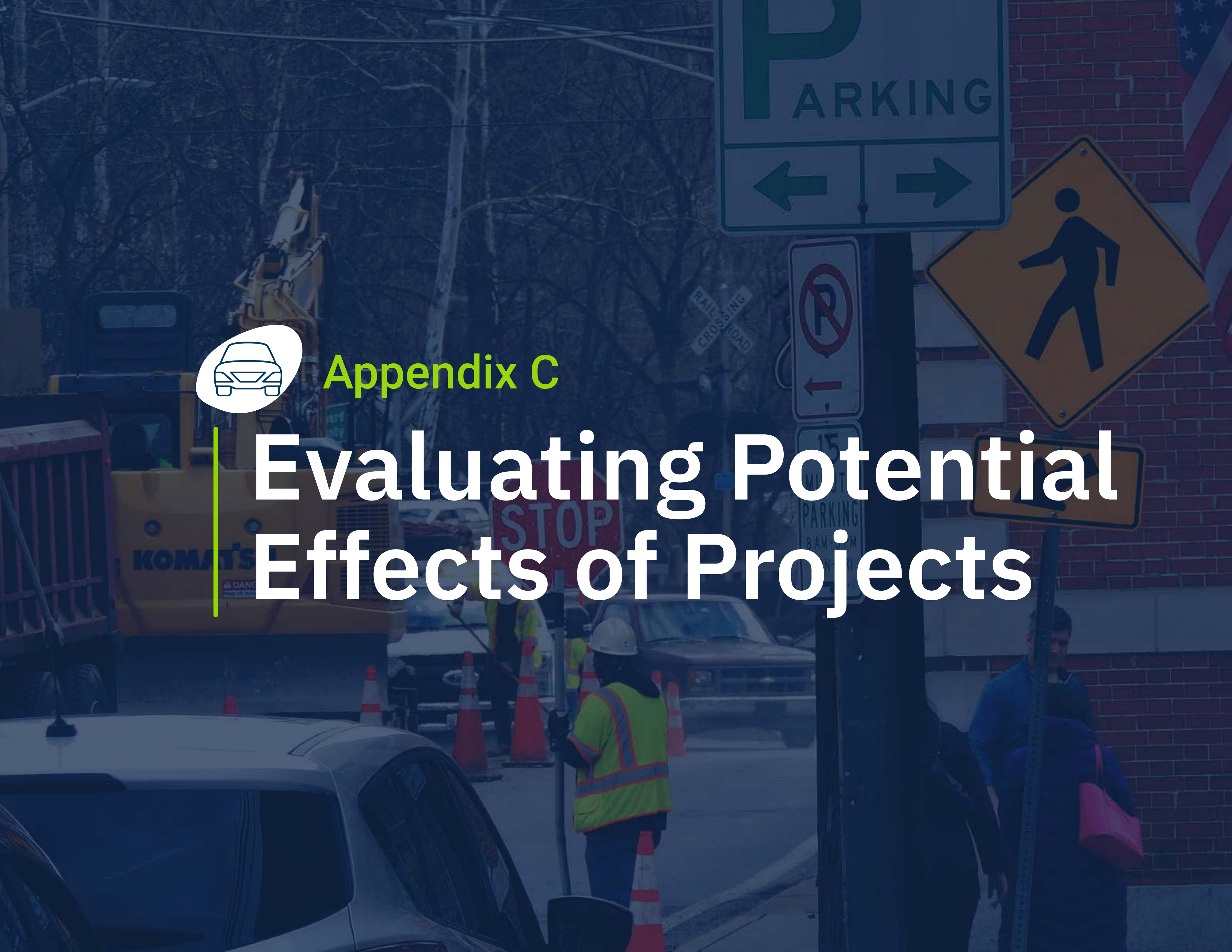


Appendix C

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
Average Summer Weekday 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**
Average Summer Weekday 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**
Average Summer Weekday 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, known as *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 as any complete round trip such as traveling from home to work, to the grocery store and back home again. Each segment is counted as a trip. 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 schools, 4) meal, 5) shop, 6) personal business, 7) social/recreation, 8) escort, and 9) 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 TIP 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.

