21): Transportation legislation enacted by the U.S. Congress reauthorizing and restructuring funding and planning for highway and transit programs. MAP-21 emphasized performance-based planning and programming. It was signed into law on July 6, 2012. Superseded by the FAST Act.

National Ambient Air Quality Standards (NAAQS): To protect public health, the U.S. Environmental Protection Agency (EPA) sets the NAAQS for certain "criteria pollutants." The EPA then determines the areas that do not meet these standards. The Baltimore region is designated as a nonattainment area with regard to the 8-hour ozone standard.

National Highway System (NHS): This system consists of roadways important to the nation's economy, defense and mobility. Examples of NHS roadways include interstate highways (I-95, I-695, etc.), other principal arterials (US routes such as US 1), highways in the Strategic Highway Network (such as highways that are important to the US's strategic defense policy and that provide defense access, continuity and emergency capabilities for defense purposes), major Strategic Highway Network Connectors (i.e., highways that provide access between major military installations and highways that are part of the Strategic Highway Network), and intermodal connectors (i.e., highways that provide access between major intermodal facilities and the other four NHS subsystems). A specific route can be on more than one subsystem.

Nonattainment: The U.S. Environmental Protection Agency (EPA) sets NAAQS for certain air pollutants, called "criteria pollutants," to protect public health. The EPA then determines the areas of the country that do not meet the NAAQS. These are designated as nonattainment areas. The EPA has determined that the Baltimore region is a nonattainment area since it does not meet the NAAQS for ground-level ozone pollution.

Ozone: One of the "criteria pollutants" for which the EPA sets NAAQS. Ozone forms at ground level when nitrogen oxides (NOx) and volatile organic compounds (VOCs) undergo a chemical reaction under heat and sunlight. Reductions in NOx and VOCs are necessary for reducing ozone pollution. NOx and VOCs come from a variety of sources, some of which are emissions from cars and trucks. The Baltimore region has been found to be in moderate nonattainment with respect to the standards for ground-level ozone.

Performance-Based Planning and Programming (PBPP): PBPP refers to the application of performance management principles within transportation agencies to achieve desired performance outcomes for the multimodal transportation system. Provides a link between long-range decisions and investment decisions that affect the performance of the region's transportation system. PBPP took on a greater significance with the passage of MAP-21 and subsequent transportation legislation. Federal rulemaking specifies 25 performance measures and targets that MPOs must adopt in coordination with the state and public transportation providers.

Performance Measures / Performance Targets: Performance measures are specific metrics used to assess progress toward achieving goals (such as "Decrease number of highway fatalities"). Performance targets are specific levels to be achieved within certain time frames (such as "Decrease number of highway fatalities to 202 by 2030").

Preferred Alternative: The term used for the fiscally constrained list of projects and programs included in *Resilience 2050*.

Priority Funding Area (PFA): Concept introduced by the Smart Growth and Neighborhood Conservation - Smart Growth Areas Act, enacted by Maryland in 1997. The 1997 legislation directs state funding for growth-related infrastructure to PFAs, thereby focusing growth in already developed areas. PFAs include municipalities (as they existed on January 1, 1997), Baltimore City, areas inside of the beltways, neighborhoods designated for revitalization by the Department of Housing and Urban Development, Enterprise and Empowerment Zones, and certified heritage areas within county-designated growth areas. Jurisdictions are also able, though not required, to designate additional PFAs, known as locally designated PFAs, based on criteria established by the legislation.

Public Participation Plan: MPOs are required to develop a public participation plan that defines a process for providing the public and interested parties with reasonable opportunities to be involved in the metropolitan planning process. The public participation plan must consider the needs of people and groups traditionally underserved by transportation systems, including low-income and minority households.

Ridesharing: A program intended to match commuters so that they might share rides to work, thereby reducing the number of cars on the road. MDOT administers the rideshare program in the Baltimore region and provides funding support to local rideshare coordinators.

Round 10 Socioeconomic Forecasts: A set of population, household and employment estimates and forecasts at the regional, jurisdiction and small area levels of geography extending through 2050. Used for transportation planning purposes and serve as key inputs to the region's travel demand model. The Round 10 forecasts are developed by the BRTB Cooperative Forecasting Group.

Safe System Approach (SSA): A systemic approach focused on reducing roadway fatalities and serious injuries to zero by taking a holistic view of the road transportation system. Under the SSA, road safety is a shared responsibility among everyone, including those that design, build, operate and use the road system.

Single-Occupancy Vehicle (SOV): Refers to a vehicle with no passengers that may be prohibited from using a facility for vehicles with two or more individuals.

State Implementation Plan (SIP): A required air quality planning document prepared by states and submitted to EPA for approval. SIPs identify state actions and programs to implement designated responsibilities under the Clean Air Act. In Maryland, the Maryland Department of the Environment (MDE) develops the SIP.

Strategic Highway Safety Plan (SHSP): A federally required statewide-coordinated safety plan that provides a comprehensive framework for reducing highway fatalities and serious injuries on all public roads. An SHSP identifies a State's key safety needs and guides investment decisions towards strategies and countermeasures with the most potential to save lives and prevent injuries. In addition, all jurisdictions in the Baltimore region have a local SHSP, with six being implemented.

Strategy: Specific approach or policy to help the region make progress toward a broad goal (such as "Eliminate hazardous or substandard conditions in high-crash locations and corridors").

Sustainable Communities: A shared geographic designation established by the Sustainable Communities Act of 2010 to promote efficient use of state resources based on local sustainability and revitalization strategies. The Sustainable Communities program consolidated geographically targeted resources for historic preservation, housing and economic development under a single designation. The designation places special emphasis on infrastructure improvements, multimodal transportation and development that strengthens existing communities.

Teleworking: Working from a remote location, usually a home office. Also known as telecommuting.

Transit Economic Requirements Model (TERM): The Federal Transit Administration uses the TERM to develop values to determine its transit state of good repair backlog. The TERM condition ratings scale for facilities has the following values: 5 – Excellent, 4 – Good, 3 – Adequate, 2 – Marginal, 1 – Poor.

Title VI: Title VI of the Civil Rights Act of 1964 states that no person in the U.S. shall, on the basis of race, color or national origin, be excluded from participation in, be denied the benefits of or be subjected to discrimination under any program or activity receiving federal financial assistance. Because the BRTB receives federal funding in carrying out the metropolitan planning process, its products (for example, the Long-Range Transportation Plan and the TIP) and programs must comply with Title VI.

Transit Asset Management (TAM): Business model that prioritizes funding based on condition and performance to achieve and maintain a state of good repair for public transportation assets, such as vehicles, equipment and facilities.

Transit Signal Priority (TSP): General term for a set of operational improvements that use technology to reduce dwell time at traffic signals for transit vehicles by holding green lights longer or shortening red lights.

Transportation Analysis Zone (TAZ): Basic unit of geography used to predict travel behavior in the travel demand model. Constructed using census block information.

Transportation Demand Management (TDM): Strategies intended to reduce travel demand (particularly that of single-occupancy private vehicles) or to redistribute this demand. TDM strategies can help relieve traffic congestion and reduce vehicle emissions. Examples include congestion pricing, incentives to use transit, rideshare programs, flexible work hour programs, etc.

Transportation Emission Reduction Measures (TERMs): Projects or policies intended to reduce air pollutant emissions from the transportation sector. These could include strategies to reduce travel demand (particularly from single-occupancy private vehicles) or to reduce per-mile emissions.

Transportation Improvement Program (TIP): One of the documents an MPO is legally mandated to produce. This document lists all surface transportation projects with committed funding that are programmed for implementation over the next four years. Generally updated every year in the Baltimore region. Before a project can receive federal funding, it must appear in the TIP. By law, this document must be fiscally constrained.

Transportation Management Area (TMA): An urbanized area with a population of more than 200,000. Within a TMA, all transportation plans and programs must be based on a continuing, cooperative and comprehensive planning process carried out by the MPO in cooperation with states and transit operators. In addition, all TMAs must have a Congestion Management Process in place.

Transportation Network Company (TNC): A company that matches passengers with drivers through mobile apps and websites (such as Lyft and Uber). Also called ride-hailing services.

Transportation System Management and Operations (TSMO): Integrated program of strategies intended to optimize the performance of existing infrastructure. Through such a program, an agency can implement systems, services and projects designed to preserve capacity and improve security, safety and reliability of the transportation system. Similar to TDM strategies, TSMO strategies can help relieve traffic congestion and reduce vehicle emissions. Examples of TSMO strategies include bottleneck elimination through channelization, signal system upgrades and coordination, freeway ramp metering, transit scheduling and dispatching improvements, relocation of bus stops, etc.

Travel Demand Model: Software used to predict where people travel (such as to work, to home, to other destinations) and how they travel (such as by driving, by taking transit, by bicycling, by walking). Uses population and employment forecasts as well as land use data to predict this travel behavior at a regional scale.

Vehicle Miles Traveled (VMT): A standard measure of travel activity. The U.S. Department of Transportation definition is "One vehicle mile traveled is the movement of one privately operated vehicle for one mile, regardless of the number of people in the vehicle."

Vehicle Revenue Miles (VRM): The miles traveled when the vehicle is in revenue service (in other words, the time when a vehicle is available to the general public and there is an expectation of carrying passengers).

Appendix B

Cost Estimation, Project Evaluation and Scoring

Cost Estimation Methodologies

Estimating project costs for *Resilience 2050* was a joint effort that included the assistance of state agencies, local jurisdictions and transportation consultants. MDOT SHA provided cost estimates for all roadway projects, regardless of whether the facility was a state or locally maintained roadway. Local jurisdictions provided necessary information to MDOT SHA for projects on local roadways. MDOT MTA developed capital cost estimates for the transit projects it would operate. MDOT MTA, through an existing contract with a consultant, provided cost estimates for locally sponsored transit projects. Project cost estimates were provided in current dollars.

For planning and budgeting purposes, agencies need to be able to program funds for projects from planning to construction. High level cost estimates at the planning stage help project sponsors develop a budget and determine if the project is financially viable. Often, understanding the construction cost helps program the design and engineering fees as well. The issue becomes producing a high-level cost for a project when work on the project has not begun. The following are a few examples of why estimating a construction cost very early in the process can be difficult:

1. The scope of the project is not clearly defined early on
2. The proposed project being estimated is a concept and no actual design work has yet taken place
3. Visual inspection of the corridor or site in which the project is proposed has not been investigated
4. Projects are ever evolving. What may be initially proposed could radically change throughout the design process or after information is known and could render the initial cost estimate obsolete.

In practical terms, there are at least two rounds of cost development. The first estimate, expressed in year of expenditure (YOE) dollars, is less intensive. This first-round estimate is developed for use in documents such as *Resilience 2050*. The second, more detailed, estimate is developed as the project moves to project planning and is reviewed at least once a year to reflect updates to fields in the cost estimating program. When developing cost estimates, however, there are some basic principles and factors that can and should be identified early in the process to minimize errors throughout the design process. Some of these considerations are:

- Identifying all potential impacts before a project gets initial funding and providing reasonable costs with contingencies to cover those impacts
- Making sure that all specifications clearly define the scope of work
- Using standard pay items from the category code book whenever possible.

Estimating Roadway Project Costs

For projects not included in the CTP, MDOT SHA utilized the all-inclusive (cost categories 1 – 8) cost per mile (CPM) from the 2022 MDOT SHA Cost Estimating Manual. The MDOT SHA staff have reviewed each project's characteristics and have utilized the following methodology and estimation assumptions:

- Cost of new lanes are estimated assuming the project can add new lanes without the need of reconstructing existing lanes. The cost of resurfacing, at a rate of $0.12 million per lane-mile, is included for all existing lanes.
- If no lanes are being added to an existing roadway, reconstruction of all existing lanes are still assumed. If only a segment of a roadway needs a lane addition, the engineer would review the project and determine the length of additional lane-mile needed.
- The lead engineer is provided flexibility to determine which CPM rate to apply for new lane-miles: low, median or high. Given the existing project areas, a low CPM rate per lane-mile was used for all estimations.
- All interchanges within the project limit were reviewed to determine if the proposed improvements would require interchange reconstruction. The guide provides two interchanges costs, dependent on the roadway classification of both roadways: $110 million / full interchange for freeway-to-freeway interchanges or $45 million / full interchange otherwise. The total interchange cost is determined by the cost per full interchange and the number of interchange quarters potentially impacted by the roadway improvement.
- The cost of Project Planning (PP) varies by project size as follows: for a construction cost under $50 million, PP is calculated at 6.0 percent; for a construction cost of between $50 and $99.9 million, PP is calculated at 2.5 percent; and for a construction cost greater than $100 million, PP is calculated at 1.5 percent.
- The cost of Preliminary Engineering (PE) varies by project size as follows: for a construction cost under $50 million, PE is calculated at 15 percent; for a construction cost of between $50 and $99.9 million, PE is calculated at 10 percent; and for a construction cost greater than $100 million, PE is calculated at 8.5 percent.
- A contingency rate of 40 percent of the construction cost is added to calculate the neat construction cost.
- An overhead cost, an estimate of related administrative and incidental costs, is added to the cost of each project phase.
- The Right-of-Way (ROW) area needs are based on three factors: the existing MDOT SHA ROW area, the anticipated typical section width of the new roadway and the length of the project. The anticipated typical section width is determined by the functional classification of the roadway, the project area terrain and the speed limit of the roadway. Each project was reviewed to ensure these assumptions were appropriate and changes to the typical section width

were made to reflect what could be feasibly done within the confines of the project area.

- The per acre ROW cost is based on annual average County cost, as provided by the MDOT SHA Office of Real Estate, taking into account roadway functional classification. The ROW costs used did not factor in current market forces, which were assumed to be temporary and not impactful to long range planning costs.

Estimating Locally Sponsored Transit Project Costs

The Association for the Advancement of Cost Engineering International (AACE) set forth guidelines and classifications for estimating projects at different design levels. These levels range from a Class 1 - detailed unit costs, schedule and design ranging from 65 percent to 100 percent, to a Class 5 estimate – conceptual design, 0 percent to 2 percent design.

Class 5 estimates were selected for all locally sponsored transit projects in *Resilience 2050* due to the project information, stage of design and contract drawings provided.

Preparing cost estimates for a Class 1-4 designation is fairly straightforward since plans, details and schedules are available. This enables estimators to perform quantity take-offs and develop appropriate unit prices. Preparing high-level Class 5 cost estimates requires estimators to use more judgement and less statistical data to prepare the estimate. Estimators will typically need to make additional assumptions, use construction and engineering judgement and rely more on past experience and similar project historical data.

For a Class 5 estimate, high-level unit costs were developed to be used for a wide spectrum of projects including Bus Rapid Transit (BRT), express bus routes, bus stop improvements and site work. Using past and current transit projects within the region as a baseline, composite items were developed to be used within the cost estimates. Composite items may be as simple as a cost per mile for new sidewalk (generally consisting of performing earthwork, pouring concrete and laying graded aggregate base (GAB)) or as complicated as a lump sum cost for reconstruction of a Park-&-Ride. In either case, the process is the same:

1. Establish an area/length/volume to be used as unit of measure (i.e. lane mile of roadway)
2. Identify major items to be included in the composite item (pavement, earthwork, sidewalk, etc.)
3. Apply unit costs.

In general, composite unit costs were established in three ways:

1. Using detailed estimates from at least two different past projects, with similar scope as the project being estimated, and taking an average cost
2. Where unit costs were derived using data not in the current base year of 2022, a 4 percent escalation factor per year was added based on regional inflation rates

3. Manufacturer and/or supplier quotes
4. Historical data including contractor bid tabs and published Client data.

Though projects may be similar in nature, by the time detail design takes place two projects with a similar purpose and need may end up being vastly different based on the defined project scope.

For example, designing a bus stop can be straightforward; lay new sidewalk, perform earthwork and grade around the site and add a bus shelter. However, depending on the scope of the project and the Project Sponsor's desires, a sidewalk could be standard concrete or brick pavers, a basic 'off-the-shelf' shelter could be selected or it could be custom designed, real-time bus arrival may be integrated into the stop or there could be only static messaging. With so many variables possible, it is important to establish general unit costs and list out all assumptions being used.

With high level estimates, since the projects are limited in design, many assumptions will need to be made. It is important to be consistent in the assumptions between projects when limited details are available.

Example:

One example of this is new roadway construction.

- In a Class 5 estimate, proposed pavement depth will not be known so establishing this pavement box and using it throughout will allow consistency between estimates.
- Another item that is often overlooked but could drastically change project costs is ROW impacts. With no design at a Class 5 estimate, ROW impacts can still be estimated as follows.
  - With no existing ROW information, estimators could conservatively assume that the existing ROW is located directly next to the existing roadway edge or behind the existing sidewalk and ROW will need to be purchased for the amount of widening taking place (road is being widened by one lane, assume this is a 12-ft lane and 12-ft of ROW is needed for the duration of the project).
- Document all assumptions being made to offer transparency with the estimate.

After development of unit costs and the list of assumptions, there are several other 'big ticket' items that can be difficult to estimate, including: utility impacts, stormwater management costs and maintenance of traffic. MDOT SHA has developed a Highway Cost Estimating Manual, dated February 2020, that helps engineers and estimators develop costs for a range of elements on a project, including items that cannot be estimated until the design phase of a project. For a Class 5 estimate, the estimating manual uses percentages for these categories, which are based on cost of improvements and vary depending on the type of project and setting. Ranges of these percentages were used throughout depending on the type of project, location and examination of the corridor through Google Maps.

Lastly, an overall contingency needs to be added to the estimates. Contingency factors used are based on the level of design and risk associated with the project. A 40 percent contingency is established for Class 5 estimates. Industry standards have been developed by agencies as guidelines including MDOT SHA, FTA and FHWA. It is important to remember that contingency should decrease throughout design as risk decreases and detailed design identifies all payment items.

Estimating MDOT MTA Transit Project Costs

MDOT MTA cost estimates were drawn from pre-existing estimates from a variety of sources including Cornerstone plans for Light Rail and MARC, the Capital Needs Inventory, and the Regional Transit Plan for Central Maryland. Cost estimates for the East-West and North-South transit corridor projects were based on an average per mile cost across all alternatives for the East-West transit corridor. All transit hubs were assumed to cost $5 million (Current $) unless otherwise noted as project planning has not yet begun for these hubs. These cost estimates are subject to change upon further study.

Project Evaluation and Scoring

The local jurisdictions, in consultation with MDOT SHA, submitted projects for consideration for *Resilience 2050*. MDOT MTA also submitted projects. We scored each project for technical merit, based on consistency with regional goals and strategies. The technical scoring methodology differs for highway and transit projects in some cases since the tools for evaluating highway projects may not be appropriate for transit projects and vice versa. Each submitting jurisdiction and agency also provided a policy score, depending on priority and demonstrated financial support.

The combined technical and policy score for each project represents that project's total score. This is one tool we used to determine which projects to adopt in the preferred alternative. The maximum total score (technical + policy score) is 90 points for roadway projects and 95 points for transit projects. Tables 1 and 2 provide details on the policy and technical scoring methodology.

Table 1 - Policy Score

Criteria	Methodology
Project Priority	• High Priority – Five projects maximum: 30 points each • Medium Priority – Four projects maximum: 20 points each • Low Priority – Unlimited number of projects: 10 points each
Demonstrated Financial Support	• 10 additional points
Maximum Policy Score	**40 points**

Table 2 - Technical Score

Mode and Criteria	Points	Methodology
GOAL: Safety		
Highway Safety	**10 points maximum**	• Identifies SHSP emphasis area(s)/strategy(s) addressed = 2 points • Project includes countermeasures anticipated to benefit Environmental Justice (EJ) areas = 2 points • Project identifies countermeasures addressing the following SHSP emphasis areas (6 points maximum; not additive across emphasis areas): > Non-motorist safety = 6 points > Speeding = 4 points > Lane Departure for Impaired or Distracted Drivers = 2 points
Transit Safety and Security	**10 points maximum**	• Degree to which the project improves Transit Safety (5 points): > Project designed to specifically improve system safety for all users and/or addresses an existing safety deficiency, and occurs within an EJ area = 5 points > Project designed to specifically improve system safety for all users and/or addresses an existing safety deficiency = 4 points > Project will generally result in a safety improvement for users, and occurs within an EJ area = 3 points > Project will generally result in a safety improvement for users = 2 points > Project will have no discernible positive effect on system safety = 0 points • Degree to which the project improves Transit Security (5 points): > Project designed specifically to deter crime and/or enhance system security for all users and/or staff = 5 points > Project will generally result in a security improvement for users and/or staff = 3 points > Project will have no discernible positive effect on system security = 0 points

Mode and Criteria	Points	Methodology
GOAL: Accessibility		
Highway and Transit: Complete Streets	**5 points maximum**	• Degree to which project supports complete streets (delivers safety/accessibility benefits for all modes) (4 points): > Significant features = 4 points. Over half of project includes features > Moderate features = 2 points. Up to half of project includes features > No features = 0 points • Proximity to EJ areas as determined by 1/2 mile buffer (1 point): > Over half of project in EJ area = 1 point > Up to half of project in EJ area = 1/2 points > Not in EJ area = 0 points
Highway: Access to Jobs	**5 points maximum**	• Degree to which the project improves access to jobs for workers within a 30 minute travel time (4 points): > Top 1/3 = 4 points; Middle 1/3 = 2 points; Bottom 1/3 = 0 points • Degree to which the project improves access to jobs for EJ workers within a 30 minute travel time (1 point): > Top 1/2 = 1 point; Bottom 1/2 = 0 points
Transit: Access to Jobs	**10 points maximum**	• Degree to which the project improves access to jobs for workers within a 45 minute travel time (8 points): > Top 1/3 = 8 points; Middle 1/3 = 4 points; Bottom 1/3 = 0 points • Degree to which the project improves access to jobs for EJ workers within a 45 minute travel time (2 points): > Top 1/2 = 2 points; Bottom 1/2 = 0 points

<table>
<tr><th>Mode and Criteria</th><th>Points</th><th>Methodology</th></tr>
<tr><td colspan="3">GOAL: Mobility</td></tr>
<tr><td>Highway</td><td>10 points maximum</td><td>2050 Vehicle Hours of Delay (VHOD) per VMT (with Existing plus Committed Projects) for three vehicle classes:
• Passenger VHOD at AM/PM peak hours (4 points):
> Top 1/3 = 4 points; Middle 1/3 = 3 points; Bottom 1/3 = 2 points
• Commercial VHOD Mid-Day (3 points):
> Top 1/3 = 3 points; Middle 1/3 = 2 points; Bottom 1/3 = 1 point
• Truck VHOD at Overnight Peak (3 points):
> Top 1/3 = 3 points; Middle 1/3 = 2 points; Bottom 1/3 = 1 point</td></tr>
<tr><td>Transit</td><td>10 points maximum</td><td>• Transit Options: Degree to which the project increases the number of workers with high quality (<45 minutes) transit options based on their usual place of work (3 points):
> Top 1/3 = 3 points; Middle 1/3 = 2 points; Bottom 1/3 = 1 point
• Transit Ridership: Degree to which the project supports transit ridership via walk access and drive access (5 points):
> Walk Access: Top 1/3 = 3 points; Middle 1/3 = 2 points; Bottom 1/3 = 1 point
> Drive Access: Top 1/2 = 2 points; Bottom 1/2 = 1 point
• Transit Connectivity: Degree to which the project contributes to transit connectivity as measured by the reduction in the average number of transfers required for transit trips (2 points):
> Top half of reductions = 2 points; Bottom half of reductions = 1 point</td></tr>
</table>

Mode and Criteria	Points	Methodology
GOAL: Environmental Conservation		
Highway and Transit: Effects on ecologically sensitive lands and culturally significant resources	**5 points maximum**	• Degree to which project is located near ecologically significant lands and culturally significant properties and resources via GIS buffer analysis: > Project neither intersects nor is adjacent to any data = 5 points > Project is only adjacent to any data = 3 points > Project intersects data = 1 point • Anticipated impacts to nearby EJ populations (buffer of 200 feet: distance derived from approximated distances used in NEPA analysis) > Project anticipated to benefit EJ area = +1 point (within 5 point max) > Neutral or unclear anticipated EJ impacts = 0 points > Project has anticipated negative EJ impacts = -1 point
Highway and Transit: Potential for Greenhouse Gas Emissions Reductions	**5 points maximum**	• Degree to which the project includes components that reduce GHG emissions: > Only emissions reducing components = 5 points > A majority of emission reducing components but also includes emissions inducing components = 4 points > Neutral mix = 3 points > A majority of emissions inducing components but also involves bike/ped/transit improvements improving connectivity to existing facilities = 2 points > A majority of emissions inducing components = 1 point > No emissions reducing components = 0 points

Mode and Criteria	Points	Methodology
GOAL: Security		
Highway and Transit	**5 points maximum**	• Degree to which the project enhances the multimodal evacuation mobility of vulnerable populations. Evacuation routes are defined in the Evacuation Traffic Management Support document: > Project falls on existing evacuation route or improves a critical link to an existing evacuation route in an area with a Vulnerable Populations Index (VPI) of 6 or higher = 5 points > Project falls on existing evacuation route or improves a critical link to an existing evacuation route in an area with a VPI of 4 or 5 = 3 points > Project falls on existing evacuation route or improves a critical link to an existing evacuation route in an area with a VPI of 2 or 3 = 1 point
GOAL: Economic Prosperity		
Highway and Transit	**5 points maximum**	• The project leverages or otherwise supports existing assets and programs available from the State to revitalize and improve existing and planned communities in the region: > An Opportunity Zone that is within a Sustainable Community and Priority Funding Area (PFA) = 5 points > A Sustainable Community or PFA = 3 points > Outside these areas/zones = 0 points

Project Scores

Table 3 on the following pages shows information on each candidate project submitted by local jurisdictions and MDOT MTA as well as how each project scored according to the evaluation criteria. The table lists the policy score, the technical score and the total score consisting of the sum of the technical and policy scores.

Table 3 also shows other project information, including whether it was categorized as an expansion or system preservation project (which in turn determined the financial forecast funding source for fiscal constraint purposes), project type, submitting jurisdiction, project name, limits, YOE costs and anticipated implementation time period. Projects highlighted in green at the end were submitted but not included in the preferred alternative.

The total score was used to prioritize projects for inclusion in *Resilience 2050*. We discussed the results of the project scoring with our advisory Technical Committee along with other agency and jurisdictional considerations and priorities. At the end of this process, we had agreed on a preferred alternative.

Table 3 - *Resilience 2050* Candidate Project Scoring

Project Category	Project Type	Submitting Jurisdiction	Name	Limits / Length	Estimated Cost (YOE)	Time Period	Policy Score	Technical Score	Total Score
System Preservation	Roadway	Baltimore City	US 40 Highway Deconstruction	Smallwood Street to Greene Street 1.5 miles	$157,000,000	2028-2039	40	38	78
Expansion	Roadway	Howard County	US 1	Baltimore County Line to MD 175 5.5 miles	$205,000,000	2040-2050	40	37	77
Expansion	Roadway	Anne Arundel County	MD 198	MD 295 to MD 32 2.7 miles	$275,000,000	2028-2039	40	36.5	76.5
Expansion	Transit	MDOT MTA	Bayview Medical Center Transit Hub	Baltimore City	$9,000,000	2040-2050	30	46	76
Expansion	Roadway	Baltimore County	MD 140	Painters Mill Road to Owings Mills Boulevard 0.4 miles	$33,000,000	2028-2039	40	35	75
Expansion	Transit	Howard County	US 29 Bus Rapid Transit	US 40 to MD 198 (Burtonsville, MD) 16.0 miles	$20,000,000	2028-2039	40	35	75
Expansion	Transit	MDOT MTA	East-West Transit Corridor	Ellicott City to Essex 17.0 miles	$1,829,000,000	2028-2039	40	35	75
Expansion	Transit	MDOT MTA	North-South Transit Corridor	Towson to Downtown Baltimore (potentially Lutherville to Port Covington) 14.0 miles	$2,025,000,000	2040-2050	40	35	75
Expansion	Roadway	Anne Arundel County	MD 2	US 50 to MD 100 10.0 miles	$205,000,000	2040-2050	40	33.5	73.5
Expansion	Transit	MDOT MTA	Penn Station Transit Hub	Baltimore City	$19,000,000	2028-2039	30	43	73

Project Category	Project Type	Submitting Jurisdiction	Name	Limits / Length	Estimated Cost (YOE)	Time Period	Policy Score	Technical Score	Total Score
Expansion	Roadway	Anne Arundel County	MD 3	MD 450 to MD 32 6.2 miles	$95,000,000	2028-2039	40	32.5	72.5
System Preservation	Roadway	Baltimore City	Druid Park Lake Drive Complete Streets	Greenspring Ave in the northeast to I-83 in the southeast along Druid Hill Park 2.17 miles	$43,000,000	2028-2039	30	42	72
Expansion	Roadway	Howard County	I-95	MD 32 to MD 100 6.0 miles	$45,000,000	2028-2039	40	32	72
Expansion	Roadway	Carroll County	MD 32	Howard County Line to MD 26 3.36 miles	$66,000,000	2040-2050	40	31	71
Expansion	Roadway	Howard County	US 29	Patuxent River Bridge to Seneca Drive 1.7 miles	$103,000,000	2028-2039	40	31	71
Expansion	Roadway	Carroll County	MD 26	MD 32 to the Liberty Reservoir 2.5 miles	$120,000,000	2040-2050	40	30	70
System Preservation	Roadway	Carroll County	MD 31 Corridor Improvements	MD 31 from Church Street to High Street and High Street from Main Street to Coe Drive 0.67 miles	$16,000,000	2028-2039	40	29	69
Expansion	Roadway	Howard County	MD 175 / MD 108 Interchange	0.25 miles in all directions from the current intersection as well as a direct connection of MD 108 to Columbia Gateway Drive. 0.25 miles	$102,000,000	2028-2039	30	38	68

Project Category	Project Type	Submitting Jurisdiction	Name	Limits / Length	Estimated Cost (YOE)	Time Period	Policy Score	Technical Score	Total Score
Expansion	Transit	MDOT MTA	Mondawmin Transit Hub	Baltimore City	$7,000,000	2028-2039	30	38	68
System Preservation	Roadway	Baltimore City	Vietnam Veterans Memorial Bridge and Hanover / Potee Street Corridor Improvements	Patapsco Avenue to Wells Street 2.2 miles	$339,000,000	2028-2039	30	37	67
Expansion	Transit	MDOT MTA	Charles Center Transit Hub	Baltimore City	$14,000,000	2028-2039	20	47	67
System Preservation	Roadway	Baltimore City	Russell Street Complete Streets Improvements	Annapolis Road to South Greene & South Paca Streets 1.0 mile	$54,000,000	2028-2039	30	36	66
Expansion	Transit	Harford County	Aberdeen MARC Station	US 40 at MD 132 (Bel Air Ave)	$126,000,000	2040-2050	30	36	66
System Preservation	Transit	MDOT MTA	Eastern Bus Division		$464,000,000	2028-2039	40	26	66
System Preservation	Roadway	Baltimore City	Keith Avenue / Broening Highway Improvements	Clinton Street to the Baltimore City Line Southeast of Ralls Avenue 2.5 miles	$84,000,000	2028-2039	30	35.5	65.5
System Preservation	Roadway	Carroll County	MD 851 Urban Reconstruction	Cooper Drive to South Branch of the Patapsco River 1.04 miles	$16,000,000	2028-2039	40	25	65
System Preservation	Transit	MDOT MTA	Zero Emission Bus Transition Phase 1	MDOT MTA's core service area in the Baltimore region	$1,594,000,000	2028-2039	40	25	65
System Preservation	Transit	MDOT MTA	Zero Emission Bus Transition Phase 2	MDOT MTA's core service area in the Baltimore region	$2,228,000,000	2040-2050	40	25	65