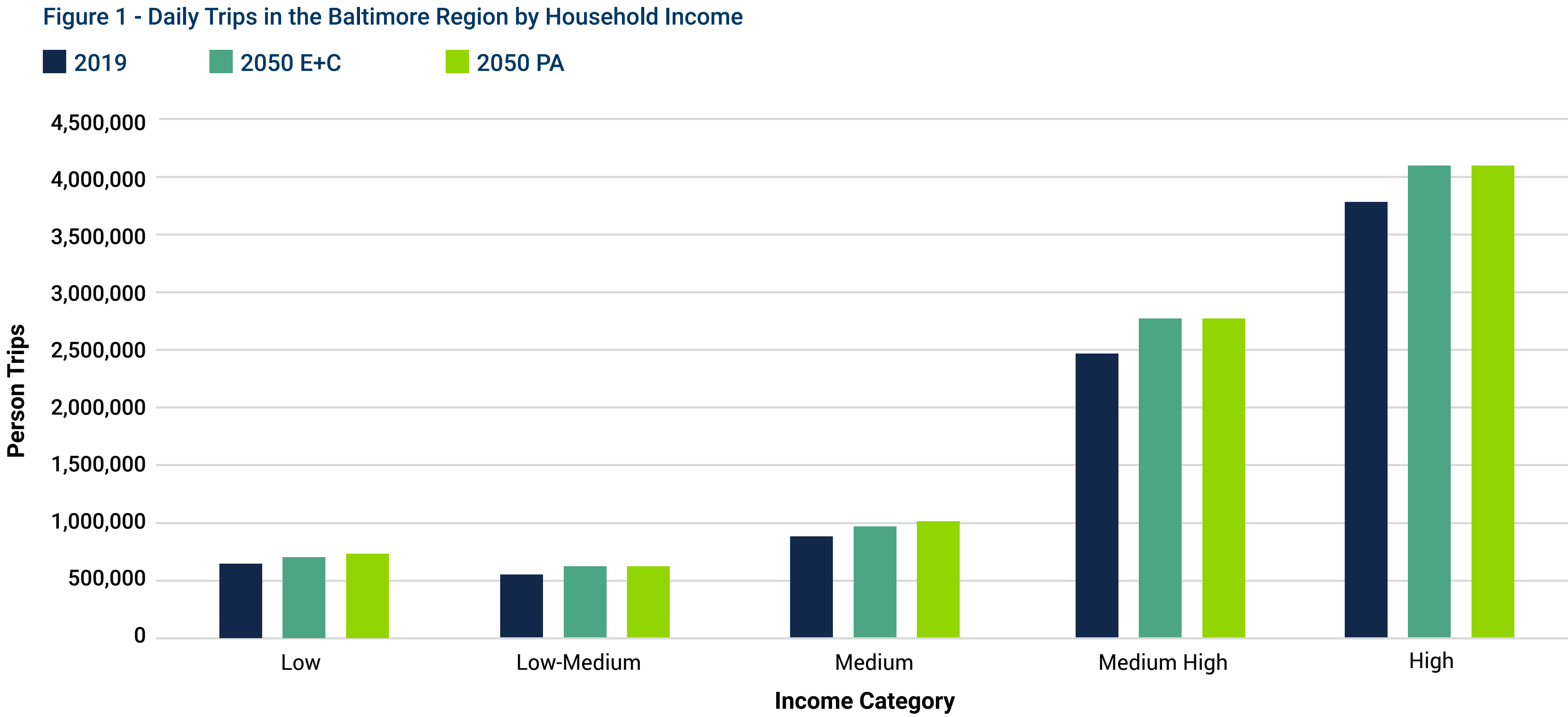


Figure 1 - Daily Trips in the Baltimore Region by Household Income
2019
2050 E+C
2050 PA
4,500,000
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
Person Trips
Low
Low-Medium
Medium
Medium High
High
Income Category