Project Category	Project Type	Submitting Jurisdiction	Name	Limits / Length	Estimated Cost (YOE)	Time Period	Policy Score	Technical Score	Total Score
Expansion	Roadway	Carroll County	MD 97	Bachmans Valley Road to MD 140 in Westminster 4.73 miles	$202,000,000	2028-2039	30	34.5	64.5
Expansion	Roadway	Carroll County	MD 140	Market Street to Sullivan Road 2.5 miles	$474,000,000	2040-2050	30	34.5	64.5
Expansion	Roadway	Harford County	MD 22	MD 543 to I-95 7.9 miles	$221,000,000	2040-2050	30	32.5	62.5
Expansion	Roadway	Harford County	MD 24	US 1 Bypass to south of Singer Road 5.0 miles	$128,000,000	2040-2050	30	31.5	61.5
Expansion	Roadway	Baltimore County	I-695 at Broening Highway Interchange		$147,000,000	2028-2039	40	20	60
Expansion	Roadway	Baltimore County	I-795	Owings Mills Boulevard to Franklin Boulevard 2.63 miles	$155,000,000	2028-2039	40	20	60
Expansion	Roadway	Harford County	MD 543	MD 136 to I-95 1.9 miles	$140,000,000	2028-2039	30	30	60
Expansion	Transit	MDOT MTA	State / Cultural Center Transit Hub	Baltimore City	$9,000,000	2040-2050	10	50	60
Expansion	Transit	MDOT MTA	Patapsco Transit Hub	Baltimore County	$9,000,000	2040-2050	10	50	60
Expansion	Roadway	Anne Arundel County	MD 214	MD 424 to Shoreham Beach Road 7.5 miles	$236,000,000	2040-2050	30	29	59

Project Category	Project Type	Submitting Jurisdiction	Name	Limits / Length	Estimated Cost (YOE)	Time Period	Policy Score	Technical Score	Total Score
Expansion	Roadway	Howard County	US 1 Revitalization Breakout Projects	MD 175 to Whiskey Bottom Road 4.5 miles	$166,000,000	2040-2050	20	39	59
System Preservation	Transit	MDOT MTA	Fleet Replacement with Low-Floor Vehicle		$757,000,000	2040-2050	30	29	59
Expansion	Roadway	Harford County	US 1	MD 152 to MD 147 / US 1 Business 1.3 miles	$212,000,000	2040-2050	30	28	58
Expansion	Roadway	Queen Anne's County	MD 8 / US 50/301 Interchange and Service Roads	Skip Jack Parkway south to Davidson Drive; east to Thompson Creek service road 2.0 miles	$90,000,000	2028-2039	30	28	58
Expansion	Roadway	Anne Arundel County	MD 170	Norcross Lane to Wieker Road 0.83 miles	$23,000,000	2028-2039	30	27.5	57.5
Expansion	Roadway	Howard County	Broken Land Parkway at Snowden River Parkway	Broken Land Parkway from south of MD 32 to north of Snowden River Parkway; Snowden River Parkway from east of Minstrel Way to Patuxent Woods Drive 0.25 miles	$63,000,000	2028-2039	20	37	57
Expansion	Transit	MDOT MTA	Johns Hopkins Hospital Transit Hub	Baltimore City	$9,000,000	2040-2050	10	47	57
Expansion	Transit	MDOT MTA	Penn-North Transit Hub	Baltimore City	$9,000,000	2040-2050	10	47	57

Project Category	Project Type	Submitting Jurisdiction	Name	Limits / Length	Estimated Cost (YOE)	Time Period	Policy Score	Technical Score	Total Score
Expansion	Roadway	Queen Anne's County	MD 18	Kent Narrows to Bay Bridge – MD 18 and MD 835 on east side of Kent Narrows to MD 18 5.0 miles	$114,000,000	2028-2039	30	26.5	56.5
Expansion	Transit	MDOT MTA	Owings Mills Transit Hub	Baltimore County	$9,000,000	2040-2050	10	46	56
Expansion	Roadway	Harford County	US 1 Bypass	MD 147 / US 1 Business to Hickory Bypass 4.6 miles	$354,000,000	2040-2050	40	15	55
Expansion	Transit	Howard County	Bus Rapid Transit to BWI	Dorsey MARC Station to BWI Light Rail Station 9.7 miles	$240,000,000	2040-2050	20	34.5	54.5
Expansion	Transit	MDOT MTA	Glen Burnie Transit Hub	Anne Arundel County	$9,000,000	2040-2050	10	44.5	54.5
Expansion	Transit	Howard County	US 1 Corridor Bus Rapid Transit	Dorsey MARC Station to College Park Purple Line Station 19.5 miles	$281,000,000	2040-2050	20	33	53
Expansion	Roadway	Howard County	US 1 at MD 175 Interchange	0.5 miles	$184,000,000	2040-2050	20	33	53
Expansion	Transit	MDOT MTA	UM Medical Center Transit Hub	Baltimore City	$9,000,000	2040-2050	10	43	53
Expansion	Roadway	Anne Arundel County	MD 175	Reece Road to MD 170 2.7 miles	$277,000,000	2040-2050	20	32	52
Expansion	Roadway	Harford County	US 40 at MD 22 Interchange		$48,000,000	2040-2050	20	32	52
Expansion	Transit	MDOT MTA	Camden Station Transit Hub	Baltimore City	$9,000,000	2040-2050	10	42	52

Project Category	Project Type	Submitting Jurisdiction	Name	Limits / Length	Estimated Cost (YOE)	Time Period	Policy Score	Technical Score	Total Score
Expansion	Transit	Anne Arundel County	Anne Arundel Countywide Microtransit	Countywide	$3,000,000	2028-2039	20	31	51
Expansion	Roadway	Carroll County	MD 27 Corridor Improvements	Carroll County Line to Leishear Road 3.2 miles	$78,000,000	2040-2050	20	30.5	50.5
Expansion	Roadway	Howard County	TSMO System 1	I-70 from I-695 to MD 32 (11.0 miles) US 29 from MD 99 to MD 100 (4.0 miles) US 40 from I-695 to I-70 (10.0 miles)	$48,000,000	2028-2039	30	20	50
Expansion	Roadway	Howard County	MD 175	Oceano to Anne Arundel County Line 0.54 miles	$24,000,000	2040-2050	20	30	50
Expansion	Transit	MDOT MTA	BWI Airport Transit Hub	Anne Arundel County	$9,000,000	2040-2050	10	40	50
Expansion	Transit	MDOT MTA	Rogers Avenue Transit Hub	Baltimore City	$9,000,000	2040-2050	10	40	50
System Preservation	Transit	MDOT MTA	Light Rail Fleet Mid-life Overhaul	Hunt Valley to BWI/Glen Burnie	$210,000,000	2028-2039	20	30	50
Expansion	Roadway	Howard County	Snowden River Parkway Widening	Broken Land Parkway to Oakland Mills Road 1.1 miles	$21,000,000	2028-2039	10	39	49
Expansion	Roadway	Howard County	MD 175 at I-95 Interchange	1.0 miles	$196,000,000	2040-2050	20	29	49
Expansion	Transit	Anne Arundel County	Annapolis to Fort Meade / Columbia Transit	Annapolis / Parole to Fort Meade to Columbia 25.0 miles	$45,000,000	2028-2039	10	38.5	48.5

Project Category	Project Type	Submitting Jurisdiction	Name	Limits / Length	Estimated Cost (YOE)	Time Period	Policy Score	Technical Score	Total Score
Expansion	Roadway	Baltimore County	MD 7 at MD 43 Interchange		$82,000,000	2040-2050	30	18	48
Expansion	Transit	Harford County	MTA Commuter Service	Harford County to Downtown Baltimore and Harbor East	$2,000,000	2028-2039	20	28	48
Expansion	Roadway	Harford County	MD 152	US 1 to I-95 4.3 miles	$103,000,000	2040-2050	10	37.5	47.5
Expansion	Transit	MDOT MTA	White Marsh Transit Hub	Baltimore County	$9,000,000	2040-2050	10	37.5	47.5
Expansion	Roadway	Howard County	MD 100 Widening	I-95 to Anne Arundel County Line 2.0 miles	$47,000,000	2040-2050	20	27	47
Expansion	Roadway	Howard County	MD 108	Trotter Road to Guilford Road 1.67 miles	$64,000,000	2040-2050	20	27	47
Expansion	Transit	MDOT MTA	Lexington Market Transit Hub	Baltimore City	$9,000,000	2040-2050	10	37	47
Expansion	Transit	MDOT MTA	Essex Transit Hub	Baltimore County	$9,000,000	2040-2050	10	37	47
Expansion	Transit	Anne Arundel County	Glen Burnie to Annapolis Transit	Cromwell / Glen Burnie to Annapolis / Parole 16.0 miles	$7,000,000	2028-2039	20	26.5	46.5
Expansion	Roadway	Anne Arundel County	MD 295	MD 100 to I-195 3.27 miles	$393,000,000	2040-2050	20	25.5	45.5
Expansion	Roadway	Howard County	MD 32	North of I-70 to Carroll County Line 4.0 miles	$79,000,000	2040-2050	20	25.5	45.5

Project Category	Project Type	Submitting Jurisdiction	Name	Limits / Length	Estimated Cost (YOE)	Time Period	Policy Score	Technical Score	Total Score
Expansion	Roadway	Anne Arundel County	I-97	MD 32 to U.S. 50 / 301 6.5 miles	$450,000,000	2040-2050	30	15	45
Expansion	Transit	Anne Arundel County	Annapolis to New Carrollton Transit	New Carrollton to Parole 21.0 miles	$3,000,000	2028-2039	20	22.5	42.5
Expansion	Roadway	Anne Arundel County	MD 713	MD 175 to MD 176 2.6 miles	$68,000,000	2040-2050	10	32	42
Expansion	Roadway	Harford County	MD 24 (Rock Spring Road)	US 1 Bypass to MD 23 1.8 miles	$44,000,000	2040-2050	10	31	41
Expansion	Roadway	Harford County	US 40	MD 543 to Loflin Road 1.7 miles	$93,000,000	2040-2050	10	30	40
Expansion	Roadway	Harford County	Abingdon Road	MD 924 to US 40 3.0 miles	$87,000,000	2040-2050	10	29.5	39.5
Expansion	Roadway	Harford County	Thomas Run Road	MD 22 to West Medical Hall Road 0.8 miles	$21,000,000	2040-2050	10	29.5	39.5
Expansion	Roadway	Anne Arundel County	MD 177	MD 2 to Lake Shore Drive 6.1 miles	$223,000,000	2040-2050	10	28.5	38.5
Expansion	Roadway	Harford County	US 1	Baltimore County Line to MD 152 1.4 miles	$35,000,000	2040-2050	10	28.5	38.5
Expansion	Roadway	Harford County	MD 24 at Singer Road Interchange		$182,000,000	2040-2050	20	18	38
System Preservation	Transit	MDOT MTA	MARC Rolling Stock Overhauls and Replacements	All three MARC Lines (Penn, Camden, Brunswick)	$570,000,000	2040-2050	10	28	38

Project Category	Project Type	Submitting Jurisdiction	Name	Limits / Length	Estimated Cost (YOE)	Time Period	Policy Score	Technical Score	Total Score
Expansion	Transit	Anne Arundel County	Chesapeake Bay Ferry Service		$59,000,000	2040-2050	10	27	37
Expansion	Roadway	Harford County	Perryman Access - Mitchell Lane	US 40 in the vicinity of Mitchell Lane to Canning House Road 2.0 miles	$62,000,000	2040-2050	10	26.5	36.5
Expansion	Transit	Harford County	Transit Signal Priority	MD 22 corridor from MD 543 to Long Drive / Technology Drive 7.4 miles MD 924 corridor from MacPhail Road to Woodsdale Road 4.7 miles	$2,000,000	2028-2039	10	24.5	34.5
Expansion	Roadway	Howard County	MD 32	Cedar Lane to Anne Arundel County Line 8.0 miles	$1,153,000,000	2040-2050	20	21	41
Expansion	Roadway	Howard County	US 29 Widening	MD 100 to I-70 3.2 miles	$771,000,000	2040-2050	10	26	36
Expansion	Roadway	Anne Arundel County	US 50	I-97 to MD 2 5.5 miles	$368,000,000	2040-2050	10	24	34
Expansion	Roadway	Anne Arundel County	MD 32	I-97 to Howard County Line 11.0 miles	$524,000,000	2040-2050	10	23.5	33.5
Expansion	Roadway	Anne Arundel County	MD 100	Howard County Line to I-97 6.5 miles	$299,000,000	2040-2050	10	19	29
Expansion	Roadway	Harford County	MD 24 @ Wheel Road		$182,000,000	2040-2050	10	19	29

Note: Projects highlighted in green below bold line are not included in the preferred alternative.

Appendix C: Evaluating Potential Effects of Projects

This appendix presents details about the technical analyses we conducted during the development of *Resilience 2050*. These analyses help the BRTB to evaluate and understand the potential effects of the proposed projects and programs of *Resilience 2050* with respect to adopted regional transportation goals, including conserving and enhancing the environment, increasing mobility, and improving accessibility.

Analysis of Preferred Alternative – Air Quality Conformity

Chapter 1 describes the federal requirements each metropolitan planning organization (MPO) must follow to make sure the projects in its long-range transportation plan (LRTP) will not cause new air quality violations, worsen existing violations, or delay timely attainment of air quality standards.

To protect public health and improve air quality, the U.S. Environmental Protection Agency (EPA) sets the National Ambient Air Quality Standards (NAAQS) for six criteria air pollutants. The EPA then determines the areas that do not meet these standards.

The EPA has determined that the Baltimore region does not meet the national standard for ground-level ozone. As a result, the EPA has classified the region as a moderate “nonattainment” area for the 2015 8-hour ozone standard. The standard is 70 parts per billion (ppb). The applicable pollutants for 8-hour ozone are Volatile Organic Compounds (VOCs) and Nitrogen Oxides (NOx).

The State Implementation Plan (SIP) developed by the Maryland Department of the Environment (MDE) establishes a plan for how the region will achieve the NAAQS by the required attainment date. The SIP addresses all sources of pollution in the region. For on-road mobile sources of pollution (such as cars, trucks, and buses), the SIP establishes motor vehicle emission budgets.

Conformity Evaluation

The Clean Air Act Amendments (CAAA) require MPOs for regions in nonattainment of the NAAQS to perform technical analyses to demonstrate that regional transportation plans and programs conform to the most recently approved or adequate motor vehicle emission budgets in the SIP, and do not make air quality worse.

Emissions from mobile sources are among the most significant contributors to ozone pollution. Because of this, the transportation conformity process is a critical element of the region’s and the State’s efforts to improve air quality and reduce congestion.

The transportation conformity process is coordinated through the Interagency Consultation Group, a subcommittee of the BRTB. In January 2023, MDE submitted a SIP for the 2015 8-hour ozone standard. Because of the tight timeline, EPA has not finalized their review and approval of those budgets. Therefore, the 2023 motor vehicle emissions budgets were not used for the conformity analysis of the 2024-2027 Transportation Improvement Program (TIP) and *Resilience 2050*. Instead, the 2012 reasonable further progress (RFP) budget for mobile sources was used, which was deemed adequate by EPA in 2016.

The Baltimore region is no longer required to address Carbon Monoxide (CO) or Particulate Matter (PM) 2.5 in the conformity determination. The region attained the CO NAAQS in 1995 and the PM 2.5 NAAQS in 2014.

Table 1 depicts the results of the conformity analysis. The results indicate that projected mobile source emissions are below the established 2012 RFP budgets for years 2023, 2025, 2035, 2045, and 2050. Based on the conformity analysis, the BRTB, in its capacity as the MPO for the Baltimore region, has concluded that implementation of the projects in *Resilience 2050* and the 2024-2027 TIP will not worsen the region's air quality or delay the timely attainment of the NAAQS.

Table 1 – Air Quality Conformity Final Emissions Results (Tons per Day)

Horizon Year	2023	2025	2035	2045	2050
NOx Emissions					
Total Emissions Modeled	30.551	25.433	17.586	17.514	18.132
Conformity Budget*	93.5	93.5	93.5	93.5	93.5
Conformity Result	Pass	Pass	Pass	Pass	Pass
VOC Emissions					
Total Emissions Modeled	16.986	15.232	10.047	9.261	9.259
Conformity Budget*	40.2	40.2	40.2	40.2	40.2
Conformity Result	Pass	Pass	Pass	Pass	Pass
Vehicle Miles Traveled (VMT)	82,709,094	82,745,203	87,710,953	92,587,692	95,128,952

** 2012, 8-hour ozone Reasonable Further Progress (RFP) SIP budget for the Baltimore region (motor vehicle emission budgets determined adequate by EPA on February 22, 2016)*

Analysis of Preferred Alternative – Travel Demand Model

BMC staff developed and applied performance measures to quantify simulated horizon year travel effects on the Baltimore region transportation network. Using the region's disaggregate microsimulation travel demand model called, *Initiative to Simulate Individual Travel Events* or InSITE, analysis was performed to understand the potential effects of the *Resilience 2050* preferred alternative for the selected performance measures. The InSITE model, originally estimated from the 2008 Household Travel Survey, was recently calibrated using observations from the 2019 Maryland Household Travel Survey and validated to 2019 traffic count and transit boarding data.

The InSITE microsimulation model consists of four parts:

1) The first part is a household and household person roster estimation tool, which estimates the number of households and the number of persons in each household.

2) The second part is a person tour/trip roster generator containing the sequence of tours/trips by purpose, time of day and mode. You can think of tours or trips as any transportation trip you make such as traveling from home to work, to the grocery store and back home again. Tours or trips can be on multiple modes such as taking transit, driving, riding as a passenger, or walking.
3) The third part is a freight model estimating long-distance commodity flows and local freight, as well as a commercial truck/vehicle goods, deliveries and services touring model.
4) The fourth part is a process to load the simulated vehicle and transit trips onto the representative transportation networks, such as which roads or transit routes are taken.

The InSITE model includes nine tour/trip purposes: 1) work, 2) school (daycare through primary school), 3) post-secondary, 4) meal, 5) shop, 6) personal business, 6) social/recreation, 7) escort, and 8) school escort. Each tour or trip can be taken via multiple modes of travel. Modes included in the InSITE model for tours or trips include motorized (drive alone and shared ride), non-motorized (walk and bike), and transit (walk and drive access) along with freight: heavy, medium, and commercial vehicle freight modes. The Round 10 socioeconomic forecasts of population, households, and employment discussed in Chapter 2 serve as key demographic inputs for the InSITE model.

We used the InSITE model to analyze performance measures for two scenarios:

- **2050 Existing and Committed (2050 E+C) projects**: The 2050 E+C scenario illustrates the forecasted level of service that would result in 2050 if only Existing and Committed projects were completed. “Committed” means that a schedule is in place and sponsors have identified fund sources and have committed funds to build these projects by 2027. In this case, E+C is a “no-build” scenario assuming that there will be no new capacity adding infrastructure projects beyond 2027. The short-range Transportation Improvement Program to be approved alongside *Resilience 2050* covers the years 2024 - 2027.
- ***Resilience 2050* Preferred Alternative (2050 PA) projects**: This scenario includes all of the projects in the *Resilience 2050* preferred alternative in addition to the E+C projects.

Though the 2050 E+C and 2050 PA scenarios are the focus of the analysis, the figures and tables in this section also include baseline data for the year 2019. Figures 1 through 3 illustrate results for the 2019, 2050 E+C, and 2050 PA scenarios for weekday simulated travel by household income group, travel mode and trip purpose. InSITE estimates a 0.18% increase in trips under the 2050 PA scenario compared to the 2050 E+C scenario because of changes in accessibility and congestion associated with implementation of the projects in *Resilience 2050*. The InSITE model estimates that persons living in the Baltimore region will generate 9.098 million trips on an average weekday under the 2050 PA scenario as compared to 9.082 million trips in the 2050 E+C scenario.

The InSITE model can also estimate future congestion levels for a variety of scenarios. Maps 1 and 2 show congested roadway forecasts under the 2050 E+C and 2050 PA scenarios, respectively.

Figure 1 – Daily Trips in the Baltimore Region by Household Income

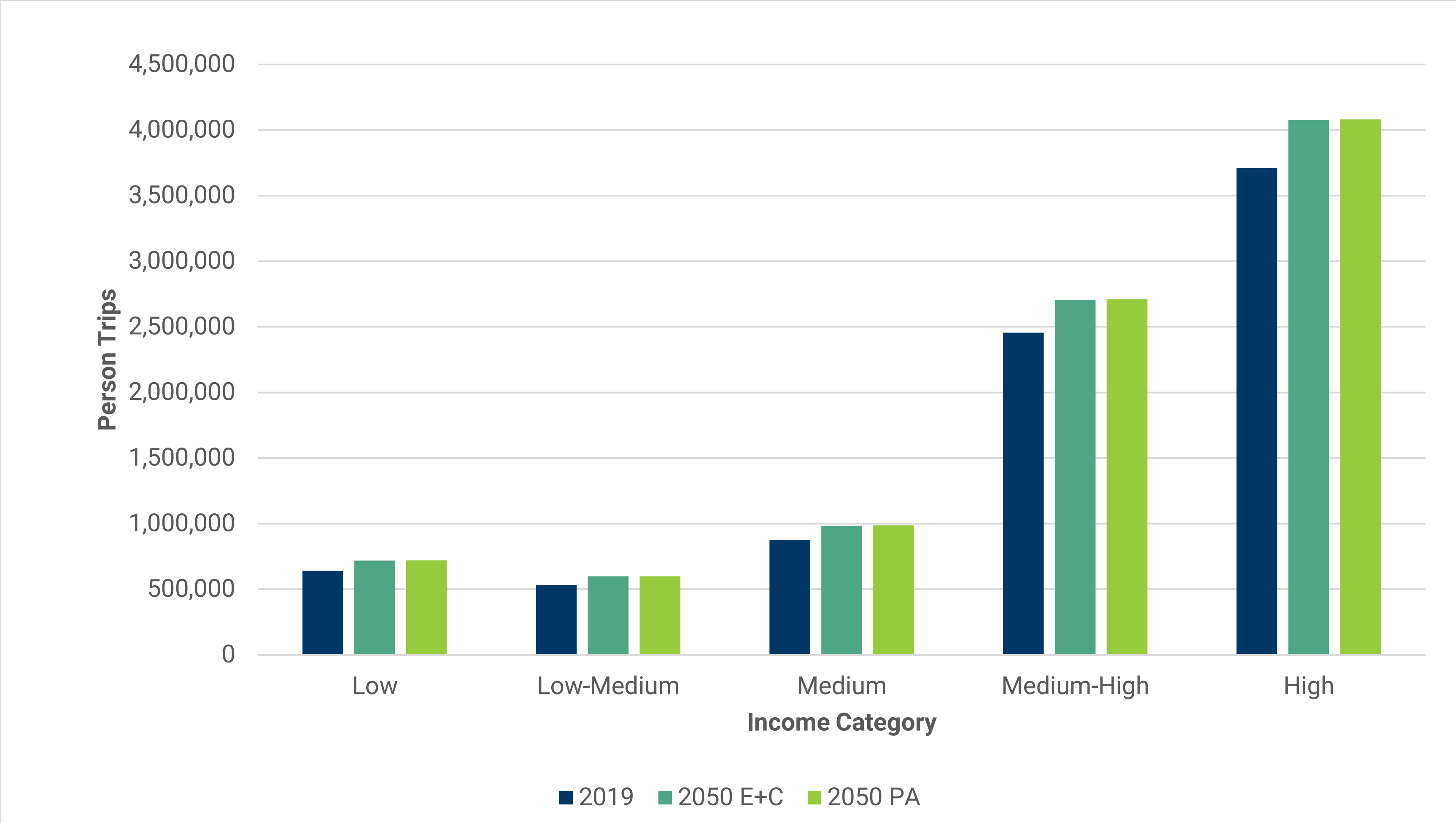


Figure 2 – Daily Trips in the Baltimore Region by Travel Mode

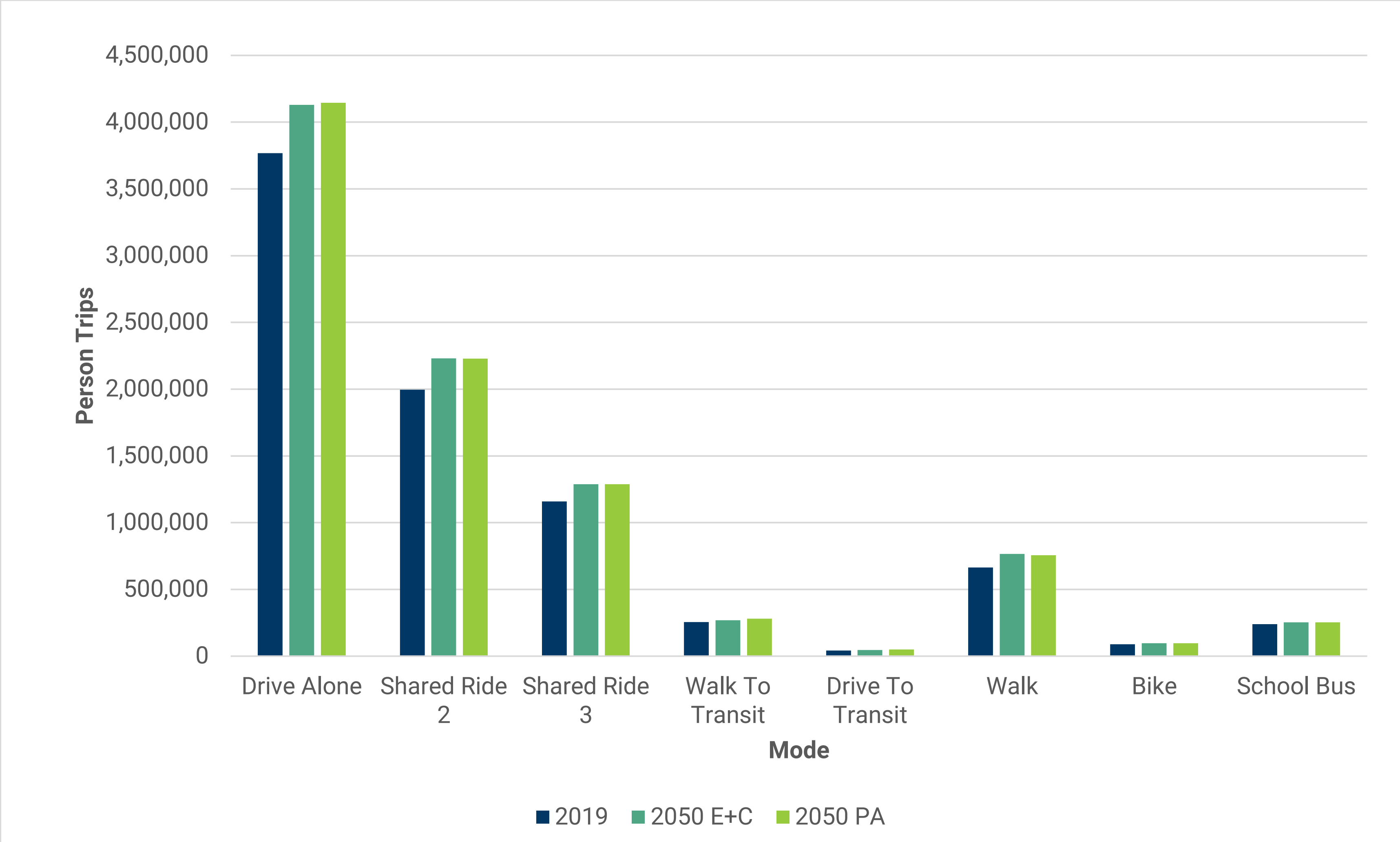
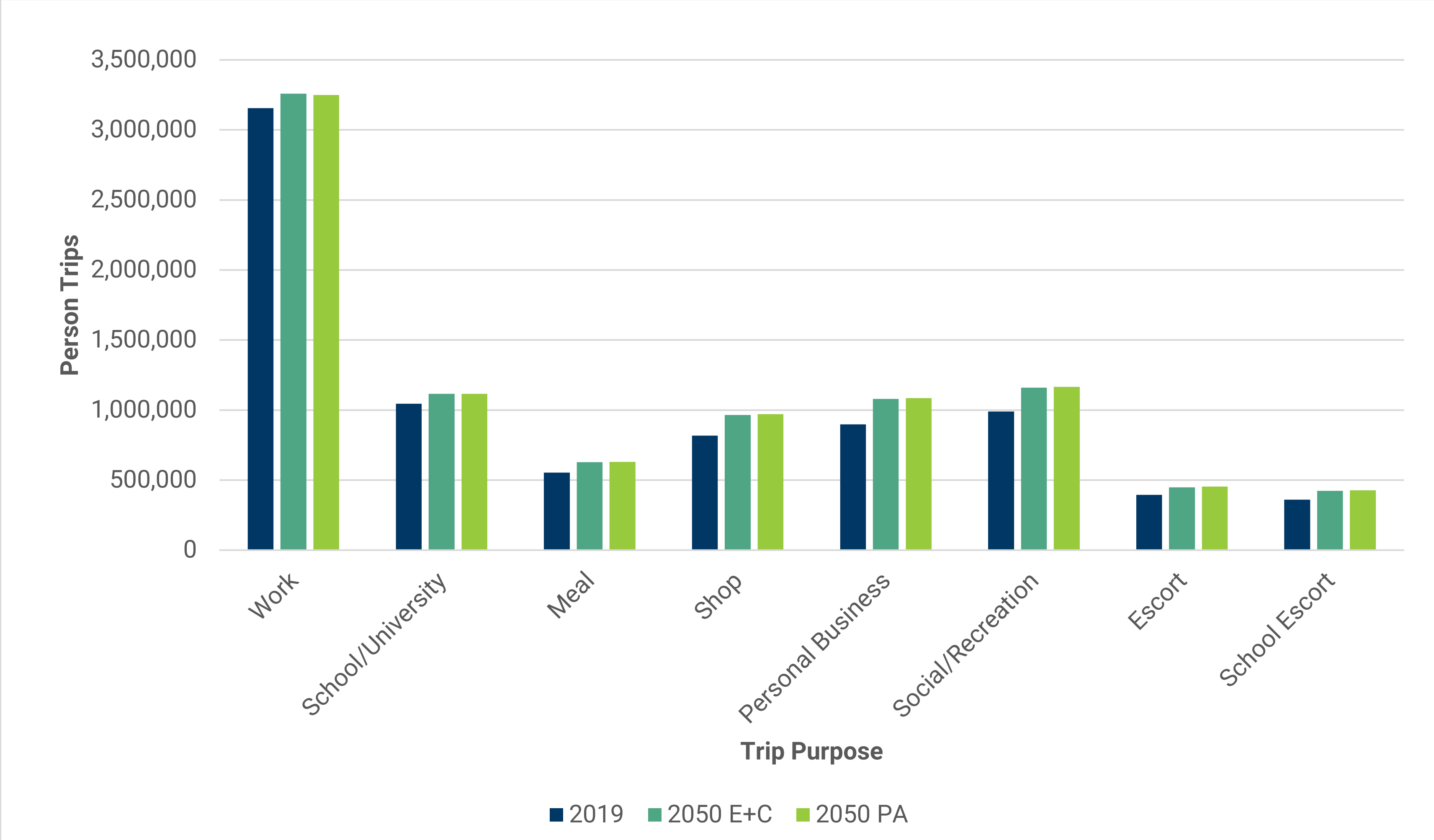
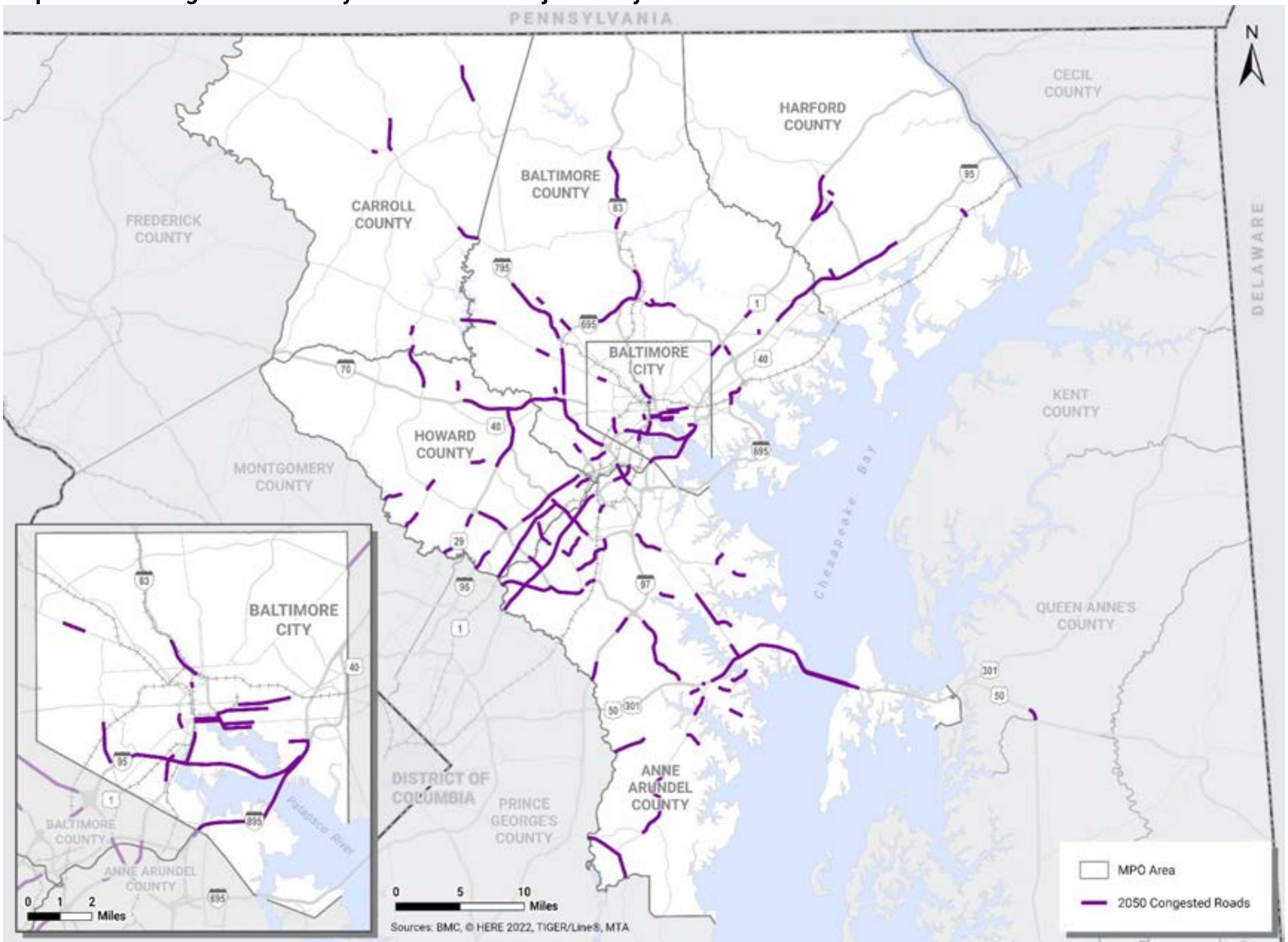


Figure 3 – Daily Trips in the Baltimore by Trip Purpose



Map 1 - 2050 Congested Roadway Forecast: E+C Projects Only



Map 2 - 2050 Congested Roadway Forecast: E+C Projects and *Resilience 2050* Preferred Alternative Projects

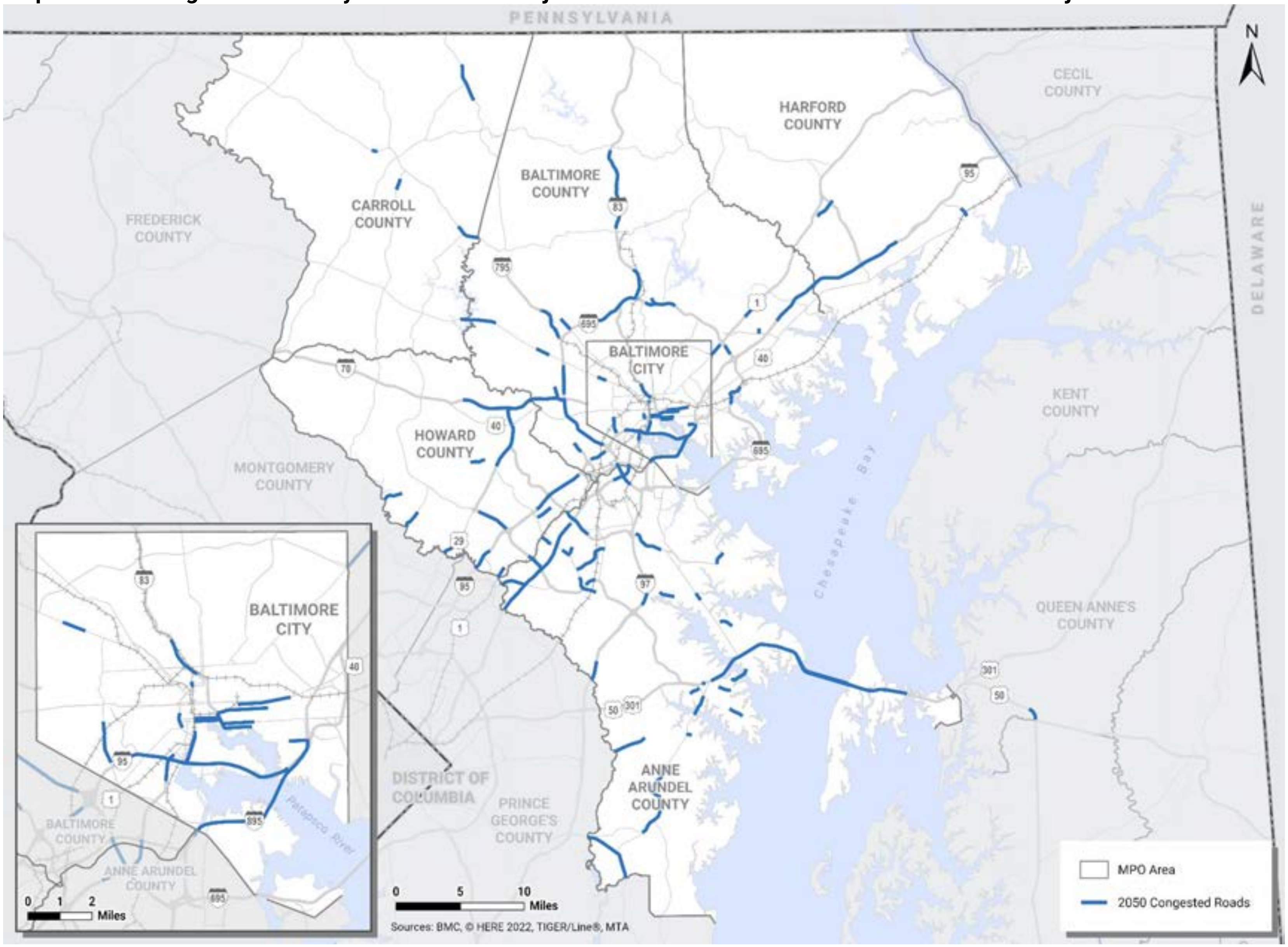


Table 2 quantifies congestion and other performance measures for the 2019, 2050 E+C and 2050 PA scenarios. The final two columns show percentage change between scenarios for each measure. The second to last column shows the percentage change between the 2019 baseline and 2050 E+C scenarios. This represents how conditions might change as the region grows through 2050, absent any of the projects included in the *Resilience 2050* preferred alternative. Some of these changes are large, as the 2019 scenario incorporates baseline demographic and socioeconomic inputs, and the 2050 scenarios incorporate demographic and socioeconomic inputs reflecting increases in population, households and employment.

The last column shows the percentage change between the 2050 E+C and 2050 PA scenarios. Both of these scenarios incorporate the 2050 demographic forecasts for population, households and employment. Thus, comparing the 2050 E+C and 2050 PA scenarios isolates the potential impact of implementing the projects contained in *Resilience 2050* while holding demographic variables constant. A red highlight indicates worsening conditions (such as more congested roadways) while a green result indicates improving conditions (such as less congested roadways).

Table 2 - 2019, 2050 Existing + Committed and 2050 Preferred Alternative Performance Measures

Performance Measure	Indicator of Travel Demand	2019 Base Year	2050 Existing & Committed	2050 Preferred Alternative	2019 to 2050 E+C % Change	2050 E+C to 2050 PA % Change
Vehicle Miles Traveled (VMT): Average Weekday - Daily	Interstates	37,807,909	44,161,620	44,178,948	16.8%	0.0%
	Arterials	26,165,052	31,236,948	30,865,765	19.4%	-1.2%
	Collectors	4,758,245	6,405,108	5,981,057	34.6%	-6.6%
	All Roads	68,731,207	81,803,676	81,025,770	19.0%	-1.0%
VMT: AM Peak Hour (7:30 - 8:30 AM)	Interstates	3,063,996	3,423,983	3,452,597	11.7%	0.8%
	Arterials	2,387,479	2,731,349	2,692,421	14.4%	-1.4%
	Collectors	517,172	668,887	609,605	29.3%	-8.9%
	All Roads	5,968,648	6,824,219	6,754,624	14.3%	-1.0%
Congested VMT (Level of Service (LOS) E and F): AM Peak Hour (7:30 - 8:30 AM)	Interstates	2,020,911	2,437,726	2,466,934	20.6%	1.2%
	Arterials	992,899	1,402,773	1,282,306	41.3%	-8.6%
	Collectors	277,584	445,193	373,981	60.4%	-16.0%
	All Roads	3,291,394	4,285,692	4,123,222	30.2%	-3.8%
Percentage of Congested VMT (LOS E and F): AM Peak Hour (7:30 - 8:30 AM)	Interstates	65.96%	71.20%	71.45%	7.9%	0.4%
	Arterials	41.59%	51.36%	47.63%	23.5%	-7.3%
	Collectors	53.67%	66.56%	61.35%	24.0%	-7.8%
	All Roads	55.14%	62.80%	61.04%	13.9%	-2.8%

	Travel Characteristics					
Transit Ridership	Boardings (Unlinked Trips)	501,637	541,974	590,718	8.0%	9.0%
Average Weekday Mode Share	Transit All Purposes	3.63%	3.48%	3.63%	-4.1%	4.3%
Personal Vehicle Occupancy	Work	1.13	1.12	1.12	-0.9%	0.0%
	All Other Purposes	1.55	1.55	1.54	0.0%	-0.6%
	Performance					
Average Speed (mph): AM Peak Hour (7:30 - 8:30 AM)	Interstates	45.6	41.1	42.3	-9.9%	2.9%
	Freeways	42.5	34.6	36.4	-18.6%	5.2%
	Principal Arterials	27.7	26.2	26.6	-5.4%	1.5%
	Minor Arterials	25.7	24.2	24.5	-5.8%	1.2%
	Collectors	25.7	23.2	23.6	-9.7%	1.7%
	All Roads*	33.3	30.1	31.0	-9.6%	3.0%
Vehicle Hours of Delay: AM Peak Hour (7:30 - 8:30 AM)	All Roads	184,765	395,633	336,380	114.1%	-15.0%
Vehicle Hours of Delay: Average Weekday - Daily	All Roads	454,642	1,084,138	963,153	138.5%	-11.2%

Following are some significant observations related to the data presented in Table 2:

- The Baltimore region's average daily weekday VMT on all roads is projected to increase from 68.7 million in the 2019 scenario to 81.8 million in the 2050 E+C scenario, an increase of 19%. The 2050 PA scenario yields a decrease in VMT to 81 million as compared to the 2050 E+C scenario, a decline of 1.0%.
- VMT on all roads in the AM peak hour is projected to increase from 5.97 million in the 2019 scenario to 6.82 million in the 2050 E+C scenario, an increase of 14.3%. The 2050 PA scenario yields a decrease in VMT to 6.75 million as compared to the 2050 E+C scenario, a decline of 1.0%.
- Congested (LOS E and F) VMT on all roads in the AM peak hour is projected to increase from 3.3 million in the 2019 baseline scenario to 4.3 million in the 2050 E+C scenario, an increase of 30.2%. The addition of transportation network capacity in the 2050 PA scenario yields a 3.8% decrease in congested VMT compared to the 2050 E+C scenario. Similarly, the percentage of congested VMT on all roads in the AM peak hour is projected to increase by 13.9% from the 2019 baseline to the 2050 E+C scenario. Implementation of the 2050 PA scenario yields a 2.8% decrease in the percentage of congested VMT in the AM peak as compared to the 2050 E+C scenario.

- Transit ridership as measured by boardings for unlinked trips is projected to increase from 502,000 to 591,000 from the 2019 baseline to the 2050 PA scenario, an increase of 17.7%. The 2050 PA transit network yields a 9% increase in transit ridership over the 2050 E+C scenario. For all trip purposes, the mode share for drive and walk transit access in the 2050 PA scenario is 3.63%.
- Non-motorized (walk and bike) travel modes account for slightly greater than 9% of all trips regardless of trip purpose under all scenarios. It is important to note that the InSITE model does not include transportation networks for bike and walk modes.
- A projected increase in VMT in the AM peak hour from the 2019 baseline to the 2050 E+C scenario results in lower travel speeds for all facility types in 2050 compared to 2019. The addition of transportation network capacity in the 2050 PA scenario yields higher projected average travel speeds on all facility types as compared to the 2050 E+C scenario.
- Vehicle hours of delay (VHOD) are projected to increase significantly from the 2019 baseline to the 2050 E+C scenario in both the AM peak hour (114.1% increase) and the average daily weekday (138.5% increase). The 2050 PA network reduces VHOD as compared to the 2050 E+C scenario in both the AM peak hour (15.0% decrease) and the average daily weekday (11.2% decrease).

Analysis of Preferred Alternative - Environmental Justice

This section describes how we address the principles of environmental justice (EJ) in *Resilience 2050*.

As discussed earlier in the plan, *Resilience 2050* contains a list of the major surface transportation projects the region expects to implement in the period from 2028 to 2050. These investments will affect the travel patterns and transportation decisions of people living in and travelling through the Baltimore region. Some of these impacts will be positive (benefits) while others will be negative (burdens). Furthermore, these impacts will be unevenly distributed throughout the region. For example, transportation investments may decrease the travel time to work for some people while increasing congestion could result in longer travel times for others. In the context of metropolitan transportation planning, the core of an EJ analysis is evaluating the distribution of these benefits and burdens on EJ and non-EJ populations.

The section begins with the definition of EJ and its guiding principles, followed by a summary of EJ populations in the Baltimore region. The methods section focuses on the identification of EJ and non-EJ areas in the Baltimore region. The identification of EJ and non-EJ areas sets the stage for an analysis of the benefits and burdens associated with the implementation of the projects included in *Resilience 2050.* To accomplish this, we identified a series of accessibility and mobility measures of interest. The report concludes with a discussion of the potential effects of *Resilience 2050* in the context of these accessibility and mobility measures.

Definition and Guiding Principles

EJ seeks to ensure that the benefits and burdens of transportation investments are shared as equitably as possible among all affected communities. Specifically, EJ considers whether low-income and minority populations bear disproportionate impacts resulting from governmental decisions.

Historically, EJ was borne out of civil rights and environmental complaints from low-income and minority communities. Concerns were raised, showing that these communities have suffered disproportionately from exposure to toxic chemicals and the siting of industrial plants and waste facilities.

In February 1994, President Clinton signed Executive Order 12898 entitled *Federal Action to Address Environmental Justice in Minority and Low-Income Populations*. In 1997, the U.S. Department of Transportation (DOT) issued an "Order to Address Environmental Justice in Minority Populations and Low-income Populations."

The DOT Order directs consideration of two groups: low-income persons and minorities.

FHWA and FTA allow recipients to establish their own definitions of low-income that are appropriate for the region, as long as they are at least as inclusive as the poverty guidelines set by the U.S. Department of Health and Human Services (HHS). The BRTB previously used the poverty level as its definition of low-income. However, the former Public Advisory Committee criticized this definition as too low and recommended increasing it due to the region's cost of living. For example, the 2023 HHS poverty guideline for a family of four is just $30,000.

In response to this critique, BMC staff reviewed alternative definitions of low-income for use in EJ mapping and analysis, the Vulnerable Populations Index and project scoring for *Resilience 2050*. Staff conducted a review of low-income definitions used by other MPOs as well as an analysis of ACS data. In addition to the population living below the national poverty level, the ACS also identifies the population that lives at or below higher percentages of the poverty level to account for the higher costs of living in some areas of the country. Many of the MPOs reviewed used a higher percentage of the poverty level as their definition of low-income.

After reviewing alternatives and practices used by other MPOs, we recommended 200% of the poverty level as the new definition for low-income populations. This increases the definition of low-income to approximately $29,000 for a one-person household and to about $60,000 for a four-person household. This definition has several advantages. It captures a larger portion of economically insecure persons in the Baltimore region, as the poverty level is not a living wage for the Baltimore region. It is also a close approximation to 50% of Baltimore region Area Median Income, an income level that is utilized for some U.S. Department of Housing and Urban Development programs. Another advantage is that it is readily available from the ACS for incorporation into BMC products. Finally, it is also a good approximation of a family-supporting wage. This wage is derived from the Massachusetts Institute of Technology living wage calculator and has been utilized in a number of BMC workforce development reports and analyses.

In December 2021, the BRTB Technical Committee agreed to move forward with 200% of the poverty level as the definition of low-income populations for use in future analyses.

Minorities are defined as a person belonging to any of the following groups:

- Person of origin in any of the black racial groups of Africa;
- Person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin;
- Person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent;
- Person having origins in any of the original peoples of North America (American Indian, Alaskan Native) and who maintains cultural identification through tribal affiliation or community recognition; or
- Person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands

The US DOT order applies to all policies, programs and other activities undertaken, funded or approved by the US DOT, including metropolitan planning. There are three fundamental US DOT environmental justice principles:

- To avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.
- To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process.
- To prevent the denial of, reduction in or significant delay in the receipt of benefits by minority and low-income populations.

MPOs are responsible for assessing the benefits and burdens of transportation system investments for different socio-economic groups. This includes both a data collection effort and the engagement of minority and low-income populations in public involvement activities.

EJ Populations in the Baltimore Region

Low-income

As stated previously, the BRTB defines low-income populations as the population below 200% of the poverty level. The primary source of data on low-income persons is the Census Bureau’s American Community Survey (ACS). The Census Bureau uses a set of income thresholds that vary by size of household and number of children to determine poverty (and 200% of the poverty level). If a household’s total income is less than the threshold for 200% of the poverty level, then that household and every individual in it is considered to have an income less than 200% of the poverty level. For example, the 2022 poverty threshold for a four-person family with two children is $29,678. This means that the 200% poverty threshold for a four-person family with two children is $59,356.

Table 3 summarizes low-income population by jurisdiction. Population at or below 200% of the poverty level are not evenly distributed throughout the region, ranging from 12.7% of the population in Carroll and Howard Counties to 38.6% of the population in Baltimore City. In total, 21.4% of the population in the Baltimore region have incomes at or below 200% of the poverty level.

Table 3 - Low-Income Population by Jurisdiction

Jurisdiction	Total Population*	Population Below 200% of Poverty Level	
		Low-Income Population	Share
Anne Arundel	568,438	79,308	14.0%
Baltimore City	569,935	220,113	38.6%
Baltimore County	830,134	181,141	21.8%
Carroll	168,464	21,461	12.7%
Harford	257,375	41,009	15.9%
Howard	326,248	41,356	12.7%
Queen Anne's	49,150	7,224	14.7%
BRTB Region Total	**2,769,744**	**591,612**	**21.4%**

Source: U.S. Census Bureau, 2017-2021 American Community Survey 5-Year Estimates (Table C17002)
**Total Population for which poverty level is counted*

Minority

The ACS also serves as the primary data source for identifying minority populations. Minorities include persons who are members of several population groups including Hispanic persons and non-Hispanic persons who are Black, American Indian or Alaskan Native, and Asian or Pacific Islander. Non-minorities are defined as those that are both white and non-Hispanic.

Table 4 summarizes minority persons by Hispanic or Latino origin and race while Table 5 summarizes minority persons by jurisdiction. As with low-income populations, minorities are not evenly distributed throughout the region. According to the latest 5-year estimates from the ACS, the share of minorities in BRTB jurisdictions ranges from 12.3% in Carroll County to 72.7% in Baltimore City. In total, minorities make up 44.7% of the Baltimore region population while white, non-Hispanics make up the remaining 55.3%.

Table 4 - Total Population in the BRTB region by Hispanic or Latino Origin and Race

<table>
<tr><th colspan="2">Categories</th><th colspan="2">BRTB Population</th><th colspan="2">Share</th></tr>
<tr><td>White, non-Hispanic</td><td></td><td>1,568,682</td><td>1,568,682</td><td>55.3%</td><td>55.3%</td></tr>
<tr><td rowspan="7">Minorities</td><td>Black, non-Hispanic</td><td rowspan="7">1,268,543</td><td>812,664</td><td rowspan="7">44.7%</td><td>28.6%</td></tr>
<tr><td>American Indian and Alaska Native, non-Hispanic</td><td>4,412</td><td>0.2%</td></tr>
<tr><td>Asian, non-Hispanic</td><td>162,578</td><td>5.7%</td></tr>
<tr><td>Native Hawaiian and Pacific Islander, non-Hispanic</td><td>1,068</td><td>0.0%</td></tr>
<tr><td>Some other race, non-Hispanic</td><td>11,492</td><td>0.4%</td></tr>
<tr><td>Two or more races, non-Hispanic</td><td>100,187</td><td>3.5%</td></tr>
<tr><td>Hispanic - all races</td><td>176,142</td><td>6.2%</td></tr>
<tr><td>Total</td><td></td><td>2,837,225</td><td>2,837,225</td><td>100.0%</td><td>100.0%</td></tr>
</table>

Source: U.S. Census Bureau, 2017-2021 ACS 5-Year Estimates (Table B03002)

Table 5 – Minority Population by Jurisdiction

Jurisdiction	Minority Population	White, non-Hispanic Population	Minority Share	White, non- Hispanic Share
Anne Arundel	198,278	385,758	33.9%	66.1%
Baltimore City	430,256	161,967	72.7%	27.3%
Baltimore Co	379,804	470,898	44.6%	55.4%
Carroll	21,206	150,942	12.3%	87.7%
Harford	65,686	193,476	25.3%	74.7%
Howard	165,763	163,490	50.3%	49.7%
Queen Anne's	7,551	42,151	15.2%	84.8%
BRTB Region Total	**1,268,543**	**1,568,682**	**44.7%**	**55.3%**

Source: U.S. Census Bureau, 2017-2021 ACS 5-Year Estimates (Table B03002)

Methodology

Identifying EJ Populations

The first step in analyzing the effects of plans and programs on EJ populations is to identify where minority and low-income populations live. We use Transportation Analysis Zones (TAZ) as a basis for identifying EJ areas. TAZs are a basic unit of geography used to predict travel behavior in our travel demand model, known as InSITE. They are constructed using census block geographies and in many cases are smaller than census tracts.

Having established that TAZs will be the geographic unit of analysis, we need a way to identify EJ and non-EJ TAZs. A TAZ is identified as an EJ area if it has a concentration of low-income persons or minorities greater than their respective regional averages. The percentage of the population in the Baltimore region with a household income below 200% of the poverty level is 21.4%. Thus, TAZs with a concentration of the population living below 200% of the poverty level greater than 21.4% are considered low-income TAZs for EJ purposes. Similarly, TAZs with a concentration of minority persons greater than or equal to the regional average of 44.7% are considered minority TAZs for EJ purposes. Table 6 and Map 3 summarize EJ TAZs in the Baltimore region.

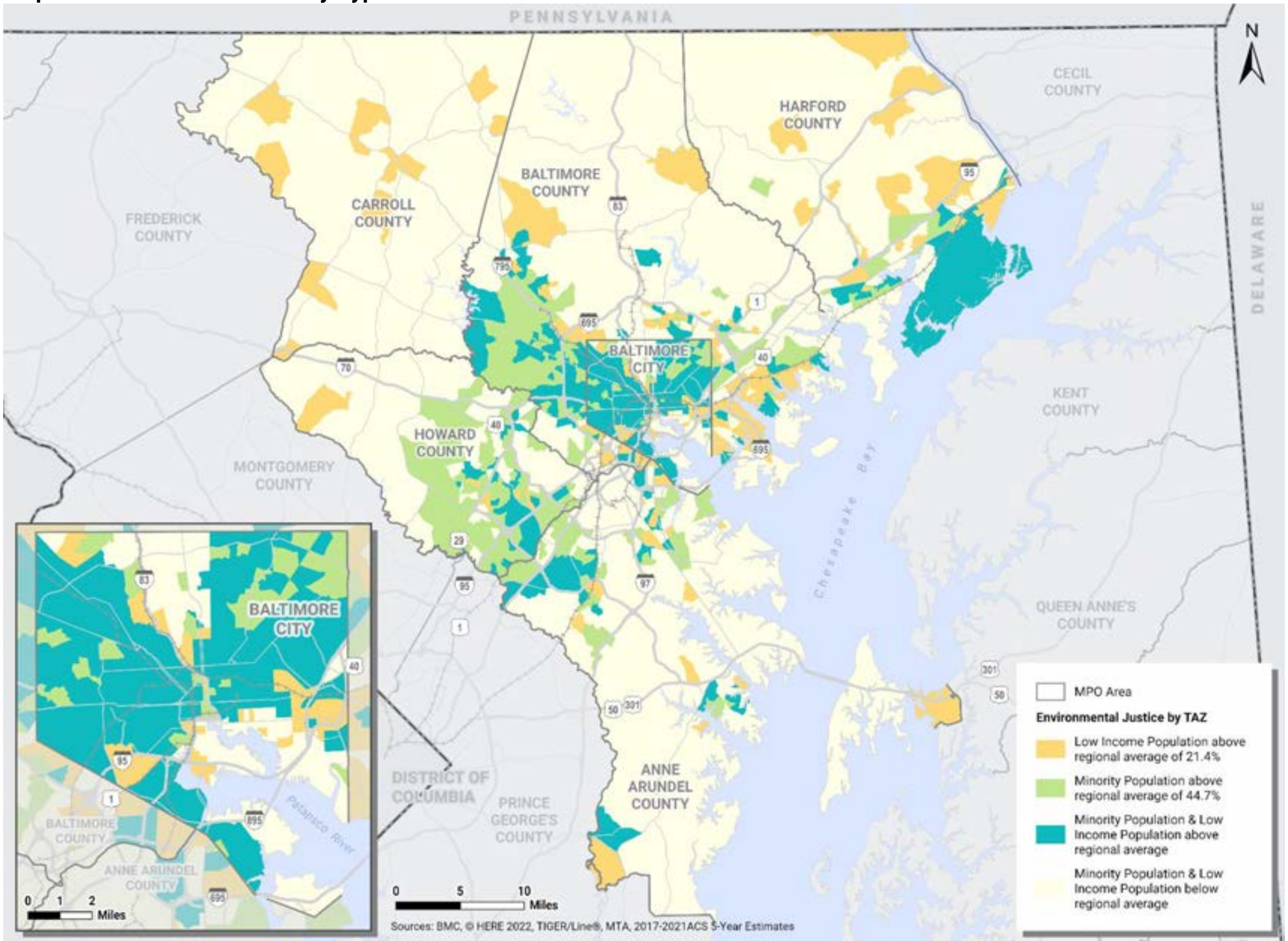
Of the 1,412 TAZs in the BRTB region, 766 qualify as EJ TAZs and 646 are non-EJ TAZs. Of the 766 EJ TAZs, 225 exceed the regional average for minority population, 159 exceed the regional average for population below 200% of the poverty level, and 382 exceed both the minority and low-income regional averages. The population living in EJ TAZs (1.59 million) exceeds the population living in non-EJ TAZs (1.25 million).

MPOs frequently utilize the regional average for low-income and minority populations to identify EJ areas for analysis. It is important to point out that this method has the shortcoming of excluding small pockets of EJ populations from the analysis. This is because some low-income and minority persons will necessarily live in TAZs identified as non-EJ. However, Table 6 shows that EJ TAZs account for most of the EJ population. EJ TAZs account for 80.6% of the region's minority population. This means that the other 19.4% of minorities live in non-EJ TAZs. Similarly, 79.3% of the region's low-income population are located in TAZs identified as EJ, with the remaining 20.7% of the low-income population located in non-EJ TAZs.

Table 6 - Summary of EJ and Non-EJ TAZs by Type

TAZs by Type	Number of TAZs	Population	EJ Populations			
			Minority Population	Minority Share	Low-Income Population (Below 200% of Poverty Level)	Low-Income Share
EJ TAZs	**766**	**1,588,831**	**1,022,312**	**80.6%**	**469,218**	**79.3%**
• Minority > 44.7%	225	473,543	306,407	24.2%	53,311	9.0%
• Low-income Population > 21.4%	159	294,279	79,447	6.3%	87,918	14.9%
• Both Minority and Low-income	382	821,009	636,458	50.2%	327,989	55.4%
Non-EJ TAZs	**646**	**1,248,394**	**246,231**	**19.4%**	**122,394**	**20.7%**
Total	**1,412**	**2,837,225**	**1,268,543**	**100.0%**	**591,612**	**100.0%**

Map 3 - EJ and Non-EJ TAZs by Type



Scenarios and Measures Used in the EJ Analysis

As noted previously, TAZs are the base geographic unit for the InSITE model. In addition to TAZs, the InSITE model requires a number of inputs to estimate travel patterns. These inputs include the existing road and transit network, the future road and transit network, and the Round 10 demographic forecasts for population, households and employment (discussed in Chapter 2). For the purposes of this section, the future road network includes all surface transportation improvements identified in the preferred alternative of *Resilience 2050*. The model takes these inputs and estimates travel times and distances from each TAZ to all other TAZs. The InSITE geographic coverage area includes the Baltimore region along with four jurisdiction from the Washington region (District of Columbia, Montgomery, Prince George's and Frederick Counties) and Adams and York Counties in Pennsylvania.

The InSITE model enables us to compare how travel patterns differ for EJ and non-EJ TAZs. To facilitate this analysis, we identified a number of specific measures related to accessibility, mobility and proximity. We calculated results for each of these measures across two scenarios:

- **2050 Existing and Committed (2050 E+C)**: The 2050 E+C scenario includes all projects that are either already in place or are committed. "Committed" means that a schedule is in place and sponsors have identified fund sources and have committed funds to build these projects by 2027. The scenario assumes that there will be no new capacity adding infrastructure projects beyond 2027 through 2050.
- **2050 Preferred Alternative Scenario (2050 PA)**: The 2050 Preferred Alternative scenario includes all projects in the 2050 E+C scenario as well as implementation of all surface transportation projects in the preferred alternative of *Resilience 2050*.

Both of these scenarios incorporate 2050 demographic forecasts for population, households and employment. This enables us to isolate the impact of implementing the projects contained in the preferred alternative of *Resilience 2050* while holding demographic variables constant. A complete EJ analysis should include a discussion of analysis both within and between these scenarios. First, the analysis can compare how conditions differ in the 2050 E+C scenario between EJ and non-EJ areas. Second, the analysis can compare how conditions differ in the 2050 PA scenario between EJ and non-EJ areas. Finally, the analysis can look at the relative change in benefits that each group is expected to experience with the implementation of the plan.

The chosen measures used for the EJ analysis are listed and summarized below. These measures quantify how *Resilience 2050* might change access to jobs and shopping opportunities, travel times to common destinations, and the percentage of the population close to certain important destinations such as supermarkets and hospitals. In all, there are eight different measures, with each applied to both auto and transit. Auto and transit travel times are TAZ to TAZ. For auto, travel times include time estimates for parking and walking to the destination.

For transit, travel times include time estimates for walking to a transit stop, wait times, transfer times (walking and waiting), and walking from the final transit stop to the destination. The transit measures are limited to walk access only, meaning that they exclude transit trips involving driving to access transit.

- **Average number of jobs accessible**: This measures the average number of jobs accessible from EJ and non-EJ TAZs within a specified travel time by both auto and transit (walk access). The travel times selected for auto and transit were 30 and 60 minutes, respectively, during the peak travel period. A weighted average of the number of jobs accessible from EJ and non-EJ TAZs was calculated based on TAZ worker population. For example, assume TAZ A contains 40 workers and 80 jobs are accessible within a 30 minute drive and TAZ B contains 60 workers and 200 jobs are accessible within a 30 minute drive. The weighted average is calculated as follows: (40/100) x 80 + (60/100) x 200 = 152.
- **Average number of shopping opportunities accessible**: This measures the average number of shopping opportunities accessible from EJ and non-EJ TAZs within a specified travel time by both auto and transit (walk access). The travel times selected for auto and transit were 30 and 60 minutes, respectively, during the peak travel period. Shopping opportunities do not measure the number of stores within these travel times because data for every retail store is not available in the InSITE model. Rather, shopping opportunities represent the number of person shopping trips retail employment attracts on an average weekday. Attractions are influenced by both the location and concentration of retail employment throughout the region. A weighted average of the number of shopping opportunities accessible from EJ and non-EJ TAZs was calculated based on TAZ population.
- **Average commute time**: This measures the average number of minutes it takes workers to commute to their usual place of work during the peak travel period from EJ and non-EJ TAZs by both auto and transit (walk access).
- **Average travel time for shopping purposes**: This measures the average number of minutes it takes to travel for shopping purposes from EJ and non-EJ TAZs by both auto and transit (walk access).
- **Average travel time to closest hospital**: This measures the average number of minutes it takes to travel to the closest TAZ containing a hospital from EJ and non-EJ TAZs by both auto and transit (walk access). The travel time is to the closest TAZ containing a hospital because the InSITE model calculates all travel times from zone to zone rather than from a particular origin to a particular destination. Hospital location data are available from U.S. Department of Homeland Security (DHS) (https://hifld-geoplatform.opendata.arcgis.com/datasets/hospitals/explore).
- **Percent of population close to a supermarket**: This measures the percent of the population living in EJ and non-EJ TAZs that lives close to a supermarket by both auto and transit (walk access). Rather than defining what “close” means, we present the data as the percent of the population within 15, 30, 45 and 60 minutes of the closest supermarket for auto and the percent of the population within 30, 45 and 60 minutes of the closest supermarket for transit. Supermarket location data are sourced from the United States Department of Agriculture (https://www.fns.usda.gov/snap/retailer/historicaldata).
- **Percent of population close to a hospital**: This measures the percent of the population living in EJ and non-EJ TAZs that lives close to a hospital by both auto and transit (walk access). Rather than defining what “close” means, we present the data as the percent of the population within 15, 30, 45, and 60 minutes of the closest hospital for auto and the percent of the population within 30, 45 and 60 minutes of the closest hospital for transit. Hospital location data are identical to that used for the average travel time measure above.
- **Percent of population close to a college or university**: This measures the percent of the population living in EJ and non-EJ TAZs that lives close to a college or university by both auto and transit (walk access). Rather than defining what “close”

means, we present the data as the percent of the population within 15, 30, 45, and 60 minutes of the closest college or university for auto and the percent of the population within 30, 45 and 60 minutes of the closest college or university for transit. College and university location data are available from the DHS (https://hifld-geoplatform.opendata.arcgis.com/datasets/geoplatform::colleges-and-universities/explore). Colleges and universities included are public and private two and four-year higher education institutions.