Figure 2 - Daily Trips in the Baltimore Region by Travel Mode

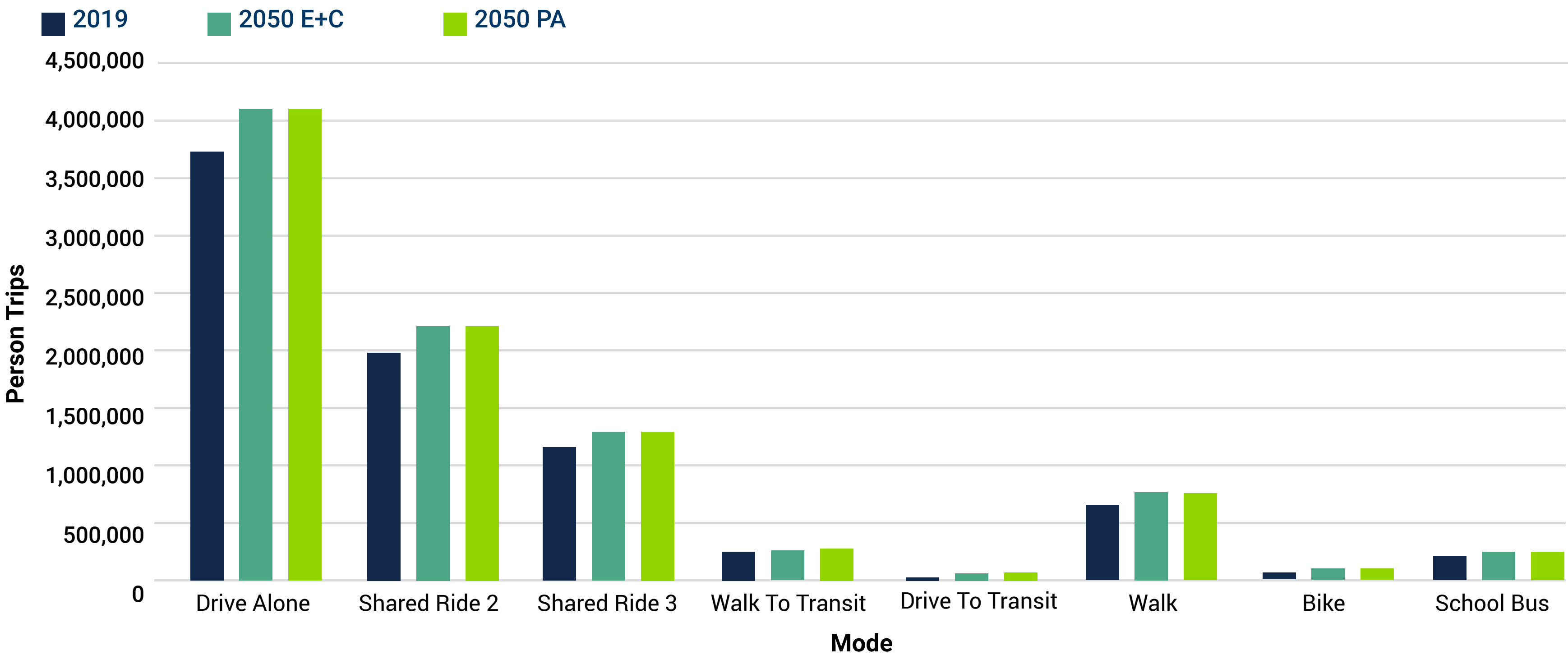