Results and Discussion of Analysis

Tables 7 through 14 along with the accompanying paragraphs present and discuss the results of the EJ analysis. The tables present results for EJ and non-EJ TAZS for both the 2050 E+C and 2050 PA scenarios. In addition, the tables include the percent change from the 2050 E+C to the 2050 PA scenario. Percent changes highlighted in green represent improvements (such as an increase in jobs accessible) while those highlighted in red represent deteriorating conditions (such as an increase in travel time).

Table 7 - Average Number of Jobs Accessible by Auto and Transit

Measure	TAZ Category	2050 E+C Scenario	2050 PA Scenario	Percent Change (E+C to PA)
Average number of jobs accessible by **auto** within 30 minutes	EJ TAZs	492,479	506,223	2.8%
	Non-EJ TAZs	293,038	304,951	4.1%
Average number of jobs accessible by **transit** (walk access) within 60 minutes	EJ TAZs	185,232	229,012	23.6%
	Non-EJ TAZs	72,477	91,978	26.9%

EJ TAZs have a higher average number of jobs accessible by auto and transit in both the E+C and PA scenarios as compared to non-EJ TAZs. The difference is particularly pronounced for transit, where the average number of jobs accessible to EJ TAZs is about 2.5 times higher than that for non-EJ TAZs in both scenarios. This is not necessarily surprising since EJ TAZs tend to be concentrated in areas with more robust existing transit service as compared to non-EJ TAZs.

Auto access to jobs within 30 minutes exceeds transit access to jobs within 60 minutes across all TAZs. For example, in the 2050 PA scenario, auto access is more than two times greater than transit access in EJ TAZs and more than three times greater in non-EJ TAZs.

Comparing results between scenarios, both EJ and non-EJ TAZs benefit from the implementation of the projects in *Resilience 2050*. These benefits are particularly pronounced for transit accessibility. Average job accessibility by auto increases by 2.8% and 4.1% for persons living in EJ and non-EJ TAZs, respectively. For transit, both EJ and non-EJ TAZs see increases of around 25% from the 2050 E+C scenario to the 2050 PA scenario. EJ TAZs see an increase of 23.6% while non-EJ TAZs see an increase of 26.9%.

Table 8 - Average Number of Shopping Opportunities Accessible by Auto and Transit

Measure	TAZ Category	2050 E+C Scenario	2050 PA Scenario	Percent Change (E+C to PA)
Average number of shopping opportunities accessible by **auto** within 30 minutes	EJ TAZs	276,928	278,316	0.5%
	Non-EJ TAZs	172,408	174,612	1.3%
Average number of shopping opportunities accessible by **transit** (walk access) within 60 minutes	EJ TAZs	158,952	166,520	4.8%
	Non-EJ TAZs	69,664	73,124	5.0%

The average number of shopping opportunities accessible by auto and transit is significantly greater in EJ TAZs versus non-EJ TAZs. Persons living in EJ TAZs have access to approximately 60% more shopping opportunities by auto in both scenarios. The difference is more pronounced for transit, where EJ TAZs have access to more than two times as many shopping opportunities regardless of scenario. Land use policies and development patterns have a lot of influence over shopping and retail locations. Retail and other commercial activity tends to be concentrated in urban and suburban activity centers. These areas are also more likely to be identified as EJ TAZs.

Auto access to shopping opportunities exceeds that for transit regardless of TAZ type or scenario. For EJ TAZs, auto access to shopping opportunities within 30 minutes is approximately 70% greater than that for transit within 60 minutes under both scenarios. For non-EJ TAZs, that number increases to more than two times greater for auto as compared to transit.

Shopping opportunities accessible by auto and transit are projected to increase from the 2050 E+C scenario to the 2050 PA scenario. Similar to job accessibility, the increases for transit are larger than that for auto. For auto, EJ and non-EJ TAZs see increases of 0.5% and 1.3%, respectively. Transit access to shopping opportunities increases by 4.8% and 5.0%, respectively, for EJ and non-EJ TAZs.

Table 9 - Average Usual Place of Work Commute Time by Auto and Transit

Measure	TAZ Category	2050 E+C Scenario	2050 PA Scenario	Percent Change (E+C to PA)
Average commute time in minutes by **auto** (drive alone and shared ride)	EJ TAZs	20.16	20.17	0.0%
	Non-EJ TAZs	26.09	26.17	0.3%
Average commute time in minutes by **transit** (walk access)	EJ TAZs	57.81	55.56	-3.9%
	Non-EJ TAZs	63.70	60.96	-4.3%

Average commute times for EJ TAZs are lower than those for non-EJ TAZs across both modes and scenarios. Auto commute times are about 23% shorter for EJ TAZs at just over 20 minutes versus just over 26 minutes for non-EJ TAZs. Transit commute times are about 9% shorter in EJ TAZs as compared to non-EJ TAZs.

Auto commute times remain similar from the E+C to the PA scenario. The average commute time in EJ TAZs is essentially flat while the commute time in non-EJ TAZs increases by 0.3%.

Average transit commute times are significantly longer than those for auto regardless of TAZ type. However, the implementation of transit projects in *Resilience 2050* improves average transit commute times for both EJ and non-EJ TAZs. The average transit commute in EJ TAZs decreases by 3.9% while the average transit commute in non-EJ TAZs decreases by 4.3%.

Table 10 - Average Travel Time for Shopping Purposes by Auto and Transit

Measure	TAZ Category	2050 E+C Scenario	2050 PA Scenario	Percent Change (E+C to PA)
Average travel time in minutes for shopping purposes by **auto** (drive alone and shared ride)	EJ TAZs	9.59	9.67	0.8%
	Non-EJ TAZs	11.47	11.54	0.6%
Average travel time in minutes for shopping purposes by **transit** (walk access)	EJ TAZs	40.94	39.29	-4.0%
	Non-EJ TAZs	46.51	43.21	-7.1%

The results for shopping travel times are similar to commute time trends. Average travel times for shopping purposes by auto are approximately 17% shorter for EJ TAZs as compared to non-EJ TAZs regardless of scenario, while transit travel times are approximately 10% shorter for EJ TAZs.

Average auto travel times remain essentially unchanged from the 2050 E+C scenario to the 2050 PA scenario. Travel times by auto for EJ TAZs increase by 0.8% while travel times for non-EJ TAZs increase by 0.6%.

As with commute times, the average travel time for shopping purposes is much longer by transit as compared to auto. Transit times are approximately four times longer than those for auto across both TAZs and scenarios. However, both EJ and non-EJ TAZs see decreases in average transit travel times in the 2050 PA scenario. The average travel time decreases by 4.0% in EJ TAZs and by 7.1% in non-EJ TAZs.

Table 11 - Average Travel Time to Closest Hospital by Auto and Transit

Measure	TAZ Category	2050 E+C Scenario	2050 PA Scenario	Percent Change (E+C to PA)
Average travel time in minutes to closest hospital by **auto** (drive alone and shared ride)	EJ TAZs	10.25	10.00	-2.4%
	Non-EJ TAZs	24.86	24.06	-3.2%
Average travel time in minutes to closest hospital by **transit** (walk access)	EJ TAZs	43.35	41.81	-3.6%
	Non-EJ TAZs	55.96	54.61	-2.4%

Average travel times to the closest hospital for EJ TAZs are lower than those for non-EJ TAZs across both modes and scenarios. Travel times to the closest hospital by auto are about 60% shorter for EJ TAZs at just over 10 minutes versus just over 24 minutes for non-EJ TAZs. Travel times to the closest hospital by transit are about 23% shorter in EJ TAZs as compared to non-EJ TAZs.

Auto travel times for EJ TAZs are projected to decrease from 10.25 minutes in the E+C scenario to 10 minutes in the PA scenario, a decrease of 2.4%. Non-EJ TAZ travel times to the closest hospital decrease by about a minute from 24.86 minutes to 24.06 minutes, a projected decrease of 3.2%.

As we saw with average commute and shopping travel times, average travel times to the closest hospital are longer for transit than they are for auto. As compared to auto, transit times are about four times higher for EJ TAZs and more than two times higher for non-EJ TAZs across both scenarios. Average transit travel times to the closest hospital decrease for both EJ and non-EJ TAZs in the 2050 PA scenario. Walk access transit travel times decrease by 3.6% and 2.4% in EJ and non-EJ TAZs, respectively.

Table 12 - Percent of Population Close to a Supermarket by Auto and Transit

Measure	Time	TAZ Category	2050 E+C Scenario	2050 PA Scenario	Percent Change (E+C to PA)
Percent of population within 15, 30, 45 and 60 minutes of the closest supermarket by **auto** (drive alone and shared ride)	15 min	EJ TAZs	99.2%	99.2%	0.0%
		Non-EJ TAZs	92.6%	93.7%	1.2%
	30 min	EJ TAZs	99.6%	99.6%	0.0%
		Non-EJ TAZs	97.8%	97.8%	0.0%
	45 min	EJ TAZs	100.0%	100.0%	0.0%
		Non-EJ TAZs	98.7%	99.5%	0.8%
	60 min	EJ TAZs	100.0%	100.0%	0.0%
		Non-EJ TAZs	99.6%	99.6%	0.0%
Percent of population within 30, 45 and 60 minutes of the closest supermarket by **transit** (walk access)	30 min	EJ TAZs	61.7%	66.3%	7.5%
		Non-EJ TAZs	32.5%	34.3%	5.5%
	45 min	EJ TAZs	85.7%	87.2%	1.8%
		Non-EJ TAZs	50.9%	51.5%	1.2%
	60 min	EJ TAZs	91.5%	91.9%	0.4%
		Non-EJ TAZs	54.9%	55.4%	0.9%

Auto access to a supermarket in the Baltimore region is uniformly good. Nearly 100% of the population is within a 15-minute drive regardless of scenario or TAZ type. In EJ TAZs, supermarkets are within 15- and 30-minute drives of 99.2% and 99.6% of the population, respectively, and 100% of the population in EJ TAZs is within the remaining drive lengths. For non-EJ TAZs, approximately

93% of the population is within a 15-minute drive, nearly 98% is within a 30-minute drive, and nearly 100% is within a 45 or 60-minute drive.

Transit results are more mixed than those for auto. EJ TAZs have consistently higher percentages than those for non-EJ TAZs, but access remains significantly less than that for auto. For EJ TAZs in the 2050 E+C scenario, the percentage within 30, 45 and 60-minute transit trips of the closest supermarket is 61.7%, 85.7% and 91.5%, respectively. Non-EJ TAZs have worse results for transit as compared to EJ TAZs. For non-EJ TAZs, these numbers are 32.5%, 50.9% and 54.9%, respectively.

The percentage of the population close to a supermarket by auto remains essentially unchanged from the 2050 E+C to the 2050 PA scenario, mostly because auto access is already so high. However, the percentage of the population close to a supermarket improves across the board for EJ and non-EJ TAZs upon implementation of the projects in the *Resilience 2050* preferred alternative. The largest changes occur for the percentage of the population within a 30-minute walk access transit trip of the closest supermarket. In the 2050 PA scenario, EJ TAZs see an increase of 7.5% while non-EJ TAZs see an increase of 5.5%. The remaining percent increases are less than 2%.

Table 13 - Percent of Population Close to a Hospital by Auto and Transit

Measure	Time	TAZ Category	2050 E+C Scenario	2050 PA Scenario	Percent Change (E+C to PA)
Percent of population within 15, 30, 45 and 60 minutes of the closest hospital by **auto** (drive alone and shared ride)	15 min	EJ TAZs	85.5%	85.4%	-0.1%
		Non-EJ TAZs	58.4%	58.9%	0.9%
	30 min	EJ TAZs	98.4%	98.5%	0.1%
		Non-EJ TAZs	87.6%	89.0%	1.6%
	45 min	EJ TAZs	99.3%	99.4%	0.1%
		Non-EJ TAZs	92.2%	92.6%	0.4%
	60 min	EJ TAZs	99.6%	99.5%	-0.1%
		Non-EJ TAZs	95.5%	95.6%	0.1%
Percent of population within 30, 45, and 60 minutes of the closest hospital by **transit** (walk access)	30 min	EJ TAZs	29.3%	30.7%	4.8%
		Non-EJ TAZs	9.3%	9.1%	-2.2%
	45 min	EJ TAZs	60.7%	63.2%	4.1%
		Non-EJ TAZs	24.1%	25.3%	5.0%
	60 min	EJ TAZs	75.6%	78.1%	3.3%
		Non-EJ TAZs	36.7%	38.9%	6.0%

Similar to supermarket data, auto access to the closest hospital is relatively good throughout the Baltimore region. Approximately 85% and 60% of the population in EJ and non-EJ TAZs is within a 15-minute drive of the closest hospital. Increasing the drive time to

30 minutes increases access to approximately 98% and 88% of the population in EJ and non-EJ TAZs, respectively. Nearly 100% of the population is within a 45 and 60-minute drive time of the closest hospital in EJ TAZs. These numbers are 92% and 95% for non-EJ TAZs. The percentage of the population within the specified auto travel times increases slightly from the E+C to the PA scenario for most times and TAZ types, though all percentage changes are less than 2%.

EJ TAZs have consistently higher percentages within the specified transit travel times as compared to non-EJ TAZs. The percentages of the population close to a hospital in EJ TAZs is approximately three times higher for 30-minute transit trips, 2.5 times higher for 45 minutes, and approximately two times higher for 60-minutes. However, transit access is once again significantly less than that for auto travel. In the 2050 E+C scenario, 29.3% of the population in EJ TAZs is within a 30-minute transit trip of the closest hospital, while just 9.3% of the population in non-EJ TAZs meets this criteria. Percentages for EJ TAZs in the 2050 E+C scenario gradually increase to 60.7% and 75.6% for the remaining transit travel times. Just 36.7% of the population in non-EJ TAZs is within a 60-minute transit trip of the closest hospital in the E+C scenario.

The percentage of the population close to a hospital by transit increases for most times and TAZ types from the 2050 E+C scenario to the 2050 PA scenario. For EJ TAZs, the percentage of the population within 30, 45 and 60-minute transit trips of the closest hospital increases by 4.8%, 4.1%, and 3.3%, respectively. For non-EJ TAZs, these numbers are -2.2% (the lone negative result), 5%, and 6%.

Table 14 - Percent of Population Close to a College or University by Auto and Transit:

Measure	Time	TAZ Category	2050 E+C Scenario	2050 PA Scenario	Percent Change (E+C to PA)
Percent of population within 15, 30, 45 and 60 minutes of the closest college or university by **auto** (drive alone and shared ride)	15 min	EJ TAZs	87.2%	86.3%	-1.0%
		Non-EJ TAZs	53.7%	55.8%	3.9%
	30 min	EJ TAZs	98.8%	99.2%	0.4%
		Non-EJ TAZs	90.3%	92.4%	2.3%
	45 min	EJ TAZs	99.6%	99.6%	0.0%
		Non-EJ TAZs	97.1%	97.8%	0.7%
	60 min	EJ TAZs	100.0%	100.0%	0.0%
		Non-EJ TAZs	99.0%	98.9%	-0.1%
Percent of population within 30, 45, and 60 minutes of the closest college or university by **transit** (walk access)	30 min	EJ TAZs	31.5%	33.3%	5.7%
		Non-EJ TAZs	13.3%	14.4%	8.3%
	45 min	EJ TAZs	62.5%	66.5%	6.4%
		Non-EJ TAZs	28.5%	31.2%	9.5%
	60 min	EJ TAZs	79.1%	79.8%	0.9%
		Non-EJ TAZs	36.6%	38.8%	6.0%

Auto access to the closest college or university is greater than 90% for travel times of 30 minutes or greater for the population in both TAZ categories. More than 98% of the population in EJ TAZs is within a 30-minute drive of the closest college or university. There is a larger difference between EJ and non-EJ TAZ results for 15-minute auto access. Approximately 87% of the population in EJ TAZs is within a 15-minute auto trip of the closest college or university while approximately 55% of the population in non-EJ TAZs fits this criterion. EJ TAZs see little change from the 2050 E+C to the 2050 PA scenario, mostly because auto access is already so high. Non-EJ TAZs see slight increases of 3.9% and 2.3% upon implementation of the 2050 PA scenario for the share of the population within auto trips of 15 minutes and 30 minutes of a college or university, respectively.

Similar to the other closeness measures, the TAZ percentages for transit are significantly less than those for auto. For example, the percentage of the population within a 30-minute transit trip of the closest college or university is approximately 32% in EJ TAZs and just 14% in non-EJ TAZs.

Transit results indicate consistently higher percentages for EJ TAZs as compared to non-EJ TAZs across all time thresholds and scenarios. The scale of the difference between EJ and non-EJ TAZs mirrors that for hospitals. Transit results for EJ TAZs are approximately two times higher than those for non-EJ TAZs regardless of the travel time or scenario. Non-EJ TAZs see larger increases from the 2050 E+C to the 2050 PA scenario, though they have more room to improve due to their low starting values. Non-EJ TAZs see increases of 8.3%, 9.5% and 6.0% for transit travel times of 30, 45 and 60 minutes, respectively. EJ TAZs see increases of 5.7%, 6.4% and 0.9% for the same travel times. Nearly 80% of the population in EJ TAZs is within a 60-minute transit trip of the closest college or university in the 2050 PA scenario as compared to 39% in non-EJ TAZs.

Conclusion

The measures analyzed indicate that the surface transportation investments in *Resilience 2050* should not have disproportionate impacts on EJ TAZs. The measures are discussed below in the order the results were presented above. They are grouped broadly into accessibility measures (jobs and shopping), travel time measures (commute, shopping purposes, closest hospital), and proximity measures (supermarket, hospital, college/university). Table 15 lists the full results for all measures.

EJ TAZs have access to more jobs and shopping opportunities on average as compared to non-EJ TAZs across both scenarios. This holds for both auto and transit access. All TAZs see increases in accessibility with the implementation of the *Resilience 2050* preferred alternative. Auto access measures see relatively small increases of around 4% or less for both EJ and non-EJ TAZs, though those for non-EJ TAZs are slightly larger. Transit access improvements are larger and are similar for EJ and non-EJ TAZs. Increases in job accessibility by transit are particularly pronounced, with projected increases of 23.6% in EJ TAZs and 26.9% in non-EJ TAZs.

EJ TAZs have lower average travel times across nearly all measures including commute time, travel time for shopping purposes, and travel time to the closest hospital. Implementation of the preferred alternative does not have a significant impact on average auto travel times in the region. Commute times and travel times for shopping purposes change by less than 1.0%. The average travel time to the closest hospital by auto decreases by 2.4% for EJ TAZs and by 3.2% for non-EJ TAZs. The preferred alternative has a slightly larger impact on transit travel times, with travel times for commuting, shopping, and to the closest hospital decreasing for EJ and non-EJ TAZs. Transit travel times for commuting and shopping decrease by slightly more in non-EJ TAZs as compared to EJ TAZs, though transit travel times for non-EJ TAZs were much longer to start. The average transit travel time to the closest hospital decreases more in EJ TAZs as compared to non-EJ TAZs, with reductions of 3.6% and 2.4%, respectively.

Proximity to supermarkets, hospitals, and colleges/universities by auto is quite good throughout the Baltimore region. Nearly 90% or more of the population in EJ and non-EJ TAZs lives within a 30-minute auto trip of all of these important destinations. EJ TAZs have consistently higher percentages as compared to non-EJ TAZs. This is most pronounced for the percentage of the population within a 15-minute auto trip of a hospital and college/university. Greater than 85% of the population in EJ TAZs is within a 15-minute auto trip versus less than 60% in non-EJ TAZs. Implementation of the preferred alternative yields only small changes in the percentage of the population close to these destinations by auto. All percent changes for auto are 2.0% or less except for two (15 and 30-minute auto trips to the closest college or university in non-EJ TAZs).

Proximity to these important destinations by transit is significantly less than that for auto. EJ TAZs see higher percentages in close proximity to these destinations as compared to non-EJ TAZs for both scenarios. However, implementation of the preferred alternative yields larger increases in the percentage of the population close to supermarkets, hospitals, and colleges/universities by transit as compared to auto. The percentage of the population close to all of these destinations increases for nearly all travel times and TAZ types. The lone decrease for transit proximity measures is for the share of the population within a 30-minute trip of the closest hospital in non-EJ TAZs. EJ TAZs see larger percent increases for most supermarket proximity measures by transit, while non-EJ TAZs see slightly larger percent increases for hospital and higher education proximity measures by transit.

Several other trends are worth noting:

- Auto access and mobility are uniformly better than that for transit. This holds for both EJ and non-EJ TAZs. For example, EJ TAZs are accessible to an average of 506,223 jobs in the preferred alternative scenario by auto (30 minutes) versus 229,012 by transit (60 minutes, walk access). These numbers for non-EJ TAZs are 304,951 and 91,978, respectively.
- While the auto measures are better than those for transit, transit accessibility and mobility see significantly larger increases with the implementation of the *Resilience 2050* preferred alternative. Only one auto data point (job accessibility in non-EJ TAZs) changes by more than 4.0% in either direction. Auto results are also decidedly more mixed, with several negative results. On the other hand, results for transit are uniformly positive with the implementation of the preferred alternative, with just one negative result in the hospital proximity measure. Many transit measures see increases of more than 4.0%. Job accessibility via transit sees the largest increases, with jumps of about 25% for both EJ and non-EJ TAZs in the 2050 PA scenario.
- The percentage increases from the 2050 E+C scenario to the 2050 PA scenario are relatively similar for EJ and non-EJ TAZs. Non-EJ TAZs tend to have slightly larger increases than EJ TAZs for some of the measures. However, non-EJ TAZs also start with worse baselines relative to EJ TAZs for these measures. EJ TAZs tend to have larger absolute improvements as

compared with non-EJ TAZs. For example, implementation of the *Resilience 2050* preferred alternative yields increases in the average number of jobs accessible by transit of 23.6% and 26.9% for EJ and non-EJ TAZs, respectively. This equates to nearly 44,000 more jobs accessible by transit to EJ TAZs and nearly 20,000 more jobs accessible by transit to non-EJ TAZs.

It is important to point out that the individual projects in *Resilience 2050* have largely not yet gone through the required environmental approvals or design process. As a result, the scope and limits of these projects could change. In addition, all projects involving federal funds are required to include an EJ analysis as a part of the federal approval process.

Table 15 - Full Results: Environmental Justice Analysis

Measure	TAZ Category	2050 E+C Scenario	2050 PA Scenario	Percent Change (E+C to PA)
Average number of jobs accessible by **auto** within 30 minutes	EJ TAZs	492,479	506,223	2.8%
	Non-EJ TAZs	293,038	304,951	4.1%
Average number of jobs accessible by **transit** (walk access) within 60 minutes	EJ TAZs	185,232	229,012	23.6%
	Non-EJ TAZs	72,477	91,978	26.9%
Average number of shopping opportunities accessible by **auto** within 30 minutes	EJ TAZs	276,928	278,316	0.5%
	Non-EJ TAZs	172,408	174,612	1.3%
Average number of shopping opportunities accessible by **transit** (walk access) within 60 minutes	EJ TAZs	158,952	166,520	4.8%
	Non-EJ TAZs	69,664	73,124	5.0%
Average commute time in minutes by **auto** (drive alone and shared ride)	EJ TAZs	20.16	20.17	0.0%
	Non-EJ TAZs	26.09	26.17	0.3%
Average commute time in minutes by **transit** (walk access)	EJ TAZs	57.81	55.56	-3.9%
	Non-EJ TAZs	63.70	60.96	-4.3%
Average travel time in minutes for shopping purposes by **auto** (drive alone and shared ride)	EJ TAZs	9.59	9.67	0.8%
	Non-EJ TAZs	11.47	11.54	0.6%
Average travel time in minutes for shopping purposes by **transit** (walk access)	EJ TAZs	40.94	39.29	-4.0%
	Non-EJ TAZs	46.51	43.21	-7.1%
Average travel time in minutes to closest hospital by **auto** (drive alone and shared ride)	EJ TAZs	10.25	10.00	-2.4%
	Non-EJ TAZs	24.86	24.06	-3.2%
Average travel time in minutes to closest hospital by **transit** (walk access)	EJ TAZs	43.35	41.81	-3.6%
	Non-EJ TAZs	55.96	54.61	-2.4%

Measure		TAZ Category	2050 E+C Scenario	2050 PA Scenario	Percent Change (E+C to PA)
Percent of population within 15, 30, 45 and 60 minutes of the closest supermarket by **auto** (drive alone and shared ride)	15 min	EJ TAZs	99.2%	99.2%	0.0%
		Non-EJ TAZs	92.6%	93.7%	1.2%
	30 min	EJ TAZs	99.6%	99.6%	0.0%
		Non-EJ TAZs	97.8%	97.8%	0.0%
	45 min	EJ TAZs	100.0%	100.0%	0.0%
		Non-EJ TAZs	98.7%	99.5%	0.8%
	60 min	EJ TAZs	100.0%	100.0%	0.0%
		Non-EJ TAZs	99.6%	99.6%	0.0%
Percent of population within 30, 45 and 60 minutes of the closest supermarket by **transit** (walk access)	30 min	EJ TAZs	61.7%	66.3%	7.5%
		Non-EJ TAZs	32.5%	34.3%	5.5%
	45 min	EJ TAZs	85.7%	87.2%	1.8%
		Non-EJ TAZs	50.9%	51.5%	1.2%
	60 min	EJ TAZs	91.5%	91.9%	0.4%
		Non-EJ TAZs	54.9%	55.4%	0.9%
Percent of population within 15, 30, 45 and 60 minutes of the closest hospital by **auto** (drive alone and shared ride)	15 min	EJ TAZs	85.5%	85.4%	-0.1%
		Non-EJ TAZs	58.4%	58.9%	0.9%
	30 min	EJ TAZs	98.4%	98.5%	0.1%
		Non-EJ TAZs	87.6%	89.0%	1.6%
	45 min	EJ TAZs	99.3%	99.4%	0.1%
		Non-EJ TAZs	92.2%	92.6%	0.4%
	60 min	EJ TAZs	99.6%	99.5%	-0.1%
		Non-EJ TAZs	95.5%	95.6%	0.1%
Percent of population within 30, 45, and 60 minutes of the closest hospital by **transit** (walk access)	30 min	EJ TAZs	29.3%	30.7%	4.8%
		Non-EJ TAZs	9.3%	9.1%	-2.2%
	45 min	EJ TAZs	60.7%	63.2%	4.1%
		Non-EJ TAZs	24.1%	25.3%	5.0%
	60 min	EJ TAZs	75.6%	78.1%	3.3%
		Non-EJ TAZs	36.7%	38.9%	6.0%

Measure		TAZ Category	2050 E+C Scenario	2050 PA Scenario	Percent Change (E+C to PA)
Percent of population within 15, 30, 45 and 60 minutes of the closest college or university by **auto** (drive alone and shared ride)	15 min	EJ TAZs	87.2%	86.3%	-1.0%
		Non-EJ TAZs	53.7%	55.8%	3.9%
	30 min	EJ TAZs	98.8%	99.2%	0.4%
		Non-EJ TAZs	90.3%	92.4%	2.3%
	45 min	EJ TAZs	99.6%	99.6%	0.0%
		Non-EJ TAZs	97.1%	97.8%	0.7%
	60 min	EJ TAZs	100.0%	100.0%	0.0%
		Non-EJ TAZs	99.0%	98.9%	-0.1%
Percent of population within 30, 45, and 60 minutes of the closest college or university by **transit** (walk access)	30 min	EJ TAZs	31.5%	33.3%	5.7%
		Non-EJ TAZs	13.3%	14.4%	8.3%
	45 min	EJ TAZs	62.5%	66.5%	6.4%
		Non-EJ TAZs	28.5%	31.2%	9.5%
	60 min	EJ TAZs	79.1%	79.8%	0.9%
		Non-EJ TAZs	36.6%	38.8%	6.0%

Potential Effects of Preferred Alternative – Natural and Cultural Resources

When agencies collaborate in their planning for the natural, cultural and community context of the transportation system, it can lead to better results. Collaboration can lead to the avoidance or minimization of impacts to important resources, improved procedures for mitigation on a regional basis, fewer project delays and avoidance of repeated consultations, added trust among stakeholders and, ultimately, better transportation solutions and environmental outcomes.

Federal regulations require coordination with resource agencies during planning. These requirements state that planning agencies (such as MPOs) should consult with federal, state and local agencies responsible for land use management, natural resources, environmental protection, conservation and historic preservation as part of the development of the LRTP. Consultations are expected to involve a comparison of transportation plans with conservation plans, maps and inventories of natural, cultural, and historic resources. The LRTP is required to include a discussion of potential environmental mitigation activities and potential areas to carry out mitigation activities based on this resource agency consultation.

We understand the benefits of effective coordination with resource agencies during planning. For *Resilience 2050*, the environmental coordination process involved sharing mapping data with resource coordination partners and communicating environmental mitigation activities and practices.

We continue to be involved in MDOT SHA-led Interagency Review meetings involving state and federal resource and regulatory agencies, in order to understand and discuss potential impacts of projects at all stages of planning and design. These meetings provide an opportunity for us to share the full range of projects in the very early planning stages with resource and regulatory agencies. As agencies are exposed to the location and magnitude of proposed projects, an appropriate strategy can be developed that provides benefits beyond the impact of an individual activity.

Consultation to Improve Environmental Impact Mitigation

During the development of *Resilience 2050*, we consulted with federal, state and local agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation on various aspects of plan development. Involved agencies were provided opportunities for coordination through an MDOT SHA-led Interagency Review meeting in February 2023, emails, and the online interactive mapping application. The online interactive mapping application was created to enable a broad analysis comparing proposed projects with known resources in the region.

Through these comparisons, and ongoing conversations with resource and regulatory agencies, this environmental consultation process creates the opportunity to bring issues to light in advance of project planning. Analysis of natural and historic resources becomes very detailed at the short-range project planning level, so it is important to provide an opportunity for broad-based discussions of resources during long-range transportation planning that consider all proposed projects.

The online interactive map includes the following resources along with the proposed projects and was shared with coordinating agencies. Maps 4 through 14 in the following pages show examples of static maps created to assist the environmental coordination process. The maps display a comparison of highway and transit projects in the preferred alternative with known resource data:

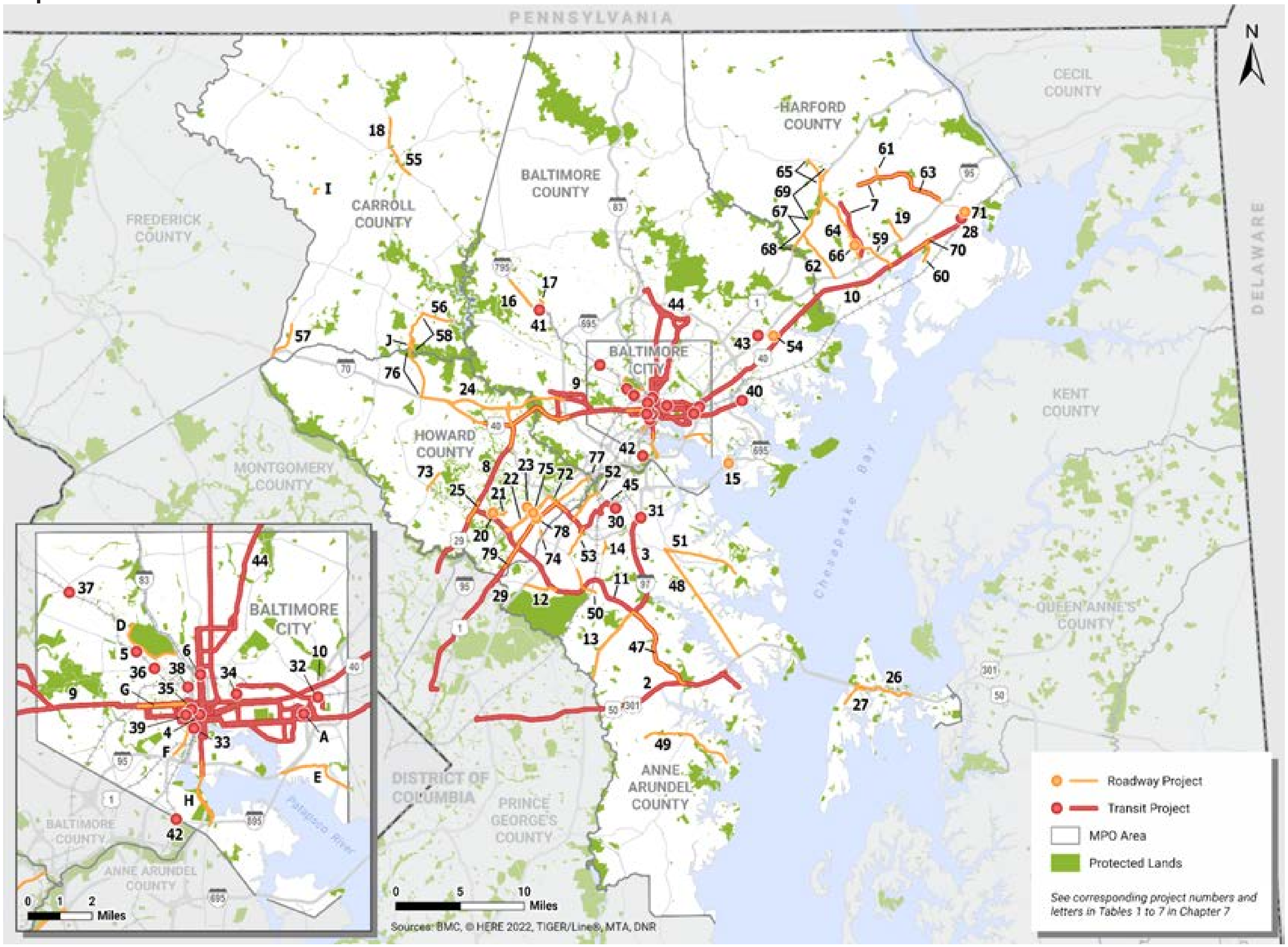
- Map 4 - Protected Lands (protected local lands, protected federal lands, and Maryland Department of Natural Resources (DNR) owned properties and conservation easements)
- Map 5 - Green Infrastructure Corridors and Hubs
- Map 6 - Chesapeake Bay Critical Area
- Map 7 - Nutrient and/or Sediment Impaired Watersheds
- Map 8 - National Register of Historic Places
- Map 9 - Maryland Inventory of Historic Properties
- Map 10 - Maryland Department of Planning Land Use / Land Cover Data
- Map 11 - Sensitive Species Project Review Areas
- Map 12 - Wetlands of Special State Concern
- Map 13 - Sea Level Rise

- Map 14 - Maryland Priority Funding Areas and Sustainable Communities

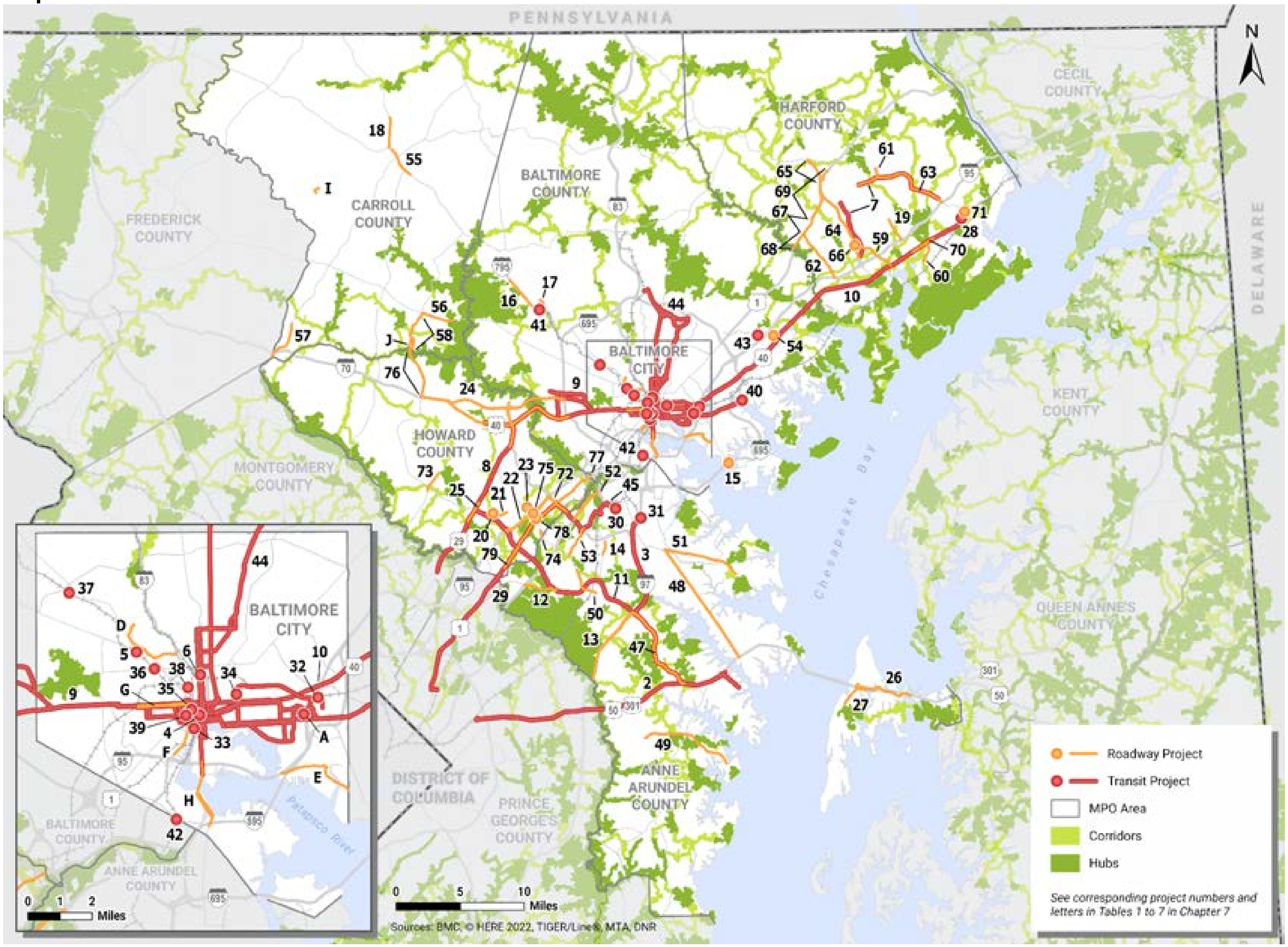
The following layers are included in the online interactive map and were shared with coordinating agencies, but are not depicted in the static maps in this Appendix:

- Maryland Dams Inventory
- Maryland DNR Coldwater Trout Watersheds
- EJ TAZs

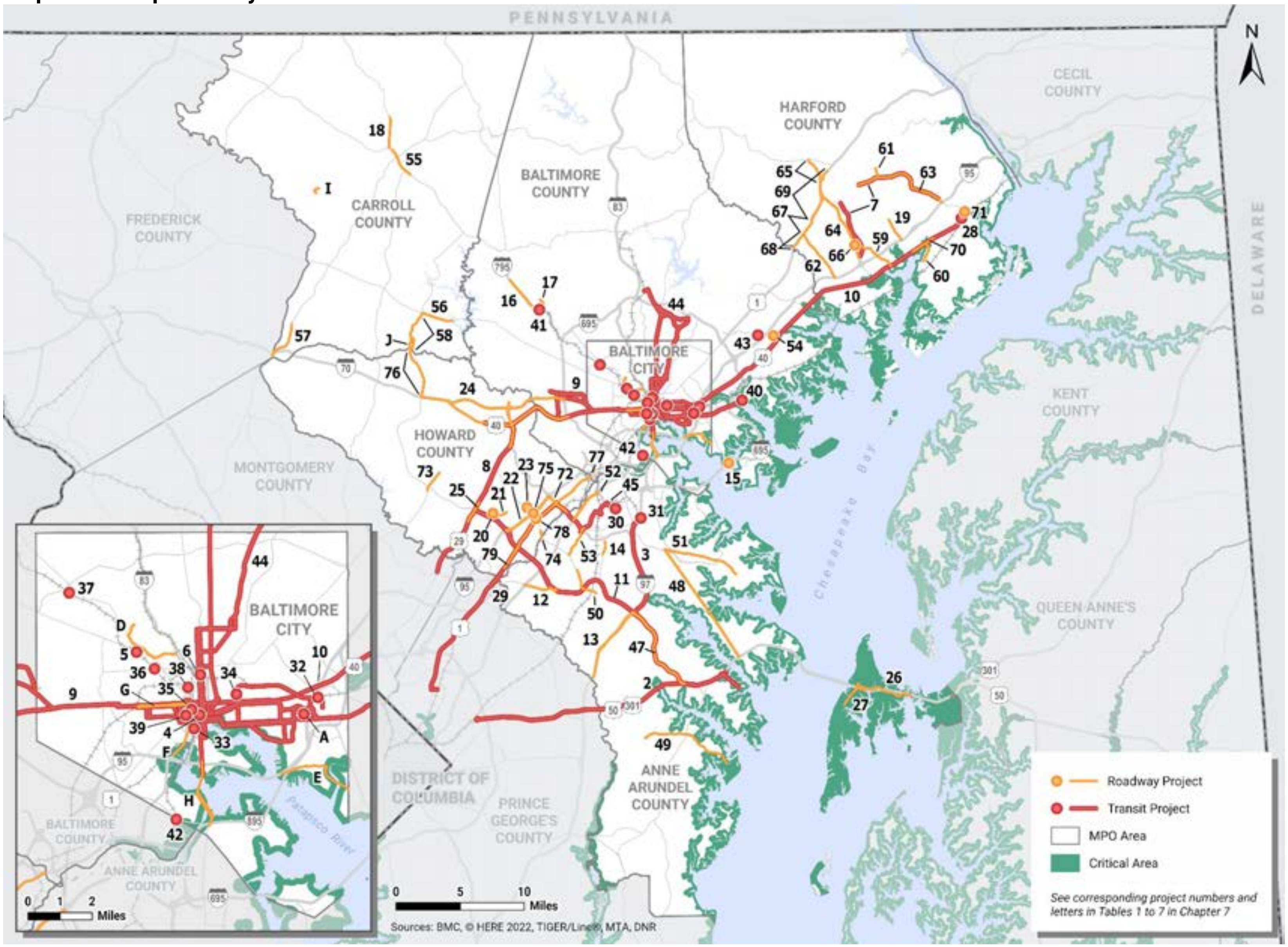
Map 4 – Protected Lands



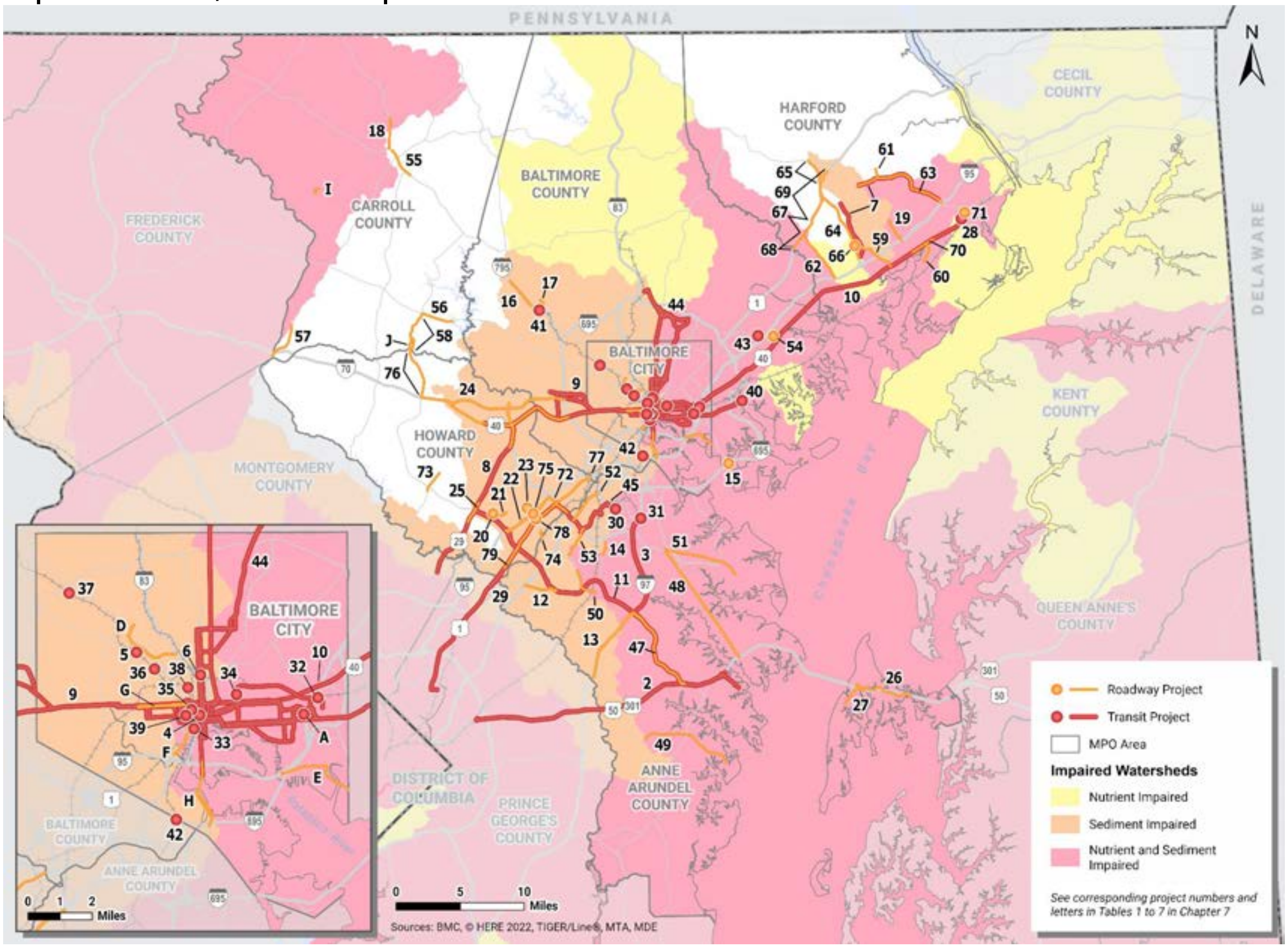
Map 5 - Green Infrastructure Corridors and Hubs



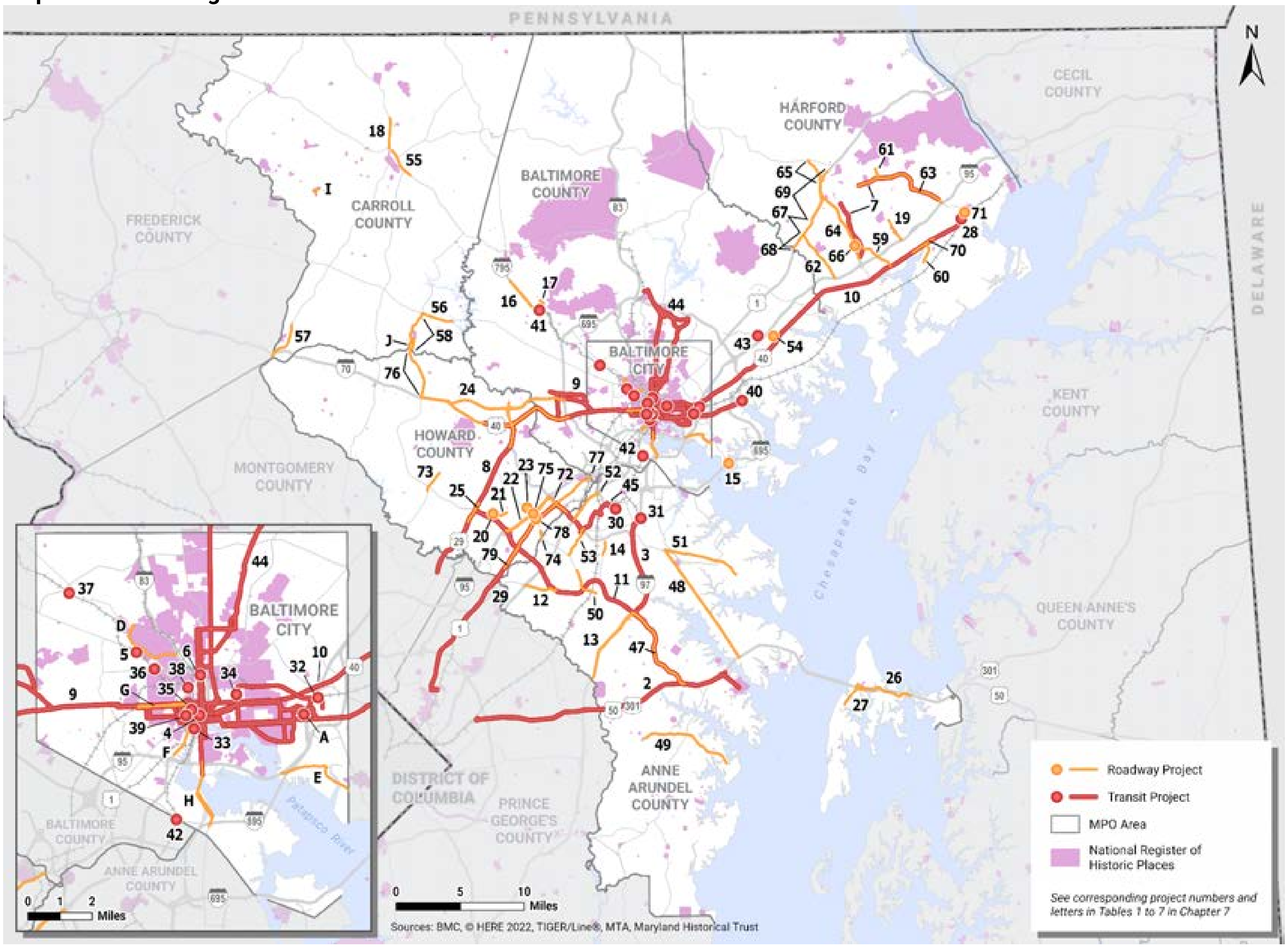
Map 6 - Chesapeake Bay Critical Area



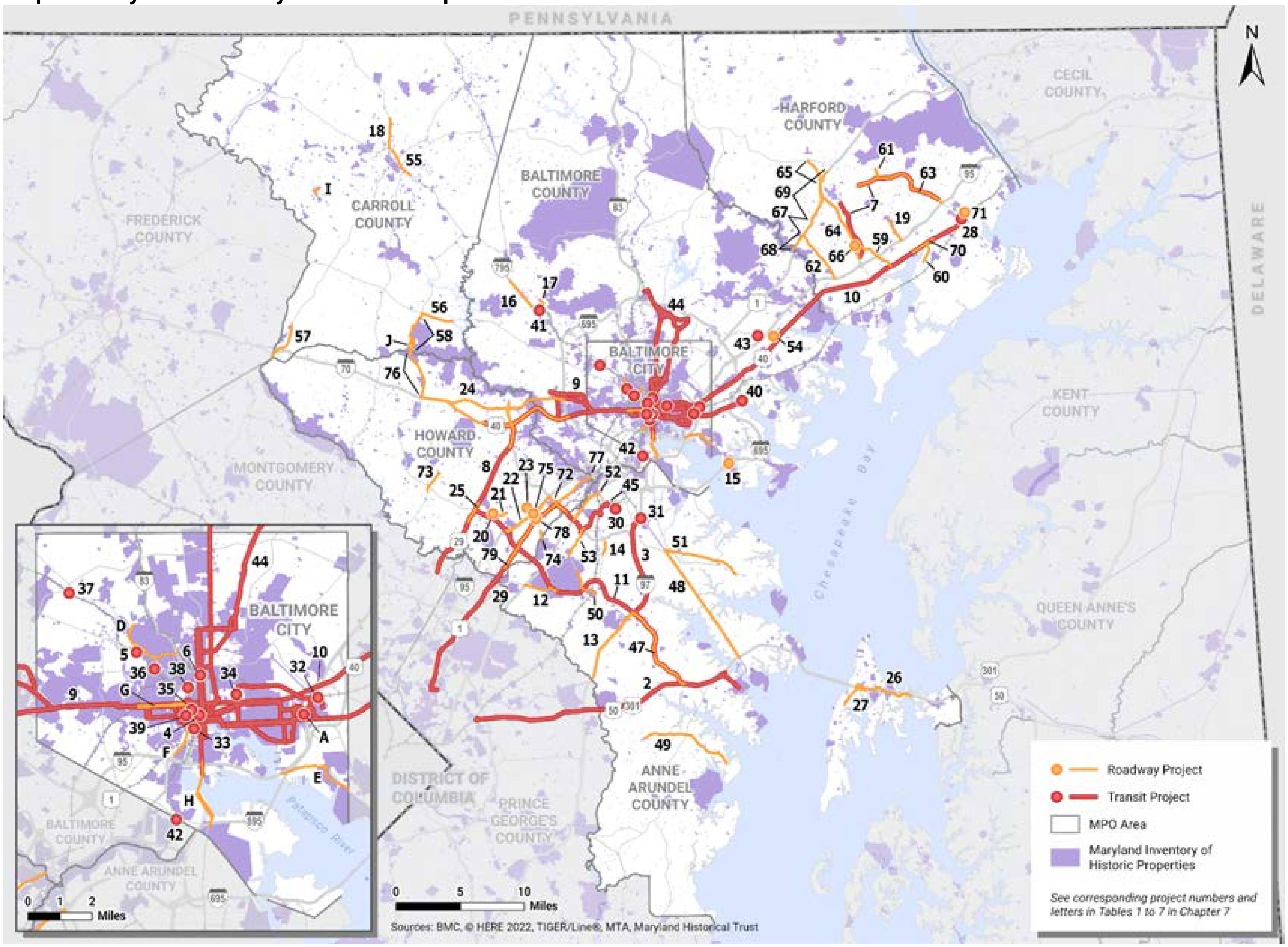
Map 7 - Nutrient and/or Sediment Impaired Watersheds



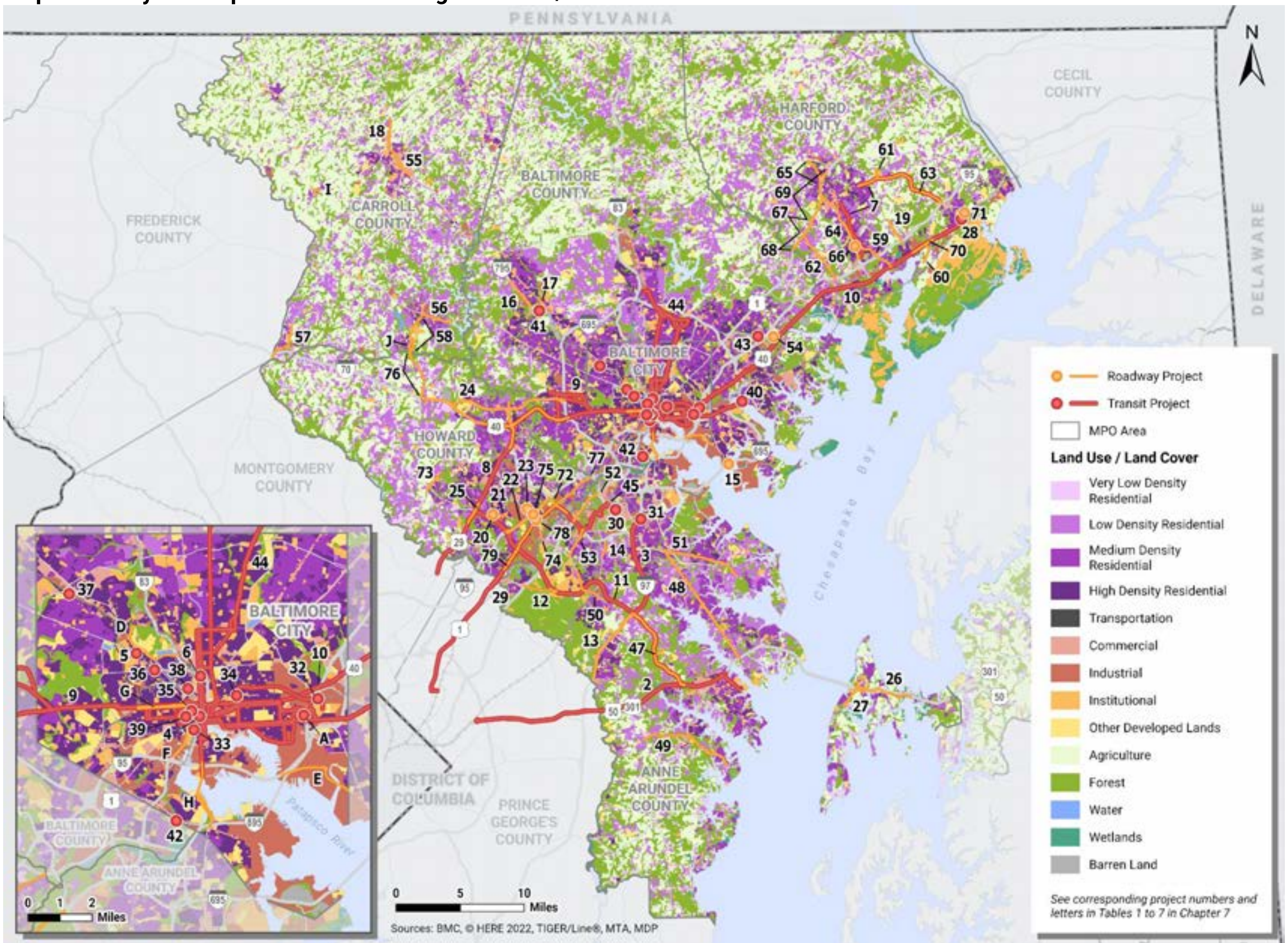
Map 8 - National Register of Historic Places



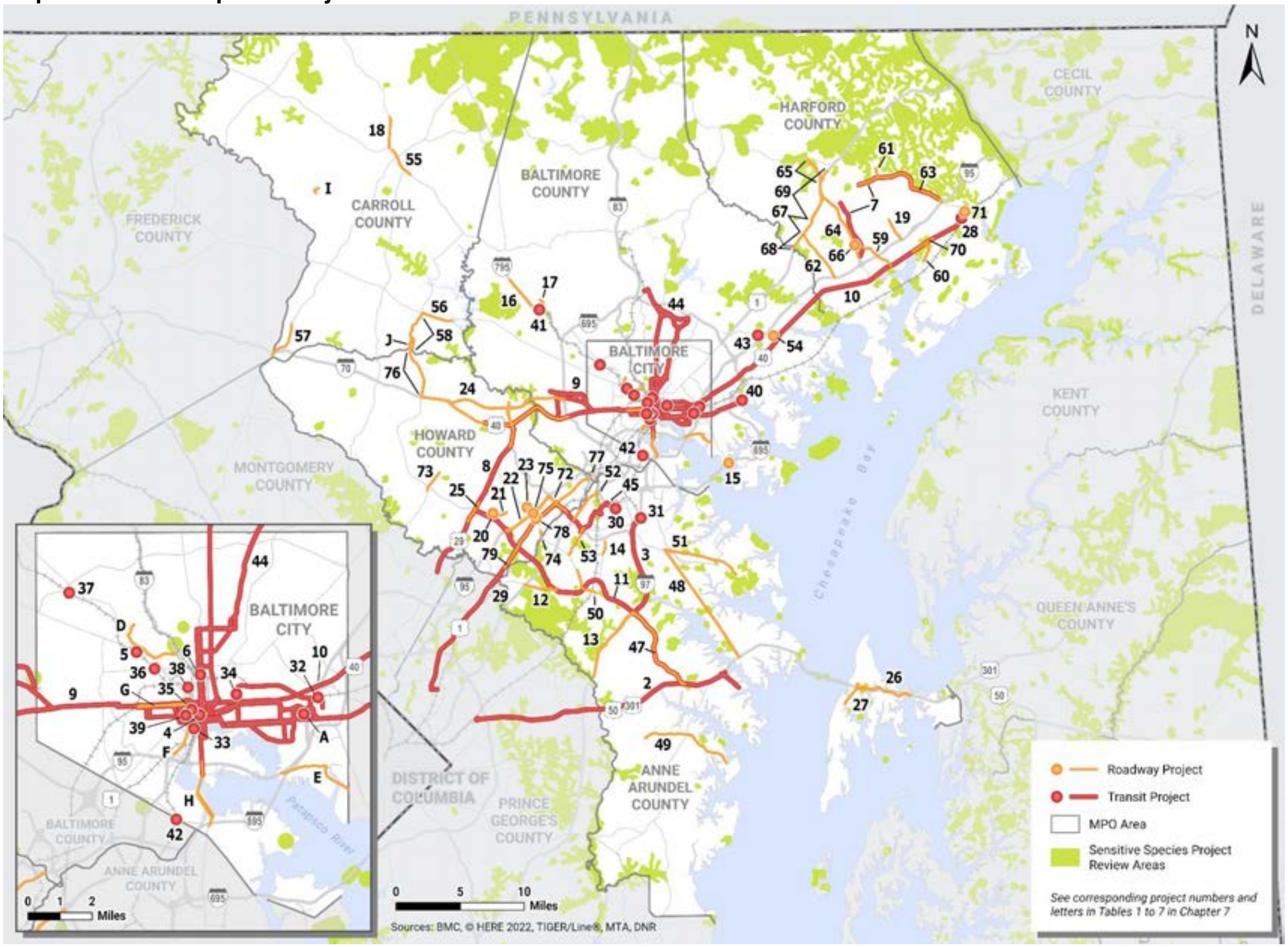
Map 9 - Maryland Inventory of Historic Properties