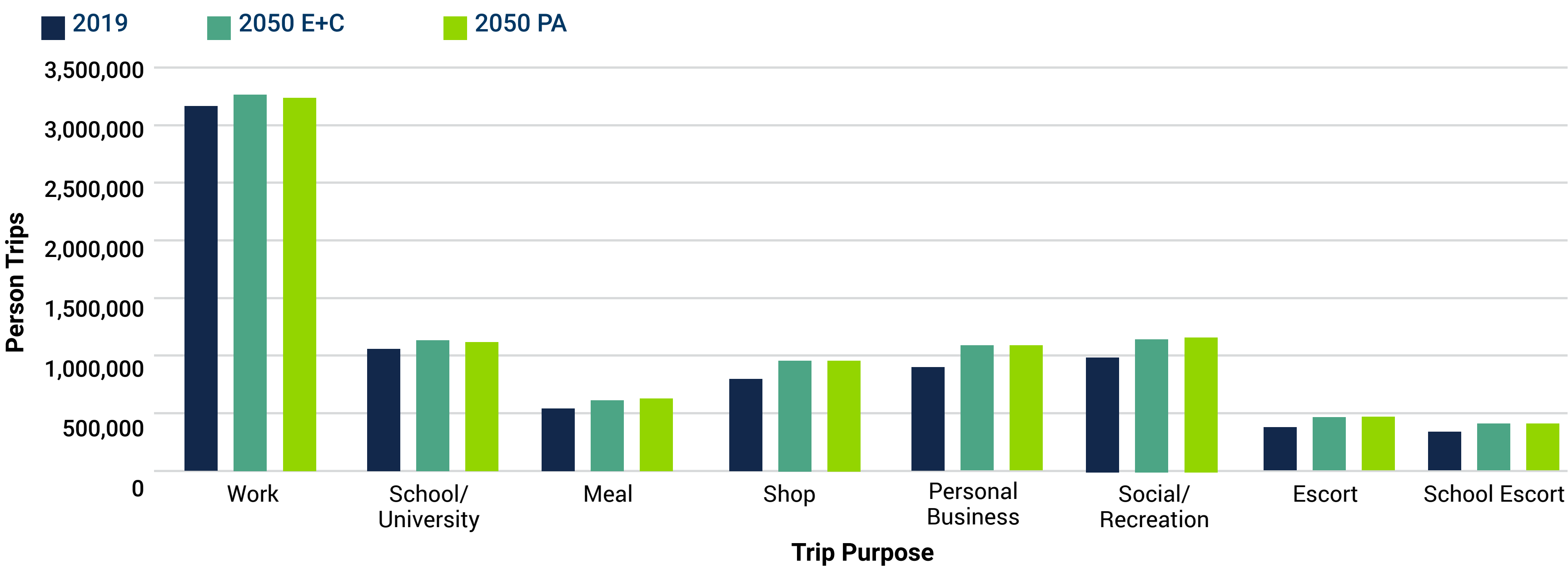
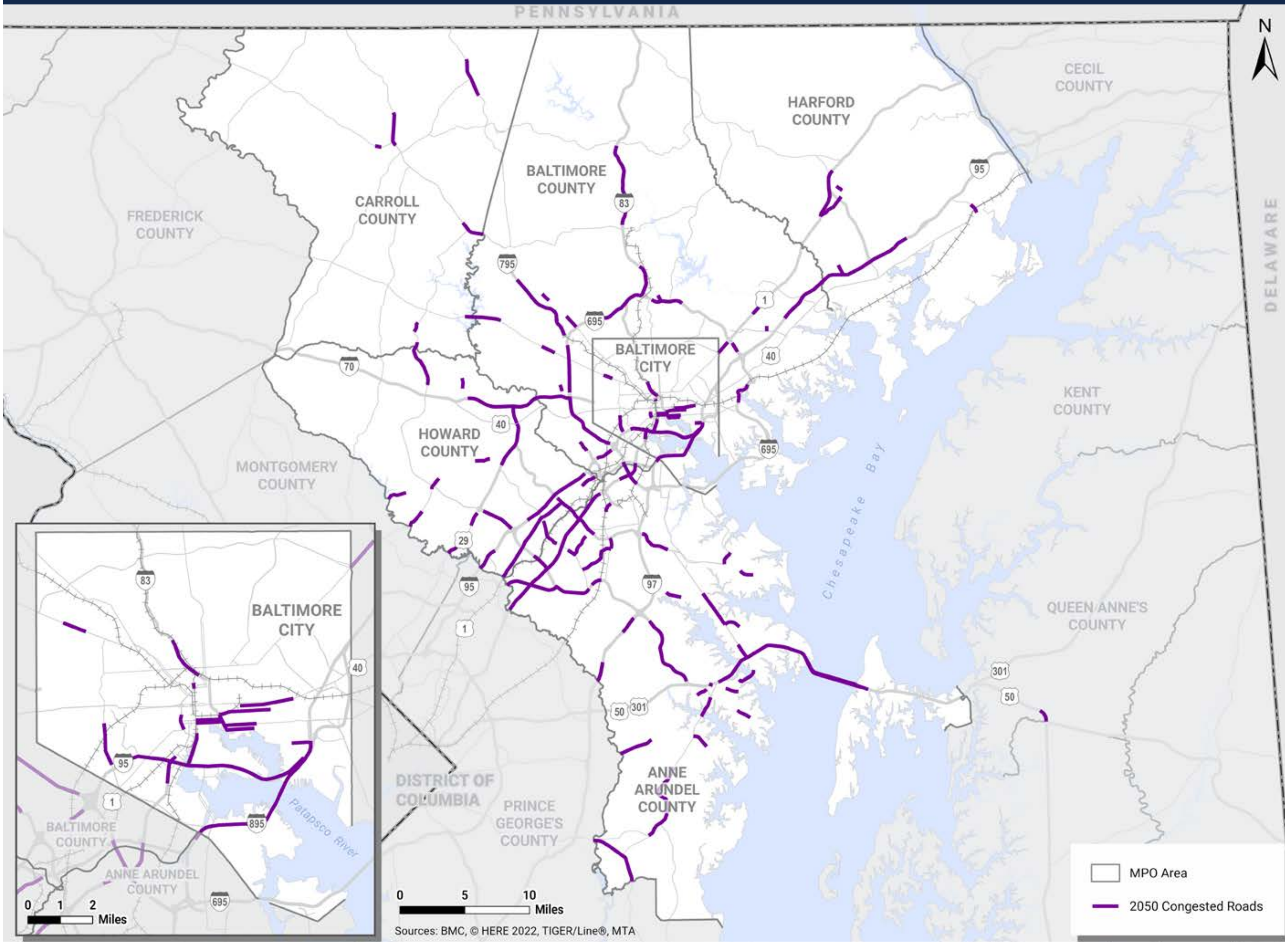


Figure 3 - Daily Trips in the Baltimore by Trip Purpose



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

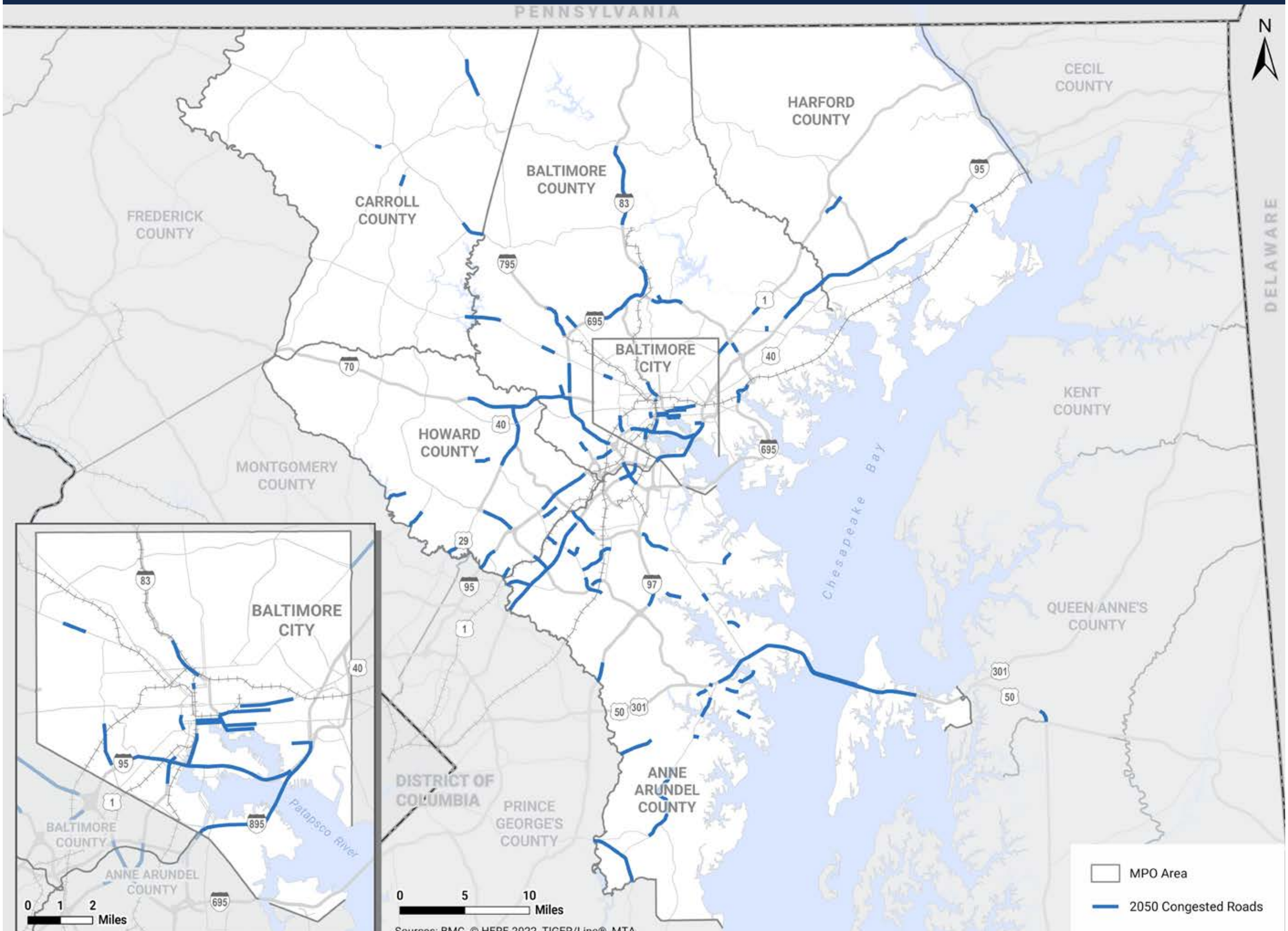


Table 2 quantifies congestion and other performance measures for the 2019, 2050 E+C and 2050 PA scenarios. The final two columns show percentage change between scenarios for each measure. The second to last column shows the percentage change between the 2019 baseline and 2050 E+C scenarios. This represents 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 highlight indicates improving conditions (such as less congested roadways).

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%.

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%

- 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 the 2050 E+C scenario 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).

Comparing the 2050 E+C scenario to the 2050 PA scenario isolates the potential impact of implementing the projects in *Resilience 2050* while holding demographic variables constant

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 the Census Bureau's American Community Service (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 family and to about $60,000 for a four-person family. 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 DOT order applies to all policies, programs and other activities undertaken, funded or approved by the DOT, including metropolitan planning. There are three fundamental DOT EJ 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 ACS is the primary data source on low-income