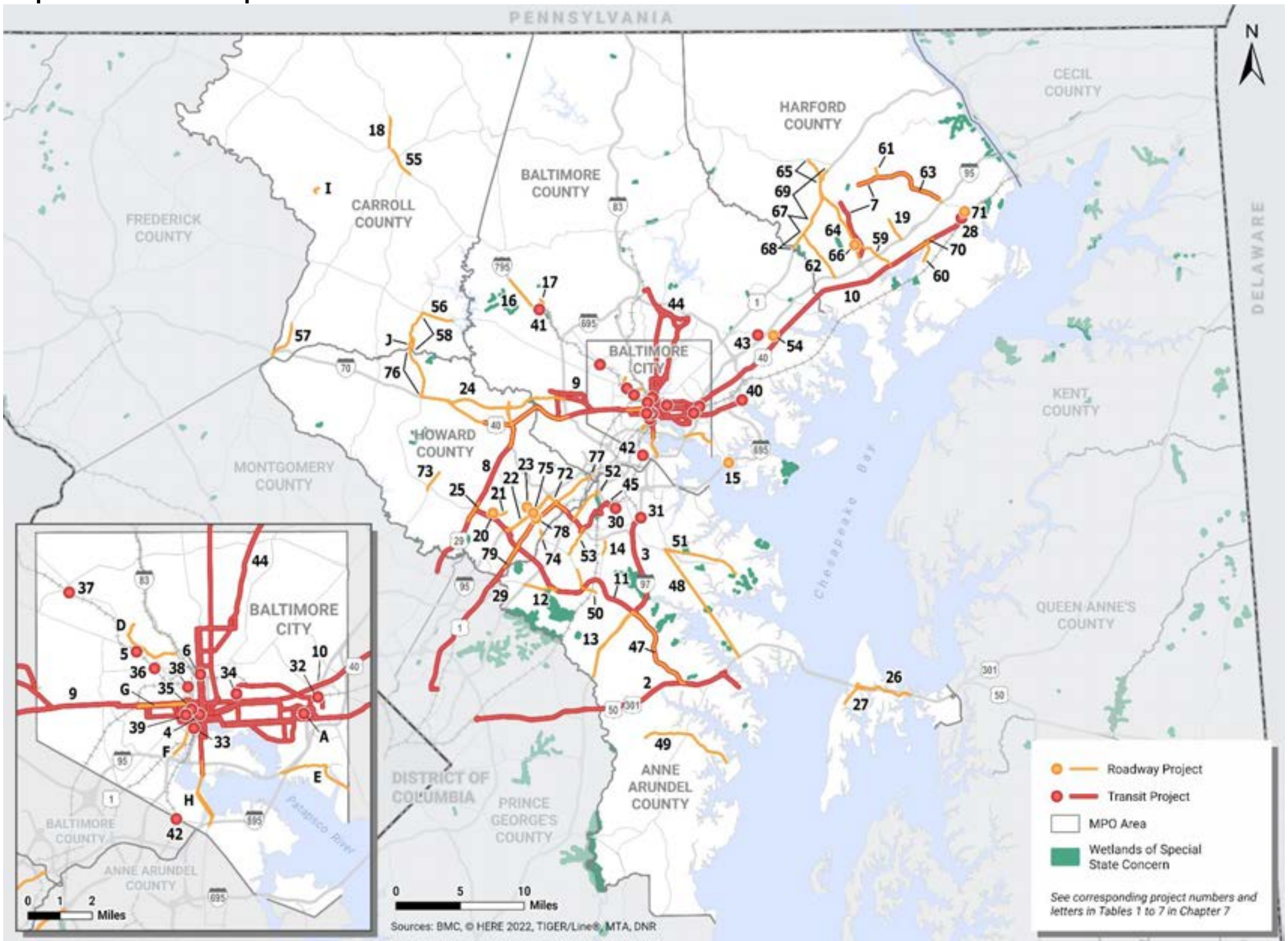
Map 10 - Maryland Department of Planning Land Use / Land Cover Data



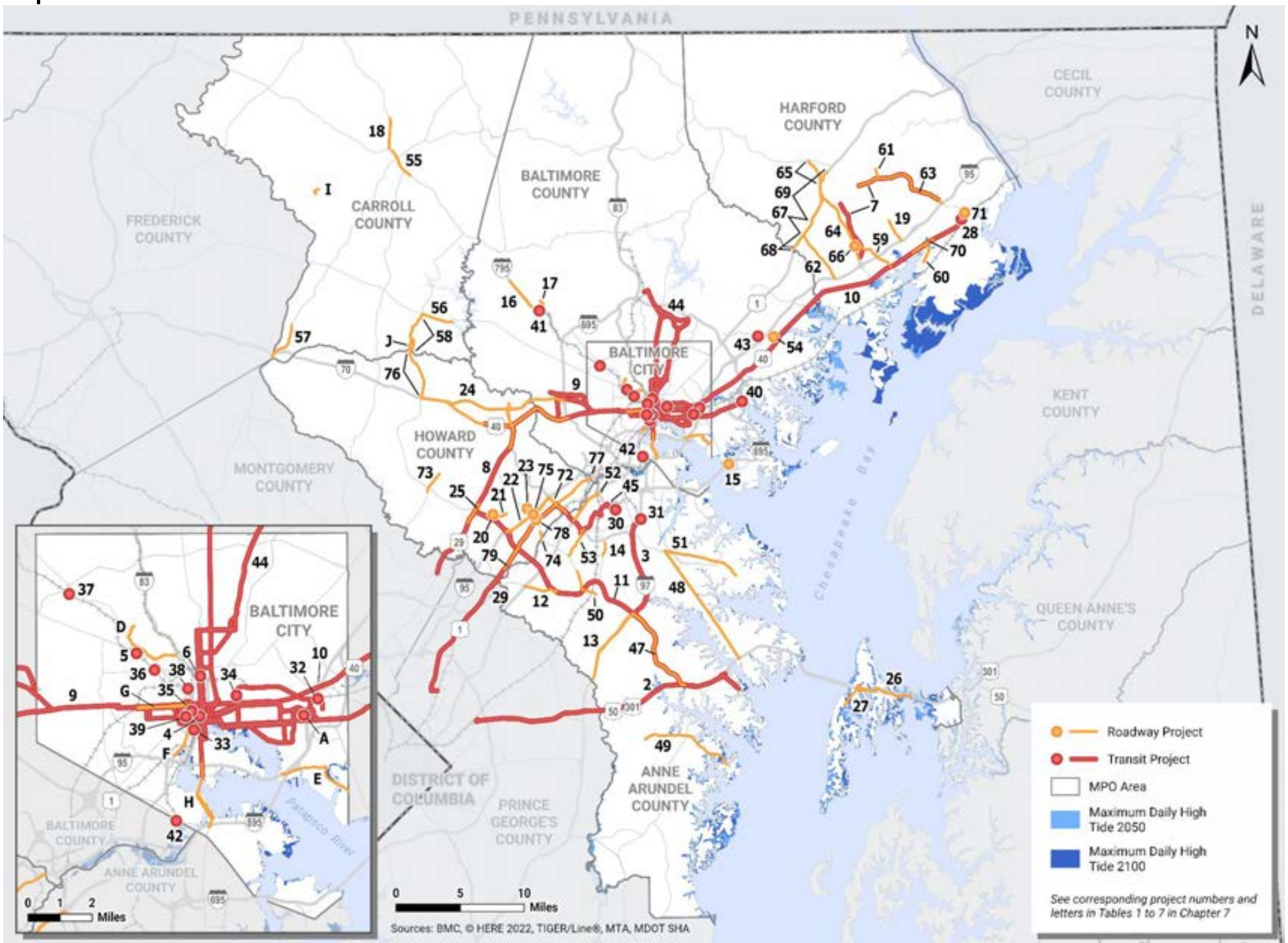
Map 11 - Sensitive Species Project Review Areas



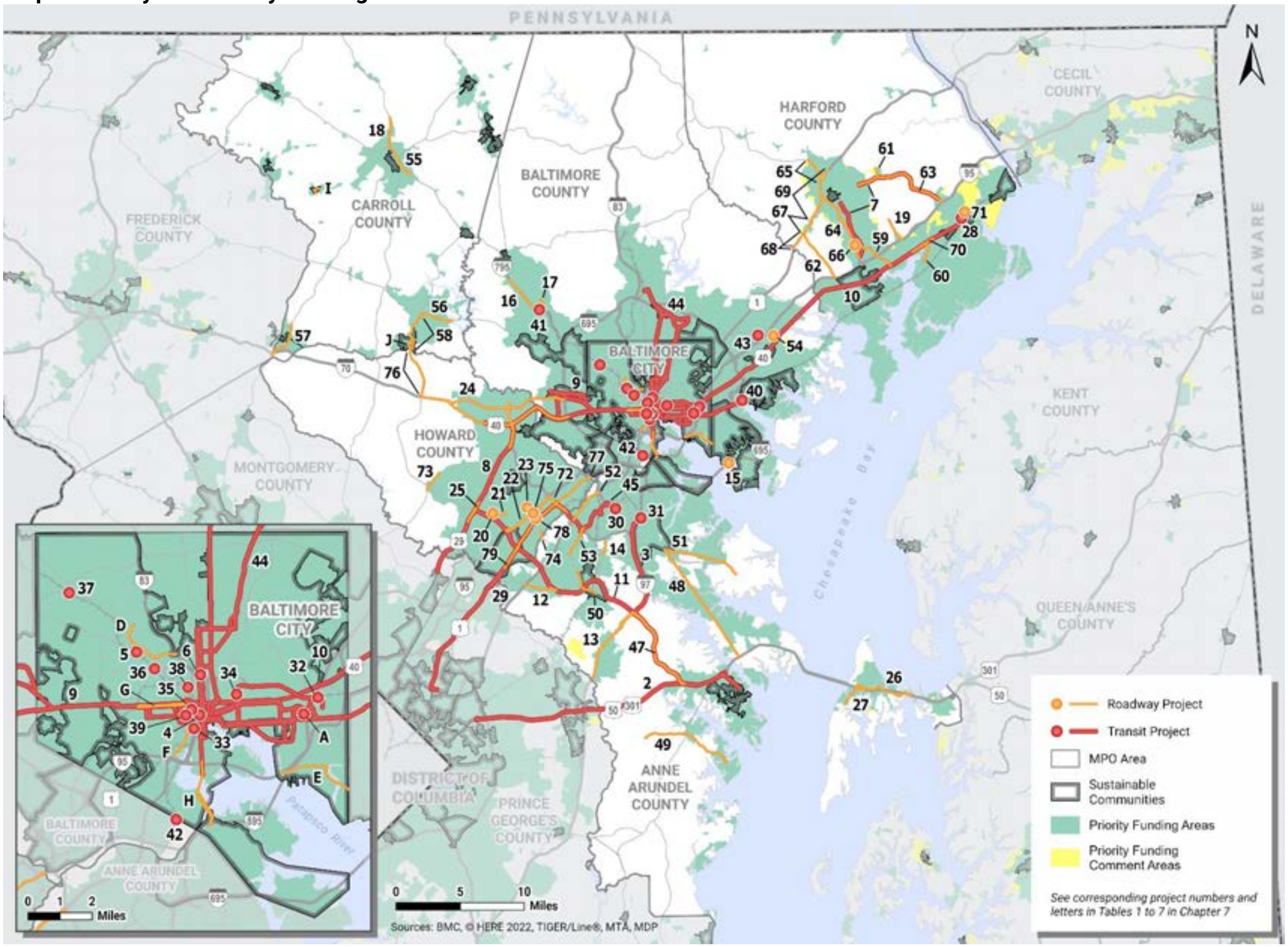
Map 12 - Wetlands of Special State Concern



Map 13 - Sea Level Rise



Map 14 - Maryland Priority Funding Areas and Sustainable Communities



Specific Impact Mitigation Strategies and Measures

The project planning process, which involves National Environmental Policy Act (NEPA) requirements, is detailed and time consuming. Performing coordination and discussing regional mitigation opportunities ahead of time is meant to improve process efficiency and identify any regional mitigation goals. The environmental coordination process will continue through partnerships made during this analysis process. Bringing environmental concerns and regional mitigation planning into the long-range planning process is the ultimate goal of this coordination.

The purpose of considering mitigation early in the LRTP process is to focus attention on regional level conservation and restoration needs. This focus provides a context in which subsequent decisions on specific mitigation concepts and strategies can be developed during the later project development process. Table 16 displays resource types along with corresponding legislation that provides protection and possible mitigation strategies and measures that could be applied during later project development.

Table 16 – Examples of Mitigation Measures

Resource	Examples of Mitigation Measures	Regulation
Public Outdoor Recreation Property	Federally assisted actions that propose impacts, or the permanent conversion, of public outdoor recreation property acquired or developed with LWCF grant assistance must be approved by the Department of the Interior's National Park Service and mitigated through replacement lands of equal value, location and usefulness.	Section 6(f) of the Land and Water Conservation Fund (LWCF) Act
Parks and Recreation Areas	For publicly owned parks, replace land with land of equivalent value and equivalent location, replace impacted facilities, restore and landscape disturbed area.	Section 4(f) of the U.S. Department of Transportation Act
Wildlife and Waterfowl Refuges	For publicly owned refuges, replace land with land of equivalent value and equivalent location, incorporate habitat features.	Section 4(f) of the U.S. Department of Transportation Act
Cultural Resources	Preservation enhancement measures, context-sensitive design criteria, traditional and digital public historical interpretation, architectural recordation, impact avoidance through design, archaeological data recovery.	Section 4(f) of the U.S. Department of Transportation Act; Section 106 of the National Historic Preservation Act; Maryland Historical Trust Act

Resource	Examples of Mitigation Measures	Regulation
Water Resources and Wetlands	Mitigation for wetland and waterway impacts includes creation, restoration, preservation, enhancement, or monetary compensation into an In-lieu Fee Program or the purchase of Bank credits. Site-specific stormwater management plans; low-impact development (LID) stormwater design; Best Management Practice tracking; stormwater discharge monitoring; design of stormwater management capacity for new and existing impervious surfaces; water quality banking program with MDE; sediment control during construction.	Rivers and Harbors Act of 1899; Clean Water Act; COMAR Title 26.17, Waterway Construction; COMAR Title 26.23, Nontidal Wetlands; COMAR Title 26.24, Tidal Wetlands; 2000 Maryland Stormwater Design Manual (with 2009 Environmental Site Design Revisions); Maryland Phase II Watershed Implementation Plan for the Chesapeake Bay TMDL
Endangered and Threatened Species	Mitigation may include placing conservation easements on properties occupied by the species, expanding/linking habitat areas through habitat creation areas, or enhancing low-quality habitat.	Endangered Species Act
Forests	Forest replacement on a 1:1 basis, for construction activities.	Maryland Reforestation Law, Forest Conservation Act
Chesapeake and Atlantic Coastal Bays Critical Area	Mitigation for impacts to the Critical Area may include planting or offsets for disturbance to forests and developed woodlands, the minimum 100-foot buffer, and stormwater management practices to reduce pollutants. For specifics, refer to applicable jurisdiction's local Critical Area program or existing Memorandum of Understanding for projects proposed by a state agency.	Critical Area Act (1984); COMAR 27
Nontidal Wetlands of Special State Concern	Mitigation for wetland impacts includes creation, restoration, preservation, enhancement, or monetary compensation into an In-lieu Fee Program or the purchase of Bank credits. Acreage replacement ratios vary depending on wetland and mitigation type.	COMAR 26.23.06.01-.02

Resource	Examples of Mitigation Measures	Regulation
Prime Farmland Soils	A farmland conversion impact rating form is completed for major capital projects. The resulting score is intended for use as an indicator for the project sponsor to consider alternative sites if the potential adverse impacts on the farmland exceed the recommended allowable level.	Farmland Protection Policy Act
Noise	If Noise Sensitive Areas are identified in the project area, predictive modeling using FHWA's Traffic Noise Model is required to identify highway noise impacts and study the effectiveness of abatement measures (e.g. noise walls & berms). A full discussion of the results of the analysis and reasonableness/feasibility of abatement should be included in the environmental documentation.	Noise Control Act of 1972, 23CFR 772 and MDOT SHA/FHWA Noise Policy 2020
Air Quality	At the project level, conformity determination and mobile source air toxics (MSAT) analyses may be required to determine the potential to incur adverse effects. (See previous section in this Appendix for more information on the *Resilience 2050* regional conformity analysis.)	Clean Air Act
Greenhouse Gas/ Climate Change	On January 9, 2023, Council on Environmental Quality (CEQ) published interim guidance to assist federal agencies in assessing and disclosing climate change impacts during environmental reviews. CEQ developed this guidance in response to Executive Order (EO) 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis. This interim guidance is effective immediately.	Executive Order 13990
Environmental Justice	The project evaluations should consider demographic data on the minority and income status of those potentially affected communities to determine whether the project may affect communities with environmental justice concerns, and if so, whether those impacts would be disproportionately high and adverse compared to the general population served by the project.	Executive Orders 12898, 13985, and 14008

Mitigation of Natural Resource Impacts

When MDE and the U.S. Army Corps of Engineers (COE) issue authorizations to MDOT SHA for activities that will cause unavoidable losses of wetlands, those impacts must be compensated for through wetland mitigation. Wetland mitigation is the creation, restoration, enhancement, and preservation of wetlands lost due to regulated maintenance and construction project activities. In order to meet the "no net loss" goals of MDE and the COE, MDOT SHA utilizes the "creation" technique. In addition, to overcome temporal wetland function loss and comply with regulatory wetland replacement ratios, MDOT SHA mitigates at a 2:1 ratio for shrub/scrub and forested wetlands and at a 1:1 ratio for emergent wetlands for most highway project impacts to wetlands. The COE compensatory mitigation rule was approved in 2008. The rule establishes a preference hierarchy for mitigation options (i.e., mitigation bank credits, in-lieu fee program credits, and permittee-responsible mitigation projects). The permittee may use any of these three options to mitigate for project impacts. However, the COE preference is the use of mitigation banks.

Meeting the Chesapeake Bay TMDL

In 2010, EPA issued a “pollution diet” or Total Maximum Daily Load (TMDL) for water draining into the Chesapeake Bay. With the TMDL, and the resulting Maryland Phase I and Phase II Watershed Implementation Plans (WIPs), caps were set on levels of phosphorus, nitrogen and sediment going into watershed segments of the Chesapeake Bay.

Through the use of the Phase I MS4 permits, MDE has required ten large and medium local jurisdictions and MDOT SHA to provide “impervious restoration” by treating water pollution from 20 percent of impervious surfaces that were constructed prior to 2005 and received no stormwater runoff treatment. For MDOT SHA, this requirement was 4,621 acres and was met before the October 2020 deadline. The next Phase I permit is anticipated to continue this impervious restoration initiative.

In 2018, MDE issued Phase II MS4 general permits that also include the 20 percent impervious restoration condition to be met by 2025. The Phase II general permits cover both small municipal MS4s and state and federal agencies. The MS4 general permits now include the other MDOT transportation business units and they must adhere to the 20 percent restoration condition. MDOT modal administrations and local jurisdictions developed a significant number of best management practices (BMPs) due to these treatment requirements. MDOT SHA has made dramatic progress in treating stormwater runoff. Existing MS4 impervious restoration BMPs are tracked using GIS tools. Impacts to these facilities must be avoided or mitigated to maintain current and future levels of pollutant reductions.

Maryland released the Phase III WIP in August 2019. The Phase III WIP is designed to take a locally driven, achievable and balanced approach to achieving the 2025 targets. Maryland’s Phase III WIP targets for Bay restoration are 45.8 million pounds of total nitrogen per year and 3.68 million pounds of total phosphorus per year. It was estimated that Maryland had already achieved its aggregate phosphorus Phase III WIP target during the 2017 mid-point assessment. Maryland submitted a climate load allocation Addendum in January 2022 to address Maryland’s additional nutrient loads due to 2025 climate change conditions.

Due to the increasing costs of maintaining current BMPs, the Phase III WIP proposes a requirement to be implemented in the fifth generation of MS4 Permits. The proposal would require permit holders to restore two percent of their impervious surface areas that currently have little or no stormwater treatment annually.

Ongoing and Future MDOT SHA Mitigation Strategies

Moving forward, MDOT SHA is working closely with state and federal review agencies, local planning groups, the business community, environmental organizations, the general public and other stakeholders to engage in several other wetland and stream impact mitigation strategies. The watershed approach, wetland banking, and out-of-kind mitigation are just a few examples of anticipated actions. MDOT SHA will pursue mitigation earlier in the project development process through a watershed approach, utilizing tools such as the Watershed Resources Registry. The watershed approach is described below:

The watershed approach to compensatory mitigation is a flexible approach that encourages various partnerships among all state and federal review agencies, local planning and regional planning organizations, as well as the general public. This approach involves assessing the needs of the watershed in a comprehensive manner that allows planners and review agencies to determine the improvements that are most needed within a particular watershed and sub-watersheds. Areas targeted for improvement may include water quality and quantity, stormwater runoff, riparian buffer, stream restoration, wetland creation and restoration, wildlife habitat creation and restoration, fish passage, reforestation, etc. The watershed approach balances the needs of the watershed by often using out-of-kind mitigation strategies that would be most beneficial based on those identified needs. By identifying the most needed improvements within a given watershed, MDOT SHA and its partners can create a priority ranking of mitigation strategies that can serve as a long-term plan for the overall improvement to the watershed. MDOT SHA is currently using the Watershed Resources Registry that includes DNR's Green Infrastructure Network and is consistent with FHWA's Eco-logical Approach to assess the improvement needs of the watersheds potentially impacted by highway projects.

Although not in the Baltimore region, MDOT SHA used the watershed approach on large and complex projects such as the Intercounty Connector (ICC) in Montgomery and Prince George's counties and the U.S. 301 Transportation Study in Charles County. MDOT SHA also employs similar approaches to watershed mitigation on smaller projects in their design and construction program.

Mitigation of Historic Resource Impacts

Cultural resources typically encountered during the highway development process may include buildings, historic districts, roadway structures such as bridges and terrestrial or underwater archaeological sites dating to the precontact and historic era time periods. Mitigation measures may take many forms depending on the resource itself and the project's impact. Commonly used strategies include:

- design refinement to ensure avoidance of impacts where possible,
- sensitivity and compatibility with historic contexts,
- the recovery of significant information through the excavation of archaeological sites,
- Historic American Buildings Survey (HABS) and Historical American Engineering Record (HAER) recordation,
- photo-documentation of buildings and building relocations,
- scholarly journal articles and "popular" historical reports for public enjoyment and
- other outreach efforts designed to benefit school children and communities.

There are specific procedural requirements necessary for compliance with the National Historic Preservation Act and its implementing regulations and the Maryland Historical Trust Act. These requirements involve consideration of mitigation treatments to resolve adverse effects on National Register eligible or listed historic resources in the later stages of project planning. In general, mitigation strategies are context-specific; tailored to the specific resources and impacts after avoidance and minimization strategies are implemented; and developed in consultation with the Maryland Historical Trust, the Federal Highway Administration, the Advisory Council on Historic Preservation and other consulting parties specified in the regulations. However, MDOT SHA does engage the agencies and stakeholders in discussions that explore opportunities for more programmatically oriented treatments that are sensitive to local and regional priorities as strategies for environmental stewardship.

Potential Effects of Preferred Alternative – Strategic Highway Network (STRAHNET)

The Strategic Highway Network (STRAHNET) is a system of highways, including the Interstate System, and Connectors linking important military installations and ports to major components of the STRAHNET. Together, STRAHNET and the Connectors define the total minimum public highway network necessary to support the U.S. Department of Defense's (DOD) deployment needs.

The DOD's facilities include military bases, ports, and depots. The road networks that provide access and connections to these facilities are essential to national security. The 64,200-mile STRAHNET system consists of public highways that provide access, continuity, and emergency transportation of personnel and equipment in times of peace and war. It includes the entire 48,482 miles of the Dwight D. Eisenhower National System of Interstate and Defense Highways and 14,000 miles of other non-Interstate public highways on the National Highway System. The STRAHNET also contains approximately 1,800 miles of connector routes linking more than 200 military installations and ports to the primary highway system. The DOD's facilities are also often major employers in a region, generating substantial volumes of commuter and freight traffic on the transportation network and around entry points to the military facilities.

The policy of the DOD is to integrate the highway needs of the national defense into the civil highway programs of the various State and Federal agencies and cooperate with those agencies in matters pertaining to the use of public highways and in planning their development and construction.

Map 15 depicts STRAHNET routes along with the two DOD facilities in the Baltimore region - Fort George G. Meade and Aberdeen Proving Ground. Map 15 also includes the roadway and transit projects in the *Resilience 2050* preferred alternative. For Fort George G. Meade, I-95 serves as the primary Interstate STRAHNET while MD 32 serve as the STRAHNET connector. For Aberdeen Proving Ground, I-95 is also the primary STRAHNET link with MD 22 as the connector.

Map 15 – Maryland STRAHNET and DOD Facilities

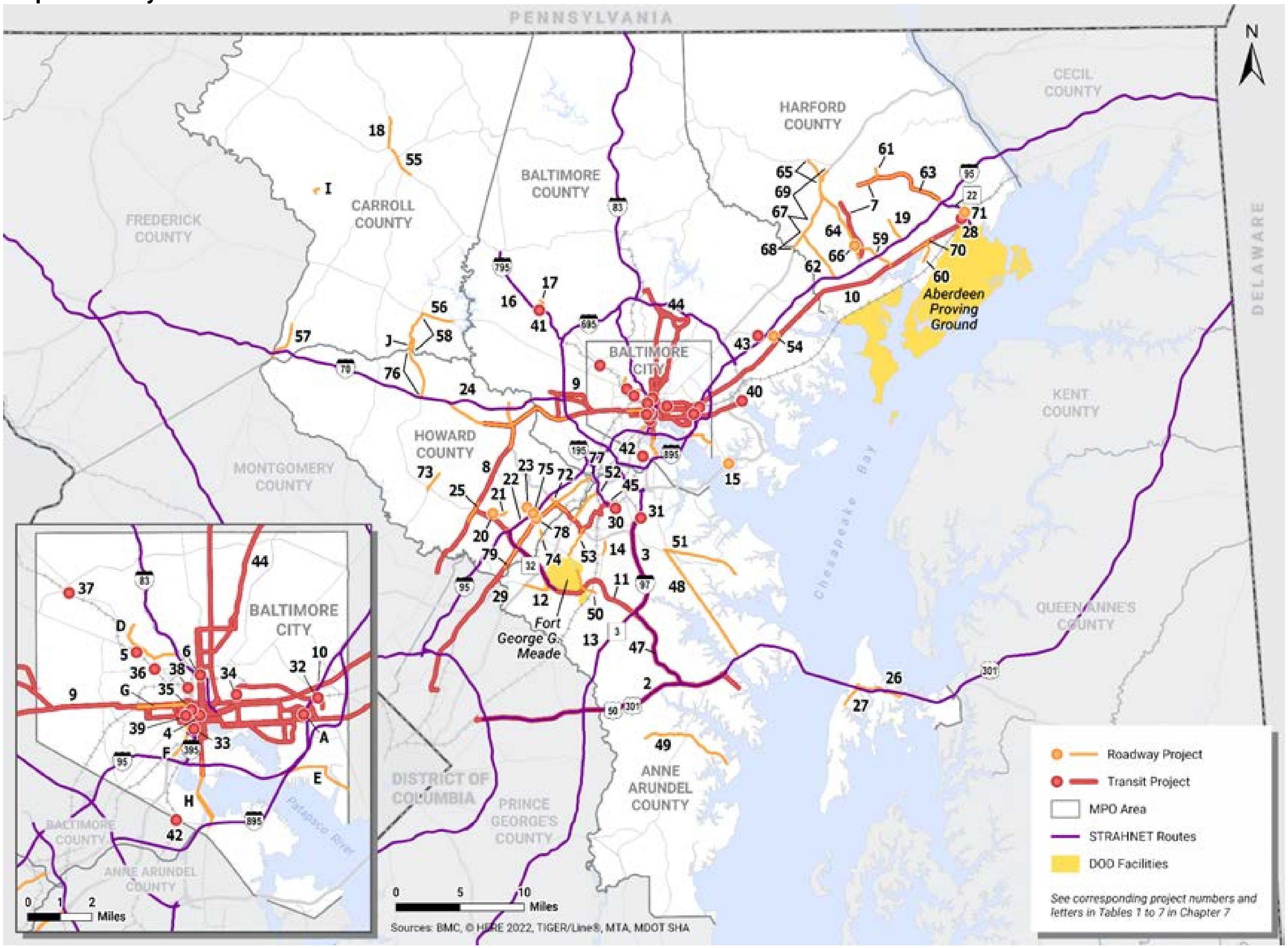


Table 17 lists the *Resilience 2050* preferred alternative projects on STRAHNET and STRAHNET Connector routes. The projects are ordered by jurisdiction and include both transit and roadway projects. As projects move forward, our Freight Movement Task Force will continue to coordinate with representatives from DOD in the transportation planning and project programming process on infrastructure and connectivity needs for STRAHNET routes and other public roads that connect to DOD facilities.

Table 17 - *Resilience 2050* Preferred Alternative Projects on the STRAHNET or STRAHNET Connectors

Map ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)	Project Type	Time Period
2	TBD (Anne Arundel)	Annapolis to New Carrollton Transit	New Carrollton to Parole (21.0 miles)	New Express Bus service between Parole and New Carrollton with stops at major communities along the way.	$3,000,000	Transit	2028-2039
3	TBD (Anne Arundel)	Glen Burnie to Annapolis Transit	Cromwell / Glen Burnie to Annapolis / Parole (16.0 miles)	New Express Bus service between Annapolis / Parole and Glen Burnie along I-97.	$7,000,000	Transit	2028-2039
11	TBD (Regional)	Annapolis to Fort Meade / Columbia Transit	Annapolis / Parole to Fort Meade to Columbia (25.0 miles)	New Express Bus service between Parole and Columbia with primary service to Fort Meade and stops at major communities along the way.	$45,000,000	Transit	2028-2039
13	MDOT SHA (Anne Arundel)	MD 3	MD 450 to MD 32 (6.2 miles)	Targeted widening from 4 to 5 lanes, including intersection improvements, access controls to address safety, TSMO strategies to address congestion, and bicycle and pedestrian improvements.	$95,000,000	Roadway	2028-2039
47	MDOT SHA (Anne Arundel)	I-97	MD 32 to U.S. 50/301 (6.5 miles)	Widen from 4 to 6 lanes, adding managed lanes (HOV lanes) to address capacity needs. Investigate need for additional interchange access in Crownsville.	$450,000,000	Roadway	2040-2050
16	MDOT SHA (Baltimore Co)	I-795	Owings Mills Boulevard to Franklin Boulevard (2.63 miles)	Widen from 4 to 6 lanes and construct a full interchange at Dolfield Boulevard, including Transportation Systems Management and Operations (TSMO) strategies.	$155,000,000	Roadway	2028-2039

Map ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)	Project Type	Time Period
63	MDOT SHA (Harford)	MD 22	MD 543 to I-95 (7.9 miles)	Widen existing 2 and 3 lane sections to 4 and 5 lanes, including an HOV lane from Old Post Road to the Aberdeen Proving Ground (APG) gate, bicycle and pedestrian access, and transit queue jump lanes and transit priority system where applicable.	$221,000,000	Roadway	2040-2050
71	MDOT SHA (Harford)	US 40 at MD 22 Interchange		Make capacity improvements, reconfigure the existing interchange, restrict all left turn movements (allowing room for designated bike lanes), and relocate the existing signal from MD 22 to US 40.	$48,000,000	Roadway	2040-2050
22	MDOT SHA (Howard)	I-95	MD 32 to MD 100 (6.0 miles)	Create peak hour part-time shoulder use lanes.	$45,000,000	Roadway	2028-2039
24	MDOT SHA (Howard)	TSMO System 1	I-70 from I-695 to MD 32 (11.0 miles) US 29 from MD 99 to MD 100 (4.0 miles) US 40 from I-695 to I-70 (10.0 miles)	Implement a combination of information technology and geometric improvements to address safety and operations within TSMO System 1 including I-70, US 29, and US 40.	$48,000,000	Roadway	2028-2039
75	MDOT SHA (Howard)	MD 175 at I-95 Interchange	1.0 mile	Improve existing full interchange consistent with preferred options in the MDOT SHA MD 175 Improvement Study.	$196,000,000	Roadway	2040-2050

Appendix D

Congestion Management

Congestion Management

Congestion management involves applying strategies to improve transportation system performance and reliability. This helps to reduce the adverse impacts of congestion on the movement of people and goods.

A Congestion Management Process (CMP) is a systematic and regionally accepted approach for managing congestion. Such an approach can provide accurate, up-to-date information on transportation system performance. This enables transportation planners and decision makers to assess alternative strategies for managing congestion that meet state and local needs. The CMP is intended to move these congestion management strategies into the funding and implementation stages.

Congestion Management Process

The CMP, as defined in federal regulations, is intended to serve as a systematic process that provides for safe, effective and integrated management and operation of the multimodal transportation system. Federal requirements state that the CMP shall be developed and implemented as an integrated part of the metropolitan transportation planning process. The process includes:

1. Developing regional congestion management objectives,
2. Defining the CMP network,
3. Developing multimodal performance measures,
4. Collecting data and monitoring system performance,
5. Analyzing areas of congestion,
6. Identifying and applying strategies to implement regional objectives and
7. Evaluating the effectiveness of CMP strategies.

Congestion and Air Quality

A CMP is required in metropolitan areas with population exceeding 200,000, known as Transportation Management Areas (TMAs). In TMAs designated as ozone or carbon monoxide non-attainment areas, including Baltimore, the CMP takes on a greater significance. Federal law prohibits projects that result in a significant increase in the number of single-occupant vehicles (SOVs) from being programmed in these areas unless the project is addressed in the region's CMP.

Baltimore region CMP Approach

Although a CMP is required in every TMA, federal regulations are not prescriptive regarding the methods and approaches used to implement a CMP. This flexibility recognizes that different metropolitan areas may face different conditions regarding traffic congestion and may have different approaches for dealing with congestion.