populations. The Census Bureau uses a set of income thresholds that vary by family size and number of children to determine poverty (and 200% of the poverty level). If a family's total income is less than the threshold for 200% of the poverty level, then that family 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 the low-income population in the Baltimore region by jurisdiction. The population below 200% of the poverty level is 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 has an income below 200% of the poverty level.

Table 3 - Low-Income Population by Jurisdiction

Jurisdiction	Total Population*	Low-Income 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%.

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)

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)

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 low-income population below 200% of the poverty level in the Baltimore region is 21.4%. Thus, TAZs with a concentration of low-income population greater than 21.4% are considered low-income TAZs for EJ purposes. Similarly, TAZs with a concentration of minority persons greater than 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 Baltimore 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 low-income population 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 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 live in TAZs identified as EJ, with the remaining 20.7% of the low-income population living in non-EJ TAZs.

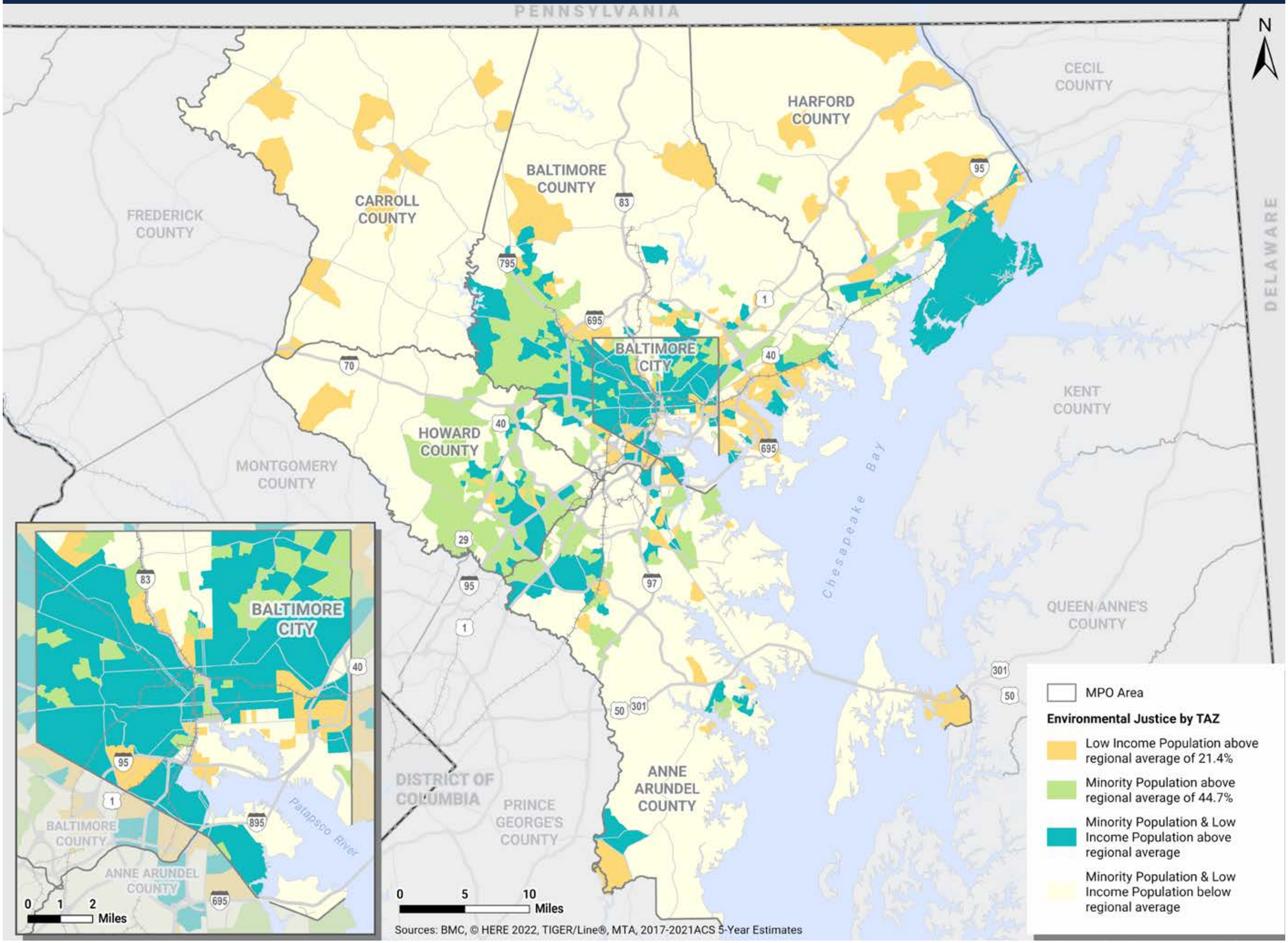
Scenarios and Measures Used in the EJ Analysis