In 2019, we worked with a consultant to refine and develop our CMP. The CMP is intended to be an integral component of the transportation planning process. Since the CMP is intended as a regional process that is fully integrated into the metropolitan transportation planning process, development of the CMP should engage a wide array of stakeholders who play an important role in transportation planning and operations within the region. In fact, the CMP development offers an opportunity to engage a wide array of stakeholders at the state and local levels, as well as federal partners and private industry.

We convened a CMP committee to provide input and guidance and serve as the main conduit for coordination with regional partners to develop the regional CMP. The CMP Committee is comprised of representatives from local planning, transportation, public works and emergency management agencies as well as state and federal transportation agencies. The following sections describe the key elements of the regional CMP.

1. Developing Congestion Management Objectives

Congestion management objectives define what the region wants to achieve regarding congestion management. They are an essential part of an objectives-driven, performance-based approach to planning for operations. Congestion management objectives serve as one of the primary points of connection between the CMP and the long-range transportation plan (LRTP), and serve as a basis for defining the direction of the CMP and its performance measures.

Following is information on how five of the nine *Resilience 2050* goals detailed in Chapter 4 relate either directly or indirectly to the Baltimore region's CMP.

Goal: Improve System Safety

While the emphasis of this goal is to protect the traveling public, reducing traffic incidents (including bicycle/pedestrian fatalities and injuries) will have the secondary effect of easing nonrecurring congestion related to incident delay.

Goal: Improve and Maintain the Existing Infrastructure

As with the safety goal, the emphasis of this goal does not directly address congestion management. However, keeping pavement, bridges, signals and intelligent transportation systems (ITS) infrastructure in a state of good repair can help to maintain traffic flow and reduce delay. In addition, maintaining and replacing transit vehicles on a timely basis can help to encourage the use of transit as an alternative to single-occupant vehicles. Maintaining sidewalks, bikeways and shared use paths in a state of good repair can encourage travelers to use these modes, which could also reduce roadway congestion.

Goal: Improve Accessibility

This involves planning for an integrated transportation system that is accessible, resilient, sustainable, equitable and reliable for all system users and that provides for improved connectivity among all modes and across inter-jurisdictional and interregional boundaries. Related strategies that have guided transportation investment decisions in the Baltimore region include expanding transit options and investing in high quality, safe, sustainable and comfortable bicycle and pedestrian facilities.

Goal: Increase Mobility

Improving mobility and travel time reliability is a critical issue for travelers, particularly in relation to incidents, weather conditions and special events. Reliability is important for both motorists and transit service, and the region has established targets for travel time reliability. This involves integrating Transportation System Management and Operations (TSMO) strategies that improve the performance and reliability of the existing transportation infrastructure to relieve congestion and reduce delay. There are unique issues associated with freight and goods movement. The region has established a target for truck travel time reliability and analyzes performance data for freight priority corridors. Improving performance and reliability includes addressing these concerns:

- **Recurring delay** – Dealing with recurring delay can involve applying such approaches as ITS, better signal timing, implementing flextime or telework arrangements at major employment centers, hard shoulder running and judicious capacity adding projects. Another approach that might be considered in the future is instituting congestion pricing or tolls.
- **Nonrecurring delay** – This involves incident management and providing information on delays related to incidents, construction, special events or weather to transportation system users.

Goal: Foster Participation and Cooperation among All Stakeholders

Improved coordination among localities, modes and agencies within the region is a key priority for the CMP Committee.

This objective enhances inter-jurisdictional coordination and promotes informed decision-making to optimize transportation system performance.

2. Defining the CMP Network

The CMP network involves defining two aspects of the system that are examined as part of the planning process: (1) the geographic boundaries or area of application and (2) the system components and network of surface transportation facilities.

The primary area covered under the CMP network includes our member jurisdictions: Baltimore City, the City of Annapolis and the counties of Anne Arundel, Baltimore, Carroll, Harford, Howard and Queen Anne's. The travel demand model also includes and considers the effects of transportation facilities and operations within areas covered by other MPOs (such as the Washington, D.C. metropolitan area, southern Pennsylvania, and Cecil County, Maryland).

The CMP network identifies geographic boundaries as well as the system components including roads, transit network and freight network. We monitor the identified network to assess operations. This network incorporates all available data throughout the region for multiple modes of transportation. The system components include:

- Highway system (interstates, arterials and local roads),
- Transit system (MDOT MTA bus, light rail, MARC and local transit service providers) and
- Freight routes / intermodal connections (intermodal terminals, airports, etc.).

3. Developing Multimodal Performance Measures

Performance measures are a critical component of the CMP. They are used to assess the performance of the region's transportation network, identify regional and local congestion and mobility issues and support the identification of strategies. As per the Metropolitan Transportation Planning Final Rule 23 CFR450.320 (a) and (b) released in 2007, the development of a congestion management process should result in multimodal system performance measures and strategies that can be reflected in the TIP and LRTP. For the CMP, the intent is to be able to explore congestion and mobility issues across the transportation system network in order to identify locations with problems and the source of those problems.

Volume-to-Capacity-Based Measures

Measures relying on volume-to-capacity ratios traditionally have been used in CMPs. This is because: (a) data on traffic volumes are usually relatively easy to obtain and often already exist, (b) travel demand models are designed to estimate future volumes on the transportation network and (c) estimates of capacity can be derived using documents such as the Highway Capacity Manual (HCM). A limitation of volume-to-capacity measures is that they may not be readily understood by the public.

Delay and Travel Time Reliability Measures

We mapped this information in the form of a CMP Analysis Tool using ArcGIS online. Several performance metrics identified by the consultant in collaboration with the CMP Committee have been integrated into this tool for use by regional stakeholders. This will help to identify areas with mobility challenges or potential needs, which will support the identification of strategies to address these problems or needs. The tool will use performance measures we adopted as required by the Infrastructure Investment and Jobs Act (IIJA). These measures will be updated annually. A few of the core measures include:

- Annual hours of peak-hour excessive delay (PHED),
- Level of Travel Time Reliability (LOTTR) – Interstate System: percentage of person-miles traveled on the Interstate System that are reliable,
- Level of Travel Time Reliability (LOTTR) – Non-Interstate System: percentage of person-miles traveled on the non-interstate NHS that are reliable and
- Truck Travel Time Reliability (TTTR) Index: ratio of Interstate System mileage indicating reliable truck travel times.

Chapter 5 includes information on these measures as well as the targets we adopted to assess system performance.

The PHED measure represents the annual hours of peak-hour excessive delay that occur within an urbanized area on the National Highway System (NHS). By law, the state and the MPO must coordinate to set a single unified set of performance targets for the urbanized area. The threshold for excessive delay is based on the travel time at 20 miles per hour or 60 percent of the posted speed limit travel time, whichever is greater, and is measured in 15-minute intervals.

Peak travel hours are defined as 6:00-10:00 a.m. local time on weekday mornings and 3:00-7:00 p.m. or 4:00-8:00 p.m. local time on weekday afternoons, providing flexibility to state DOTs and MPOs. MDOT calculated the PHED values by uploading posted speed limit data on segments of the NHS in the Baltimore urbanized area into a tool in the Regional Integrated Transportation Information System (RITIS).

Level of Travel Time Reliability (LOTTR) compares the time it takes to travel segments of the NHS in congested conditions (as shown by the 80th percentile time) relative to the time it takes to make a trip in “normal” conditions (as shown by the 50th percentile time). If the 80th percentile travel time divided by the 50th percentile travel time is less than 1.5, then travel time is considered to be reliable. As an example, traffic that takes 45 minutes to travel a segment that in normal conditions takes 30 minutes results in a ratio of 1.5. This measure uses data from FHWA’s National Performance Management Research Data Set (NPMRDS) or equivalent. Data are collected in 15-minute segments during all time periods between 6:00 a.m. and 8:00 p.m. local time.

The TTTR index compares the time it takes trucks to travel segments of the NHS in congested conditions (as shown by the 95th percentile time) relative to the time it takes to make a trip in “normal” conditions (as shown by the 50th percentile time). The TTTR ratio is generated by dividing the 95th percentile time by the normal time (50th percentile) for each segment. For example, say a truck takes 56 minutes to travel a segment of the NHS that normally takes 30 minutes. This translates into a ratio of 1.87 (56 minutes / 30 minutes). Reporting for purposes of calculating the TTTR index is divided into five periods: morning peak (6:00-10:00 a.m.), midday (10:00 a.m.-4:00 p.m.) and afternoon peak (4:00-8:00 p.m.) Mondays through Fridays; weekends (6:00 a.m.-8:00 p.m.); and overnights for all days (8:00 p.m.-6:00 a.m.). The TTTR index is calculated by multiplying each segment’s largest ratio of the five periods by its length, then dividing the sum of all length-weighted segments by the total length of Interstate.

These measures can be translated using various assumptions into other measures such as user costs, and can be used in the process of validating travel demand forecasting models.

Variability of Congestion/Reliability

The variability or change in congestion on a day-to-day basis provides a measure of reliability. Recurring congestion is generally predictable, regularly occurring and typically caused by excess demand compared to the capacity of the system.

On the other hand, nonrecurring congestion — caused by transient events such as traffic incidents, weather conditions, work zones or special events — results in unreliable travel times. Nonrecurring congestion and the unreliable travel times that result are often the most frustrating form of congestion to travelers. Moreover, FHWA has estimated that nonrecurring sources of congestion are responsible for a significant amount of travel delay.

Since the transportation planning models used in metropolitan transportation planning are designed to address recurring congestion issues, many regions have found it challenging to incorporate measures of nonrecurring congestion as part of their CMP. Some MPOs have used crash data as a surrogate measure for nonrecurring congestion under the premise that traffic incidents are directly linked to nonrecurring congestion. Others have begun to gather archived real-time traffic data from operating agencies to examine the variability in traffic volumes, speeds and/or travel times on a daily basis.

We are working on developing travel time measures using both traditional sources of data and new technologies that take advantage of operations data such as probes and ITS devices.

4. Collecting Data and Monitoring System Performance

Data collection and system monitoring are needed to make effective decisions, and are typically an ongoing activity.

According to federal regulation, the CMP must include:

> *Establishment of a coordinated program for data collection and system performance monitoring to define the extent and duration of congestion, to contribute in determining the causes of congestion and evaluate the efficiency and effectiveness of implemented actions.*

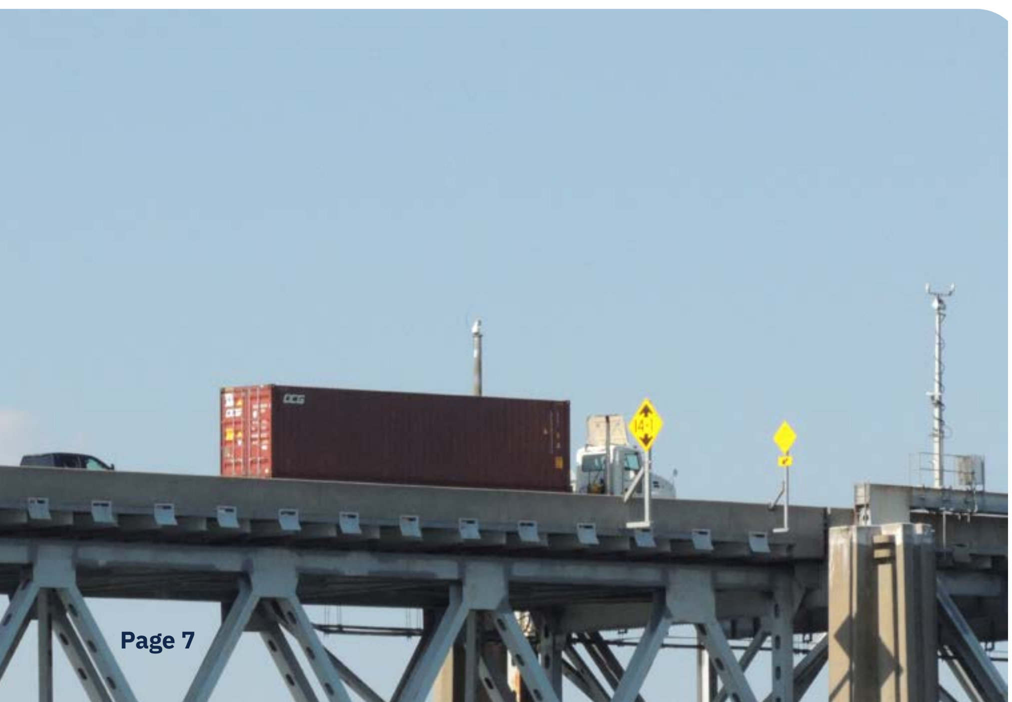
To the extent possible, this data collection program should be coordinated with existing data sources (including archived operational/ITS data) and with operations managers in the metropolitan area.

Using Vehicle Probe Data to Monitor Traffic

Since 2013, we have been in partnership with the I-95 Corridor Coalition and University of Maryland Center for Advanced Transportation Technology Lab (CATT Lab). This setup enables partners to have access to continuous (24/7) probe data to monitor traffic conditions throughout the region. Access to the data is through the Probe Data Analytics (PDA) Suite, an online set of tools that can be accessed through a web browser. This eliminates the need for the many hours of processing of raw data that our previous approach (collecting GPS speed data) required.

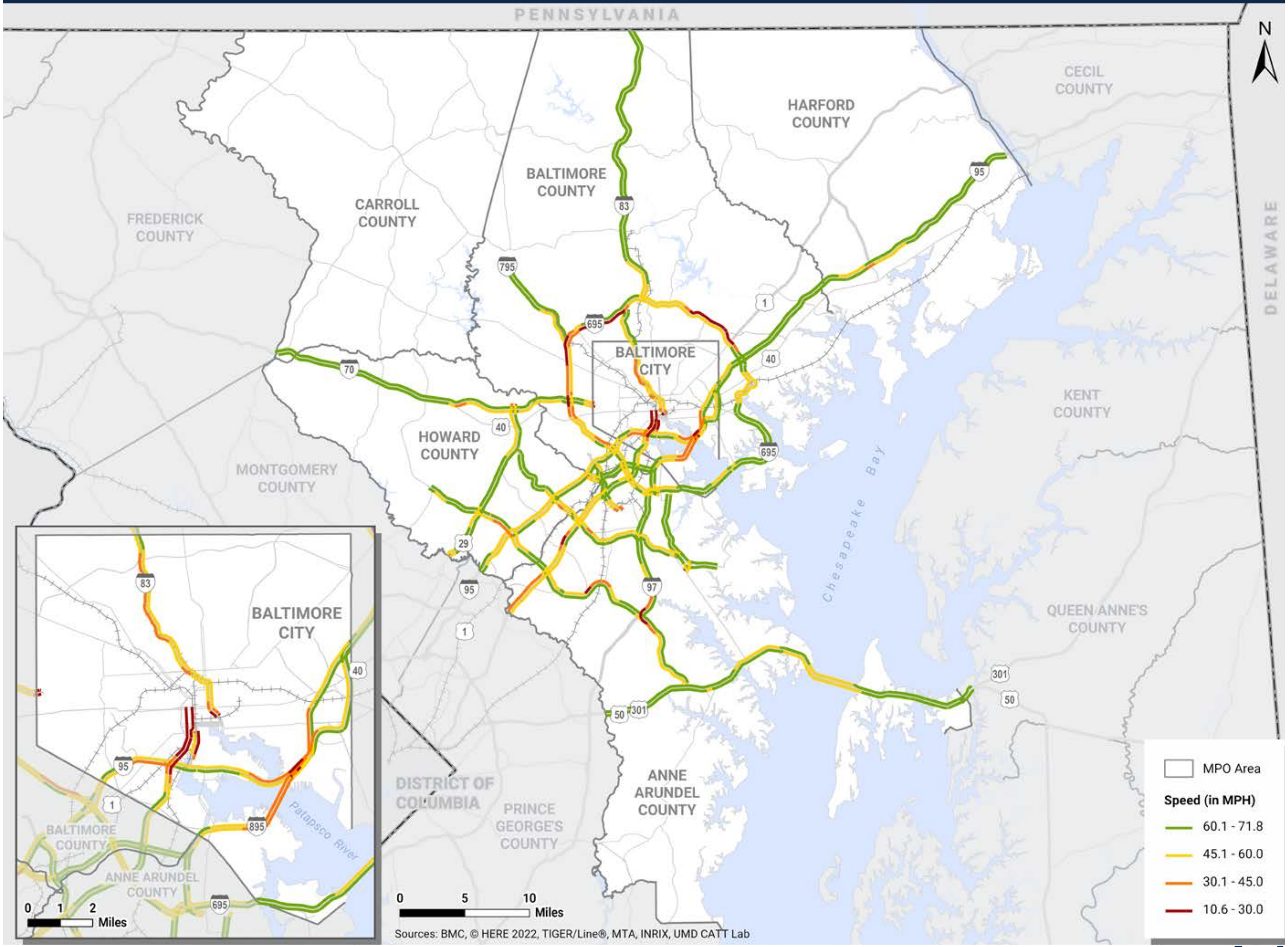
The PDA Suite began in 2008 with the primary goal of enabling Coalition members to acquire reliable travel time and speed data for their roadways without the need for sensors and other hardware.

Maps 1 and 2 show probe data for the Baltimore region, depicting average 2022 travel speeds on freeways and major arterials for the a.m. and p.m. peak periods, respectively.

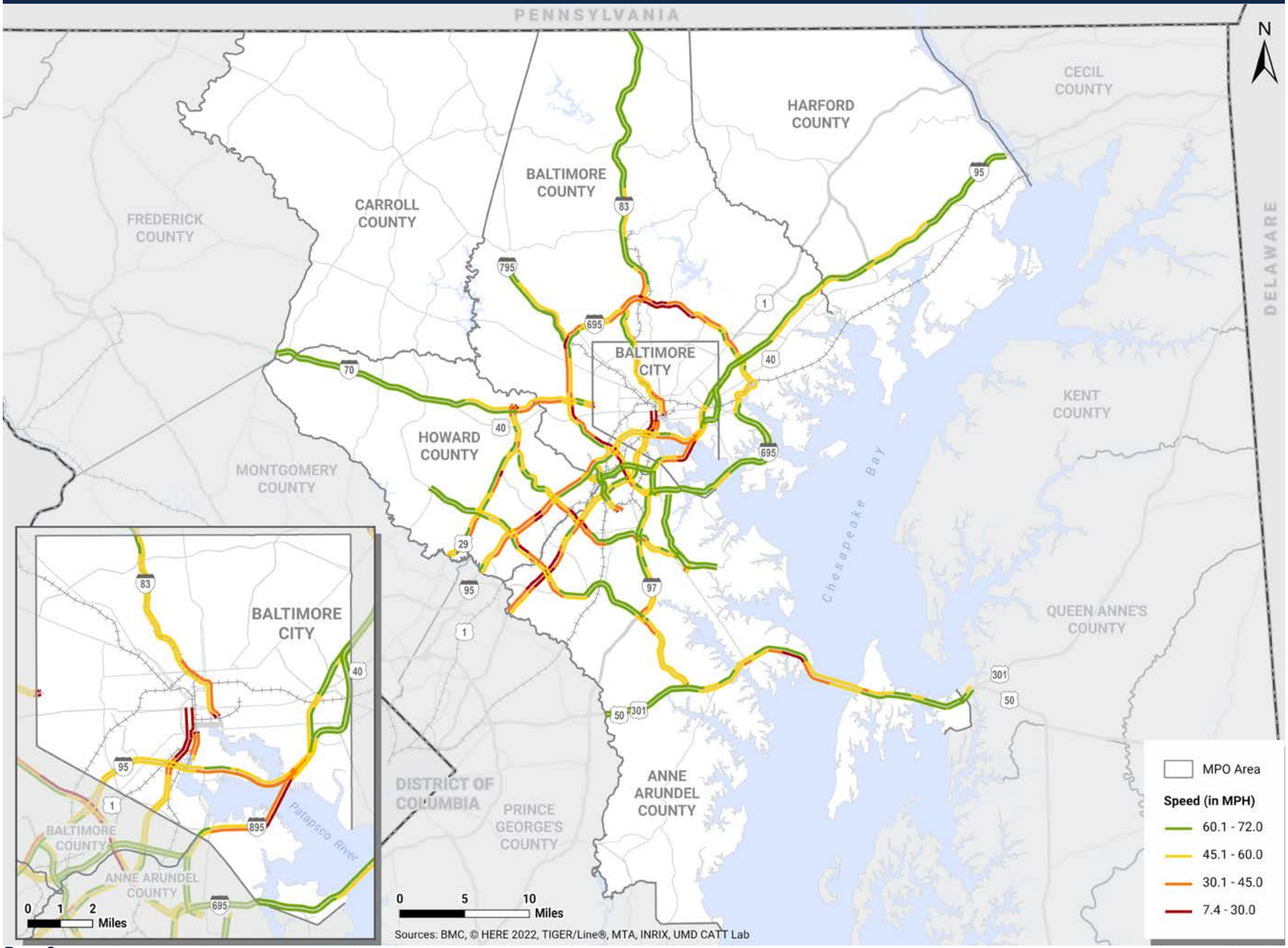


Since 2013, we have been in partnership with the I-95 Corridor Coalition and University of Maryland Center for Advanced Transportation Technology Lab (CATT Lab).

Map 1 - 2022 Average Travel Speeds for A.M. Peak Period



Map 2 - 2022 Average Travel Speeds for P.M. Peak Period



5. Analyzing Areas of Congestion

Methods to Support Analysis of Congestion and Mobility Needs

We began developing the "Quarterly Congestion Analysis Report" in 2013 using probe data from the PDA Suite. This report identifies the Top 10 Bottlenecks in the Baltimore region.

The PDA tool determines bottleneck conditions by comparing the current reported speed to the reference speed for each segment of road. INRIX provides reference speed values for each segment. These represent the 85th percentile observed speed for all time periods, with a maximum value of 65 mph. If the reported speed falls below 60 percent of the reference, the road segment is flagged as a potential bottleneck. If the reported speed stays below 60 percent for five minutes, the segment is confirmed as a bottleneck location. Adjacent road segments meeting this condition are joined together to form the bottleneck queue. When reported speeds on every segment associated with a bottleneck queue have returned to values greater than 60 percent of their reference values and have remained that way for 10 minutes, the bottleneck is considered cleared. The process ignores bottlenecks whose total queue length, determined by adding the length of each road segment associated with the bottleneck, is less than 0.3 miles.

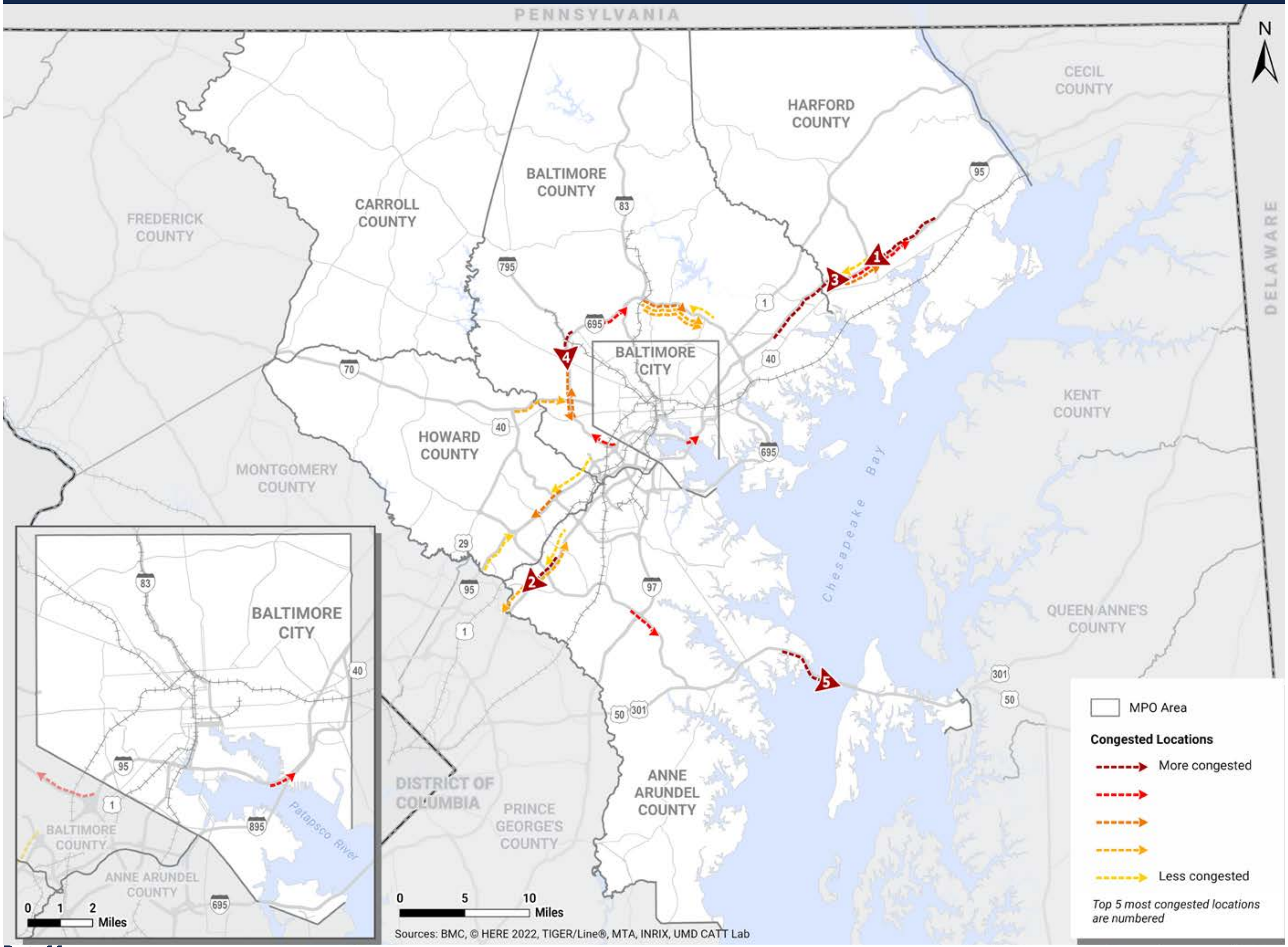
The quarterly report identifies the top bottlenecks in the Baltimore region and ranks them by Impact Factor. This is calculated by multiplying the number of times a bottleneck occurred by its average duration by its average length.

Along with the ranking, staff attempt to assess what is causing the congestion and utilize tools in the PDA Suite to illustrate what is occurring at each location. From the bottleneck report, staff can create specialized maps showing congested locations. Map 3 shows an example depicting the top 25 congested locations in 2022 based on PDA data.

In addition to the bottleneck rankings, we have recently developed the CMP Analysis Tool using ArcGIS online, which maps bottlenecks and several other performance metrics. This tool supports the analysis of congestion and mobility issues by transportation agency staff in order to identify regional and local priorities. It may also be used by interested parties, including land use planners, community groups and the public to better understand congestion and mobility issues and engage in the transportation decision-making process (and to consider policies related to land use, parking, incentives, travel demand management, etc.).

Our CMP is intended to accomplish more than just presenting data on congestion. It will identify congestion and mobility needs and the causes of congestion in order to support identification of solutions. The CMP Analysis Tool will be used with the intent to provide updated information on congestion and mobility issues on an annual basis to support identification of priorities by local governments and partners.

Map 3 - Top 25 Congested Locations in 2022 (Top 5 Most Congested Locations Numbered)



Sources: BMC, © HERE 2022, TIGER/Line®, MTA, INRIX, UMD CATT Lab

Analysis of Congestion in Selected Corridors

Each year, Maryland's 23 counties and Baltimore City send "priority letters" to MDOT. This is the formal process for local jurisdictions to submit project requests for the state's Consolidated Transportation Program (CTP). These letters list the projects that the jurisdictions consider critical to addressing their transportation needs, which often include alleviating traffic congestion and addressing safety concerns.

TSMO is a key tool for addressing both recurring and nonrecurring congestion, and the MDOT SHA TSMO Strategic Plan notes that TSMO will be a critical component of future programs and projects. However, TSMO projects often do not fit neatly into the traditional priority letter project categories of "highway," "transit" and "bicycle and pedestrian," or even within one jurisdiction. We will work with MDOT to develop a process for local jurisdictions to submit TSMO projects in their priority letters. In addition, MDOT SHA is embarking on a TSMO stakeholder outreach and education process. We will participate in this process, as well as investigate other approaches as needed, to ensure all approaches for congestion management are considered.

Conducting corridor studies to identify operational issues is one way we have aided local jurisdictions in addressing congestion and improved the priority letter process. We developed a template for conducting corridor studies and coordinate with local and state partners through the CMP Committee to identify corridors to study in the future. Analysis along the selected corridors will help local jurisdictions better understand the connections between congestion, safety, land use, freight movement and operations. This process also will establish linkages among local jurisdiction priorities, the LRTP and the TIP. Data we gather and analyze will provide information for subsequent NEPA analysis.

Our technical analysis focuses on better understanding the extent, duration and causes of congestion along the corridor and on developing potential operational countermeasures for short-term efficiency and safety. Such analyses will try to capture both recurring and nonrecurring congestion.

6. Identifying and Applying Strategies

The CMP must identify and analyze reasonable travel demand reduction and operational management strategies. If the analysis demonstrates that these strategies cannot fully satisfy the need for additional capacity and additional SOV capacity is warranted, then the CMP must identify strategies to manage the SOV facility safely and effectively, along with other travel demand reduction and operational management strategies appropriate for the corridor.

Coordinating with TSMO Activities

As stated in 23 CFR 450.320, "The congestion management process shall be developed, established, and implemented as part of the metropolitan transportation planning process that includes coordination with transportation system management and operations activities." MDOT SHA recently completed an updated TSMO Strategic Plan that states, ". . . TSMO will drive how we design and implement future programs and projects." We will continue to work closely with our partners on TSMO activities, which are a critical component to addressing congestion.

Resilience 2050 Strategies

In November 2021, we approved the following strategies under the goal of Increase Mobility. These strategies will help the region reduce congestion and improve traffic flow:

- Continue to coordinate with MDOT and local agencies to improve travel time reliability through performance-based planning and programming.
- Continue to refine and implement a CMP that incorporates TSMO strategies to optimize the performance of the existing transportation system and minimize impact and costs.
- Analyze congestion causes and mitigation strategies for corridors and locations experiencing recurring high congestion levels.
- Consider how all modes — roadway, transit, pedestrian, bicycle and shared mobility — can work together to address system capacity needs.
- Support a regional multimodal freight network for safe and efficient freight movement.
- Increase mobility, including traffic and transit incident response and recovery, through traffic and transit system management and operations techniques.
- Reduce the effects of non-recurring incidents (such as crashes, weather-related delays and special events) by enhancing methods of sharing information across agencies and modes, responding to and managing these incidents and sharing information with travelers.
- Develop and support a regional, long-distance bikeway network, including consistent guide signage.

Other strategies that might be considered in the future to help the region ease congestion are:

- Work more closely with other adjacent metropolitan areas to develop interregional approaches to measuring and managing congestion, including performance measures adopted and applied on an interregional basis. The Baltimore region has taken some initial steps in this area by meeting periodically with traffic and operations staff from adjacent MPOs and other state DOTs to discuss interregional approaches to improving mobility and managing congestion.

- Select relatively low-cost, "low-hanging fruit" congestion management projects ("spot" improvements, signal timing) that could be funded with CMAQ or potentially PL or STBG funds.

Specific Strategies – Preferred Alternative Projects

We requested some detailed information from local jurisdictions submitting projects for consideration for *Resilience 2050*. Some of this information relates to strategies, either in place or under consideration, which could provide congestion management benefits for each proposed project. The strategies are drawn from the CMP and include:

- Demand Management and Regional Strategies, including
  - Commuter related programs (employer outreach, commuter benefits policies, etc.) and
  - Promoting regional coordination (intra-jurisdictional projects/strategies),
- TSMO Strategies, including
  - Intersection control (traffic signal coordination, ramp metering, etc.),
  - Real-time monitoring (active traffic management, real time parking info, traveler information systems, etc.) and
  - Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, etc.),
- Public Transportation Strategies, including
  - Operational improvements (transit signal priority, optimizing transit service, etc.),
  - New infrastructure (bus rapid transit, network expansion, etc.) and
  - User-oriented improvements (trip-planner application, real-time data, etc.),
- Bicycle/Pedestrian and Micromobility Strategies, including
  - Infrastructure addition (new bike lanes, streetscape elements, etc.),
  - Infrastructure improvements (traffic calming, etc.) and
  - Sharing programs (bikeshare programs, micromobility, etc.) and
- Road Capacity Strategies, including
  - Roadway changes (new lanes, spot improvements, etc.),
  - Intersection changes (grade separated intersections, intersection improvements, etc.) and
  - Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.).

Tables 1-7 show the specific strategies proposed for each project in the preferred alternative. These congestion management strategies are based on information provided by the local jurisdictions and operating agencies, as well as knowledge of existing operational characteristics along these project corridors.

Table 1 - Transit Expansion Projects: 2028-2039

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
1*	Anne Arundel County	Anne Arundel Countywide Microtransit	Countywide	Expand microtransit service in Anne Arundel County from 1 zone in the south to 7 zones, providing on-demand transit services to connect to existing fixed route services across the entire county.	• Public Transportation: User-oriented improvements (trip-planner application, real-time data, universal farecards, etc.)
2	TBD Anne Arundel County	Annapolis to New Carrollton Transit	New Carrollton to Parole 21.0 miles	New Express Bus service between Parole and New Carrollton with stops at major communities along the way.	• Promoting regional coordination (intra-jurisdictional projects/ strategies) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.)
3	TBD Anne Arundel County	Glen Burnie to Annapolis Transit	Cromwell / Glen Burnie to Annapolis / Parole 16.0 miles	New Express Bus service between Annapolis / Parole and Glen Burnie along I-97.	• Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.)
• 4 • 5 • 6	MDOT MTA 3 Locations in Baltimore City	MDOT MTA Transit Hubs: • Charles Center • Mondawmin • Penn Station	Jurisdiction: • Baltimore City • Baltimore City • Baltimore City	MDOT MTA has identified transit hub locations as part of the Regional Transit Plan. Typically, a transit hub includes enhanced amenities (shelters, benches, information). The Penn Station project has received $5M in Congressionally Designated Funding for multimodal access improvements to the station and a Federal RAISE discretionary grant to further fund investments around the station.	• Commuter related programs (employer outreach, commuter benefits policies, parking cash out policies, etc.) • Promoting regional coordination (intra-jurisdictional projects/ strategies) • TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
7	MDOT SHA Harford County	Transit Signal Priority	MD 22 corridor from MD 543 to Long Drive / Technology Drive 7.4 miles MD 924 corridor from MacPhail Road to Woodsdale Road 4.7 miles	Construct queue jump lanes along MD 22 and MD 924 and install equipment on buses that syncs with traffic signals along these corridors.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.)
8	TBD Howard County	US 29 Bus Rapid Transit	US 40 to MD 198 (Burtonsville, MD) 16.0 miles	Connect Ellicott City to Columbia, Maple Lawn and Burtonsville at MD 198 in Montgomery County, including separated facilities on US 29 to integrate with Montgomery County improvements and the development of a transit center in Downtown Columbia.	• TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.) • Public Transportation: User-oriented improvements (trip-planner application, real-time data, universal farecards, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)
9	MDOT MTA Regional	East-West Transit Corridor	Ellicott City to Essex 17.0 miles	New east-west transit service to connect major Baltimore region destinations like West Baltimore, Downtown, East Baltimore and the western suburbs as identified in the RTP.	• Promoting regional coordination (intra-jurisdictional projects/ strategies) • TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.) • Public Transportation: User-oriented improvements (trip-planner application, real-time data, universal farecards, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
10	MDOT MTA Regional	MDOT MTA Commuter Service	Harford County to Downtown Baltimore and Harbor East	Additional MDOT MTA commuter bus service from Harford County to Downtown Baltimore and Harbor East.	• Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.)
11	TBD Regional	Annapolis to Fort Meade / Columbia Transit	Annapolis / Parole to Fort Meade to Columbia 25.0 miles	New Express Bus service between Parole and Columbia with primary service to Fort Meade and stops at major communities along the way.	• Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.)

Table 2 - Roadway Expansion Projects: 2028-2039

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
12	MDOT SHA Anne Arundel County	MD 198	MD 295 to MD 32 2.7 miles	Widen from 2 to 4 lanes and construct a continuous center median. Widen ramp at MD 295. Provide bicycle and pedestrian facilities within project limits.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)
13	MDOT SHA Anne Arundel County	MD 3	MD 450 to MD 32 6.2 miles	Targeted widening from 4 to 5 lanes, including intersection improvements, access controls to address safety, TSMO strategies to address congestion, as well as bicycle and pedestrian improvements.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
14	MDOT SHA Anne Arundel County	MD 170	Norcross Lane to Wieker Road 0.83 miles	Widen from 2 to 4 lanes, resurface, and restripe along MD 170 and along MD 174 to create new turn lanes and increased capacity at the MD 170 / MD 174 intersection, including sidewalks and bicycle compatible shoulders.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
15	MDOT Baltimore County	I-695 at Broening Highway Interchange		Construct a partial interchange at Exit 44 of I-695 to support redevelopment at Sparrows Point.	• TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Roadway changes (new lanes, spot improvements, etc.)
16	MDOT SHA Baltimore County	I-795	Owings Mills Boulevard to Franklin Boulevard 2.63 miles	Widen from 4 to 6 lanes and construct a full interchange at Dolfield Boulevard, including TSMO strategies.	• TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Roadway changes (new lanes, spot improvements, etc.)
17	MDOT SHA Baltimore County	MD 140	Painters Mill Road to Owings Mills Boulevard 0.4 miles	Widen from 4 to 6 lanes, including a raised median, bicycle accommodations and pedestrian facilities.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
18	MDOT SHA Carroll County	MD 97	Bachmans Valley Road to MD 140 in Westminster 2.4 miles	Widen from 3 to 5 lanes, with a full interchange at Meadow Branch Road and bicycle and pedestrian facilities.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)
19	MDOT SHA Harford County	MD 543	MD 136 to I-95 1.9 miles	Widen from 2 to 4 lanes, including intersection upgrades at MD 136, turn lanes, capacity upgrades to the MD 543 / I-95 interchange, and bicycle and pedestrian access. Improvement will fix queuing problems on MD 543 through the intersection with MD 7.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
20	Howard County	Broken Land Parkway at Snowden River Parkway	Broken Land Parkway from south of MD 32 to north of Snowden River Parkway; Snowden River Parkway from east of Minstrel Way to Patuxent Woods Drive 0.25 miles	Capacity, operational and safety improvements at this signalized intersection as well as access improvements to the MD 32 / Broken Land Parkway interchange ramps.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)
21	Howard County	Snowden River Parkway Widening	Broken Land Parkway to Oakland Mills Road 1.1 miles	Widen from 4 to 6 lanes, including auxiliary lanes and pedestrian, bicycle and transit improvements on both sides of the road.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
22	MDOT SHA Howard County	I-95	MD 32 to MD 100 6.0 miles	Create peak hour part-time shoulder use lanes.	• TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Roadway changes (new lanes, spot improvements, etc.)
23	MDOT SHA Howard County	MD 175 / MD 108 Interchange	0.25 miles in all directions from the current intersection as well as a direct connection of MD 108 to Columbia Gateway Drive. 0.25 miles	This T-intersection experiences significant congestion and an even worse collision experience. Existing intersection exhibits a collision rate higher than almost all intersections in Howard County. A partial grade-separation with direct access into Columbia Gateway will improve intersection capacity and alleviate the high collision rate.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)
24	MDOT SHA Howard County	TSMO System 1	I-70 from I-695 to MD 32 (11.0 miles) US 29 from MD 99 to MD 100 (4.0 miles) US 40 from I-695 to I-70 (10.0 miles)	Implement a combination of information technology and geometric improvements to address safety and operations within TSMO System 1 including I-70, US 29, and US 40.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
25	MDOT SHA Howard County	US 29	Patuxent River Bridge to Seneca Drive 1.7 miles	Widen northbound US 29 from 2 to 3 lanes, including improvements at intersection with Rivers Edge Road.	• Roadway changes (new lanes, spot improvements, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
26	MDOT SHA Queen Anne's County	MD 18	Kent Narrows to Bay Bridge – MD 18 and MD 835 on east side of Kent Narrows to MD 18 5.0 miles	Widen from 2 to 4 lanes, including Right-Of-Way acquisition, utility relocation, new pedestrian improvements, and reconstruction of intersections to improve capacity, safety and mobility on the only alternative route to US 50/301 on the island.	• Promoting regional coordination (intra-jurisdictional projects/ strategies) • TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
27	MDOT SHA Queen Anne's County	MD 8 / US 50/301 Interchange and Service Roads	Skip Jack Parkway south to Davidson Drive; east to Thompson Creek service road 2.0 miles	Widen from 2 to 4 lanes, convert MD 8 overpass to full divergent diamond interchange with US 50/301, and add Thompson Creek and Cox Creek service roads to improve traffic flow, add capacity and allow for alternative routes to services and residential areas. Provide for bike and pedestrian improvements along existing and new routes.	• Promoting regional coordination (intra-jurisdictional projects/ strategies) • TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)

Table 3 - Transit Expansion Projects: 2040-2050

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
28	MDOT MTA Harford County	Aberdeen MARC Station	US 40 at MD 132 (Bel Air Ave)	Transit Oriented Development (TOD), new train station, additional parking, US 40 "Green Boulevard," and remove pedestrian overpass and replace with Station Square Plaza - a new pedestrian underpass and green, terraced plaza / amphitheater.	• Commuter related programs (employer outreach, commuter benefits policies, parking cash out policies, etc.) • Promoting regional coordination (intra-jurisdictional projects/ strategies) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.) • Public Transportation: User-oriented improvements (trip-planner application, real-time data, universal farecards, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)
29	TBD Howard County	US 1 Corridor Bus Rapid Transit	Dorsey MARC Station to College Park Purple Line Station 19.5 miles	Bus Rapid Transit will emulate light rail operation at a lower cost, and is designed to link Howard County commuters from the Dorsey MARC to the Laurel MARC Station and the City of Laurel as well as to College Park and the Purple Line Light Rail.	• Commuter related programs (employer outreach, commuter benefits policies, parking cash out policies, etc.) • Promoting regional coordination (intra-jurisdictional projects/ strategies) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.) • Public Transportation: User-oriented improvements (trip-planner application, real-time data, universal farecards, etc.) • Bicycle/Pedestrian and Micromobility: Sharing programs (bikeshare programs, micromobility, etc.) • Roadway changes (new lanes, spot improvements, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
• 30 • 31 • 32 • 33 • 34 • 35 • 36 • 37 • 38 • 39 • 40 • 41 • 42 • 43	MDOT MTA 14 Locations throughout the region	MDOT MTA Transit Hubs: • BWI Airport • Glen Burnie • Bayview Medical Center • Camden Station • Johns Hopkins Hospital • Lexington Market • Penn-North • Rogers Avenue • State / Cultural Center • UM Medical Center • Essex • Owings Mills • Patapsco • White Marsh	Jurisdiction: • Anne Arundel • Anne Arundel • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore City • Baltimore Co • Baltimore Co • Baltimore Co • Baltimore Co	MDOT MTA has identified transit hub locations as part of the Regional Transit Plan. Typically, a transit hub includes enhanced amenities (shelters, benches, information).	• Commuter related programs (employer outreach, commuter benefits policies, parking cash out policies, etc.) • Promoting regional coordination (intra-jurisdictional projects/ strategies) • TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
44	MDOT MTA Regional	North-South Transit Corridor	Towson to Downtown Baltimore (potentially Lutherville to Port Covington) 14.0 miles	New North-South transit service to connect Towson to Downtown Baltimore, with associated investments to significantly improve the speed and reliability of transit service in this busy corridor.	• Promoting regional coordination (intra-jurisdictional projects/ strategies) • TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.) • Public Transportation: User-oriented improvements (trip-planner application, real-time data, universal farecards, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
45	TBD Regional	Bus Rapid Transit to BWI	Dorsey MARC Station to BWI Light Rail Station 9.7 miles	New bus rapid transit service from the Dorsey MARC station to Arundel Mills to BWI consolidated rental car facility to the BWI light rail station.	• Commuter related programs (employer outreach, commuter benefits policies, parking cash out policies, etc.) • TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.) • Public Transportation: User-oriented improvements (trip-planner application, real-time data, universal farecards, etc.)
46	TBD Regional	Chesapeake Bay Ferry Service		Establish a passenger ferry between numerous ports along the Chesapeake Bay.	• Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.)

Table 4 - Roadway Expansion Projects: 2040-2050

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
47	MDOT SHA Anne Arundel County	I-97	MD 32 to US 50/301 6.5 miles	Widen from 4 to 6 lanes, adding managed lanes (HOV lanes) to address capacity needs. Investigate need for additional interchange access in Crownsville.	• TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)
48	MDOT SHA Anne Arundel County	MD 2	US 50 to MD 100 10.0 miles	Widen existing 4-lane sections to 6 lanes to create a continuous typical section throughout corridor, including intersection improvements and pedestrian facilities throughout to connect MD 2 to the B&A Trail at various locations.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
49	MDOT SHA Anne Arundel County	MD 214	MD 424 to Shoreham Beach Road 7.5 miles	Project includes travel lane extensions from 2 to 4 lanes east of MD 2, bicycle improvements throughout most of the corridor and pedestrian improvements in segments. Traffic signal warrant assessments recommended at MD 214 / Riva Road and MD 214 / Stepneys Lane intersections.	• TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
50	MDOT SHA Anne Arundel County	MD 175	Reece Road to MD 170 2.7 miles	Widen from 4 to 6 lanes, including improvements at the MD 32 interchange, and bicycle and pedestrian facilities.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
51	MDOT SHA Anne Arundel County	MD 177	MD 2 to Lake Shore Drive 6.1 miles	Widen from 2 to 4 lanes, including intersection improvements and improved bicycle and pedestrian infrastructure in accordance with the County Study and MDOT SHA MD 177 Operational Analysis.	• TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
52	MDOT SHA Anne Arundel County	MD 295	MD 100 to I-195 3.27 miles	Widen from 4 to 6 lanes, including a new full interchange at Hanover Road and an extension of Hanover Road from the CSX railroad tracks to MD 170.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)
53	MDOT SHA Anne Arundel County	MD 713	MD 175 to MD 176 2.6 miles	Construct corridorwide improvements including reconstruction and widening, intersection improvements and bicycle and pedestrian accommodations. Primary widening is from 2 to 4 lanes between MD 175 and Stoney Run Drive.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
54	MDOT SHA Baltimore County	MD 7 at MD 43 Interchange		Upgrade interchange from partial to full, including two new ramps to accommodate full movements at interchange.	• TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Roadway changes (new lanes, spot improvements, etc.)
55	MDOT SHA Carroll County	MD 140	Market Street to Sullivan Road 2.5 miles	Widen from 6 to 8 lanes, with a full interchange at MD 97, continuous flow intersections at Center Street and Englar Road, and bicycle and pedestrian facilities.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
56	MDOT SHA Carroll County	MD 26	MD 32 to the Liberty Reservoir 2.5 miles	Widen from 4 to 6 lanes, including a raised median, intersection improvements, and pedestrian facilities.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
57	MDOT SHA Carroll County	MD 27 Corridor Improvements	Carroll County line to Leishear Road 3.2 miles	Widen to a consistent four lanes, including dedicated turn lanes, signalized traffic control, boulevard separation of lanes, and controlled intersections to allow pedestrian crossings.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)
58	MDOT SHA Carroll County	MD 32	Howard County Line to MD 26 3.36 miles	Widen from 2 to 4 lanes with pedestrian and bicycle facilities.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)
59	Harford County	Abingdon Road	MD 924 to US 40 3.0 miles	Capacity improvements including turn lanes, bicycle lanes and sidewalks.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
60	Harford County	Perryman Access - Mitchell Lane	US 40 in the vicinity of Mitchell Lane to Canning House Road 2.0 miles	Construct a new 2-lane road and bridge over Cranberry Run in Perryman, including turn lanes and bicycle and pedestrian access.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)
61	Harford County	Thomas Run Road	MD 22 to West Medical Hall Road 0.8 miles	Streetscape and capacity improvements, including center turn lane, sidewalks, bicycle accessibility, pedestrian-scale lighting with banners, crosswalks and street furniture.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.)
62	MDOT SHA Harford County	MD 152	US 1 to I-95 4.3 miles	Capacity improvements including turn lanes and bicycle and pedestrian access where applicable.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)
63	MDOT SHA Harford County	MD 22	MD 543 to I-95 7.9 miles	Widen existing 2 and 3 lane sections to 4 and 5 lanes, including an HOV lane from Old Post Road to the Aberdeen Proving Ground (APG) gate, bicycle and pedestrian access, and transit queue jump lanes and transit priority system where applicable.	• Commuter related programs (employer outreach, commuter benefits policies, parking cash out policies, etc.) • Promoting regional coordination (intra-jurisdictional projects/ strategies) • TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
64	MDOT SHA Harford County	MD 24	US 1 Bypass to south of Singer Road 5.0 miles	Widen from 4 to 6 lanes, including sidewalks and bicycle accommodations where appropriate.	• TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
65	MDOT SHA Harford County	MD 24 (Rock Spring Road)	US 1 Bypass to MD 23 1.8 miles	Add travel lane in each direction (widen from 2 to 4 lanes), including turn lanes and completion of shared use path adjacent to the roadway from Forest Valley Road to Red Pump Road.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)
66	MDOT SHA Harford County	MD 24 at Singer Road Interchange		Elevate grade of cross street through movement as well as left turn movements from all directions while allowing MD 24 through and right turn movements as well as side street right turn movements to operate with free-flowing movements as described in MD 924 study.	• Intersection changes (grade separated intersections, intersection improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)
67	MDOT SHA Harford County	US 1	MD 152 to MD 147 / US 1 Business 1.3 miles	Widen from 4 to 6 lanes, including bicycle and pedestrian accommodations.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
68	MDOT SHA Harford County	US 1	Baltimore County Line to MD 152 1.4 miles	Add travel lane in each direction (widen from 4 to 6 lanes), including turn lanes and bicycle and pedestrian access where applicable.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)
69	MDOT SHA Harford County	US 1 Bypass	MD 147 / US 1 Business to Hickory Bypass 4.6 miles	Widen from 2 to 4 lanes and improve US 1 / MD 24 and US 1 / MD 924 interchanges.	• Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
70	MDOT SHA Harford County	US 40	MD 543 to Loflin Road 1.7 miles	Widen from 4 to 6 lanes, including turn lanes, a partial interchange reconstruction at MD 543 and bicycle and pedestrian access.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)
71	MDOT SHA Harford County	US 40 at MD 22 Interchange		Make capacity improvements, reconfigure the existing interchange, restrict all left turn movements (allowing room for designated bike lanes), and relocate the existing signal from MD 22 to US 40.	• Promoting regional coordination (intra-jurisdictional projects/ strategies) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)
72	MDOT SHA Howard County	MD 100 Widening	I-95 to Anne Arundel County Line 2.0 miles	Widen from 4 to 6 lanes with additional merge/ diverge lanes.	• Roadway changes (new lanes, spot improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
73	MDOT SHA Howard County	MD 108	Trotter Road to Guilford Road 1.67 miles	Improvements as articulated in the 2014 Clarksville Pike Streetscape Plan & Design Guidelines / Traffic Study. Includes selected road capacity enhancements, sidewalks, shared use paths and traffic signal upgrades.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
74	MDOT SHA Howard County	MD 175	Oceano to Anne Arundel County Line 0.54 miles	Widen from 2 to 4 lanes, including bicycle, transit and pedestrian improvements consistent with Anne Arundel County widening proposals.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)
75	MDOT SHA Howard County	MD 175 at I-95 Interchange	1.0 miles	Improve existing full interchange consistent with preferred options in the MDOT SHA MD 175 Improvement Study.	• Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
76	MDOT SHA Howard County	MD 32	North of I-70 to Carroll County Line 4.0 miles	Widen from 2 to 4 lanes to provide safety, capacity, operational and access improvements on MD 32.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Roadway changes (new lanes, spot improvements, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
77	MDOT SHA Howard County	US 1	Baltimore County Line to MD 175 5.5 miles	Widen from 4 to 6 lanes and construct the revised typical section in the State / County MOU for US 1 revitalization, including connecting community destinations in the US 1 corridor to support safety and access as per the US 1 safety evaluation, functional plans and the regional active transportation priority project.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
78	MDOT SHA Howard County	US 1 at MD 175 Interchange	0.5 miles	Construct a new grade-separated Single Point Urban Interchange, with MD 175 passing over US 1.	• Intersection changes (grade separated intersections, intersection improvements, etc.)
79	MDOT SHA Howard County	US 1 Revitalization Breakout Projects	MD 175 to Whiskey Bottom Road 4.5 miles	Widen from 4 to 6 lanes along with bicycle, pedestrian, transit, streetscape and access improvements consistent with the US 1 Design Manual. Involve the private sector development community under the auspices of the US 1 State/County MOU and the US 1 Design Manual.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)

Table 5 - Transit System Preservation Projects: 2028-2039

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
A	MDOT MTA Baltimore City	Eastern Bus Division		Reconstruct the Eastern Bus Division as an electric bus facility.	• Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.)
B	MDOT MTA Regional	Zero Emission Bus Transition Phase 1	MDOT MTA's core service area in the Baltimore region	Transition 50% of MDOT MTA's 760-bus fleet to zero-emission by 2030. Includes procurement of over 350 Battery Electric Buses by 2030, training the transit workforce, and retrofitting Kirk and Northwest bus divisions with charging infrastructure. Beyond 2030, the MDOT MTA is preparing to have a 95% zero-emission fleet by 2045.	• Promoting regional coordination (intra-jurisdictional projects/ strategies) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.)
C	MDOT MTA Regional	Light Rail Fleet Mid-life Overhaul	Hunt Valley to BWI/Glen Burnie	Overhaul the entire Light Rail fleet, extending the fleet's life by approximately 15 years, improving safety and reliability, providing a more comfortable and secure ride, and lowering maintenance costs.	• Promoting regional coordination (intra-jurisdictional projects/ strategies)

Table 6 - Roadway System Preservation Projects: 2028-2039

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
D	Baltimore City	Druid Park Lake Drive Complete Streets	Greenspring Ave in the northeast to I-83 in the southeast along Druid Hill Park 2.17 miles	Redesign Druid Park Lake Drive to implement guidelines and recommendations in the City's Complete Streets Manual. Reduce automobile traffic by removing travel lanes and adding or improving infrastructure and accessible connections for pedestrians, the handicapped, bicyclists, transit users, and e-scooters.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.)
E	Baltimore City	Keith Avenue / Broening Highway Improvements	Clinton Street to the Baltimore City Line Southeast of Ralls Avenue 2.5 miles	Keith Avenue and Broening Highway are part of Baltimore City's critical freight route network, connecting I-95 and the Seagirt and Dundalk Terminal Port facilities. Improvements are needed to upgrade roadway conditions, improve wayfinding, and integrate complete street amenities to better accommodate safety for transit, pedestrians and bicyclists.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
F	Baltimore City	Russell Street Complete Streets Improvements	Annapolis Road to South Greene & South Paca Streets 1.0 miles	Russell Street (MD 295) in south Baltimore is in need of investments to improve asset conditions and multimodal Complete Streets infrastructure for automobile traffic as well as pedestrian, transit and freight movement. Transportation improvements will support safe mobility and economic development in the city's growing southern edge and Camden Yards.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)
G	Baltimore City	US 40 Highway Deconstruction	Smallwood Street to Greene Street 1.5 miles	US 40 is a depressed expressway built in the 1970s cutting through neighborhoods in West Baltimore. It was intended to connect with I-70, but that connection was never made. Building this fragment of an expressway has caused irreparable damage to community cohesion and economic stability. Deconstructing the highway will offer over 60 acres for redevelopment and improvements to adjacent streets.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
H	Baltimore City	Vietnam Veterans Memorial Bridge and Hanover / Potee Street Corridor Improvements	Patapsco Avenue to Wells Street 2.2 miles	Rehabilitate or replace the Vietnam Veterans Memorial Bridge and improve multimodal Complete Streets infrastructure along the Hanover/Potee Streets (MD 2) corridor in south Baltimore. Transportation improvements will improve accommodations for pedestrians, bicycles, transit, freight, and auto traffic to support safe mobility and economic development.	• TSMO: Intersection control (traffic signal coordination, ramp metering, transit signal priority, etc.) • TSMO: Real-time monitoring (active traffic management, real time parking information, traveler information systems, road weather information systems) • TSMO: Operational improvements (movable barriers, reversible commuter lanes, geometric improvements, shoulder lane use, etc.) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.) • Bicycle/Pedestrian and Micromobility: Infrastructure improvements (traffic calming, etc.) • Roadway changes (new lanes, spot improvements, etc.) • Intersection changes (grade separated intersections, intersection improvements, etc.) • Freight improvements (address freight bottlenecks, rail/port access, truck parking, etc.)
I	MDOT SHA Carroll County	MD 31 Corridor Improvements	MD 31 from Church Street to High Street and High Street from Main Street to Coe Drive 0.67 miles	Improve sidewalks, enhance bicycle and pedestrian accessibility, and improve the roadway.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.)
J	MDOT SHA Carroll County	MD 851 Urban Reconstruction	Cooper Drive to South Branch of the Patapsco River 1.04 miles	Roadway reconstruction and improvements to pedestrian and bicycle facilities, as well as streetscape amenities.	• Bicycle/Pedestrian and Micromobility: Infrastructure addition (new bike lanes, streetscape elements, etc.)

Table 7 - Transit System Preservation Projects: 2040-2050

ID	Operating Agency / Jurisdiction	Name	Limits / Length	Description	Likely Congestion Management Strategies
K	MDOT MTA Regional	Fleet Replacement with Low-Floor Rail Vehicle		Transition to low-floor Light Rail Vehicles when replacement is needed. This will require significant station retrofits, modifying maintenance facilities, and amending standard operating practices.	• Promoting regional coordination (intra-jurisdictional projects/strategies) • Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.)
L	MDOT MTA Regional	Zero Emission Bus Transition Phase 2	MDOT MTA's core service area in the Baltimore region	Transition to a 95% zero-emission fleet by 2045. Capital costs for phase 2 are rough estimates and include retrofitting for Washington Boulevard, a 5th Division, and Battery Electric Buses.	• Promoting regional coordination (intra-jurisdictional projects/strategies) • Public Transportation: New infrastructure (bus rapid transit, network expansion, etc.)
M	MDOT MTA Regional	MARC Rolling Stock Overhauls and Replacements	All three MARC lines (Penn, Camden, Brunswick)	Short-term, medium-term, and long-term plans to replace and overhaul MARC locomotives and train sets, including: • GP39H-2 Locomotive Mid-Life Overhaul • MP36PH-3C Mid-Life Overhaul • MARC III and MARC IV Railcar Overhaul • Railcar Fleet Replacement • Locomotive Fleet Replacement	• Public Transportation: Operational improvements (transit signal priority, optimizing transit service, etc.) • Public Transportation: User-oriented improvements (trip-planner application, real-time data, universal farecards, etc.)

Establishing Implementation Schedules / Identifying Possible Funding Sources

This appendix mentions MDOT's TSMO activities. MDOT's TSMO program provides funding for specific projects focused on management and operational approaches. In addition, the preceding tables showing preferred alternative projects and the periods in which they might be implemented can be the basis for additional planning. TIP projects, which have specific implementation schedules and committed funding, flow from the projects and programs identified in the LRTP. Some of these TIP projects focus on mitigating traffic congestion.

7. Evaluating Effectiveness of CMP Strategies

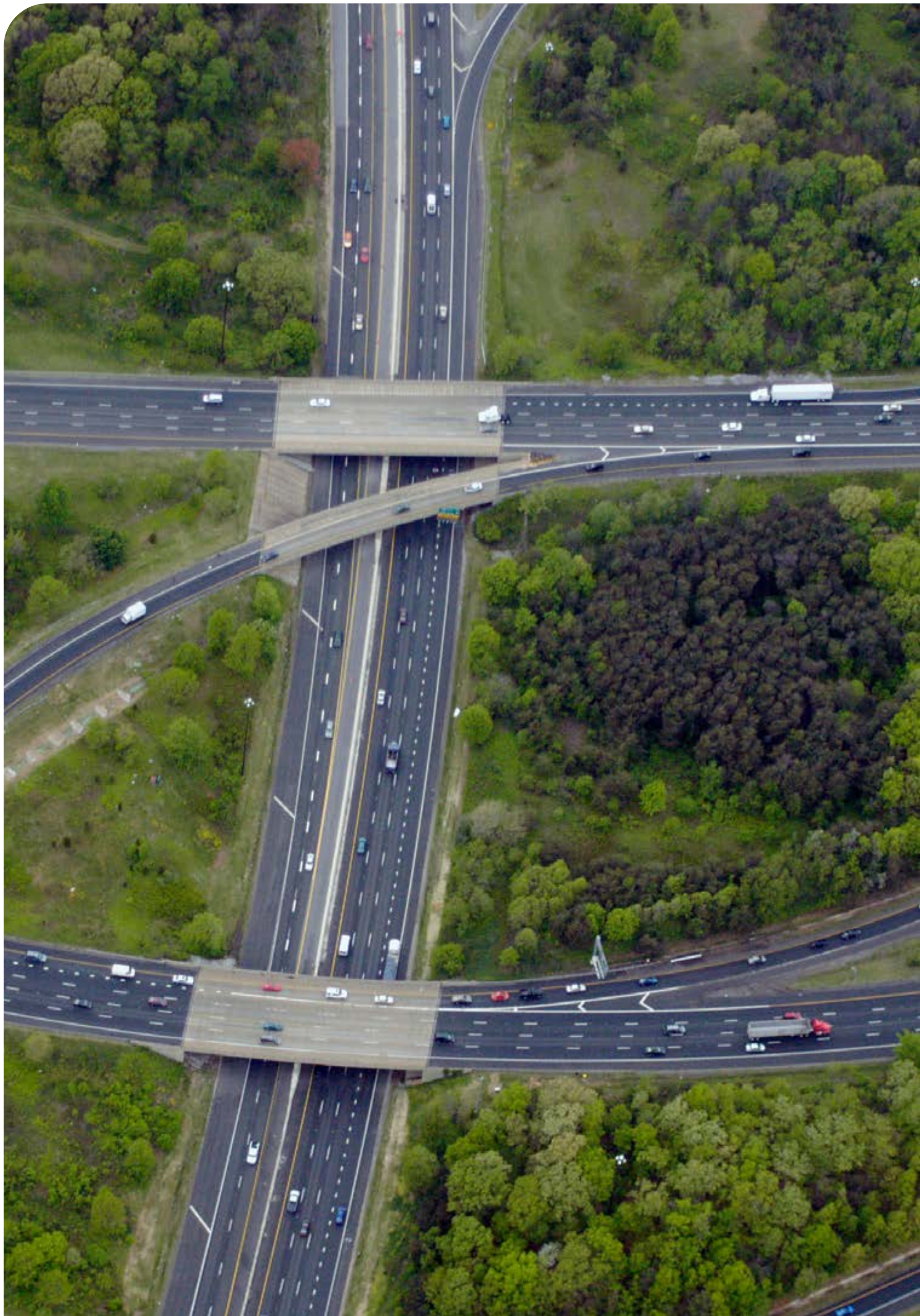
The final step in the CMP is to evaluate the effectiveness of implemented CMP strategies. The assessment of strategies (projects, programs, services, etc.) occurs earlier in the process. At that point, the assessment focuses on identifying viable strategies and analyzing likely benefits to help prioritize and select strategies to address congestion and mobility needs. In this final step, the evaluation focuses on quantifying the impacts of implemented strategies in order to understand their actual effectiveness and/or cost-effectiveness.

Evaluating post-implementation benefits provides a feedback loop to help ensure that information on the effectiveness of strategies informs future strategy selection and implementation. Strong findings of effectiveness from implemented strategies can encourage their further implementation, while weak effectiveness may suggest using alternative solutions. In addition, findings from post-implementation studies can help to identify the characteristics of a corridor or situation under which certain strategies are most effective. Finally, results will be useful for communicating with the public and decision-makers about the benefits of strategies such as demand management and operational improvements, where projects/programs are often not as readily visible to the public.

As noted in the discussions under steps 4 and 5, data from the PDA Suite and analyses using the PDA Suite, our CMP Analysis Tool and other data provide information on congestion problem areas. The ongoing program provides us and other planners with feedback on the performance of the highway system and provides insight for future decisions.

In addition, the IIJA performance measures and targets aimed at mitigating congestion and improving travel time reliability will provide us and our partners with a systematic, coordinated approach to monitoring progress and guiding investment decisions. The CMP Committee meetings can be used as platforms for the local agencies to share information on evaluation practices and findings with other local stakeholders. Coordination with state and local agencies that helps to illuminate the findings will be valuable to support future strategy choices.

Local agencies can share information on evaluation practices and findings at CMP Committee meetings.



Appendix E

Public Outreach and Engagement

Sample Print Ad

Full public outreach and engagement materials, including all comments and responses, will be added after the comment period closes.