As noted previously, TAZs are the base geographic unit for the InSITE model. In addition to TAZs, the InSITE model requires

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



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 jurisdictions 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 sourced from the U.S. Department of Homeland Security (DHS).
- **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 U.S. Department of Agriculture.

- **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. This measure uses the same hospital location data as the average travel time measure.
- **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. 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 for each measure. 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).

Average Number of Jobs Accessible

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

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%

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%

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%.

Average Number of Shopping Opportunities Accessible

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.

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%

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 those 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.

Average Commute Time

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 or scenario. Transit commute times are nearly three times longer in EJ TAZs and more than two times longer in non-EJ TAZs. However, the implementation of transit projects in *Resilience 2050* decreases average transit commute times in all TAZs. Average transit commute times decrease by 3.9% and 4.3% in EJ and non-EJ TAZs, respectively.

Average Travel Time for Shopping Purposes

The results for shopping travel times are similar to commute time trends. Average travel times for shopping purposes by auto are approximately 16% 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

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%

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%

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.

Average Travel Time to Closest Hospital

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%.

Similar to 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%

Percent of Population Close to a Supermarket

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 by transit improves across the board for EJ

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%

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%.

Percent of Population Close to a Hospital

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 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%.

Percent of Population Close to a College or University

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 of the population close to a college or university 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 values in the 2050 E+C scenario. 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.

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%

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 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. Percent decreases in transit travel times for commuting and shopping are slightly larger in non-EJ TAZs as compared to EJ TAZs, though transit travel times for non-EJ TAZs have more room to decrease as they are longer in the 2050 E+C scenario. 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 and 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 or 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).

EJ TAZs see higher percentages in close proximity to these destinations by transit as compared to non-EJ TAZs for both scenarios. As with other measures, proximity to these important destinations by transit is significantly less than that for auto. However, implementation of the preferred alternative yields larger increases in the percentage of the population close to supermarkets, hospitals and colleges and 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 overall for the supermarket proximity measure by transit, while non-EJ TAZs see slightly larger percent increases for the hospital and higher education measures by transit.

Several other trends are worth noting:

- Auto access and mobility are uniformly better than that for transit across both scenarios. This holds for both EJ and non-EJ TAZs. For example, workers in EJ TAZs can access 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 2050 E+C and 2050 PA results for auto measures are better than those for transit, transit accessibility and

mobility measures see significantly larger percent 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 nearly 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 in the 2050 E+C scenario 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 of 23.6% and 26.9% in the average number of jobs accessible by transit for EJ and non-EJ TAZs, respectively. This equates to nearly 44,000 more jobs accessible by transit for workers in EJ TAZs compared to nearly 20,000 more jobs accessible by transit for workers in 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%
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%

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 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%
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.

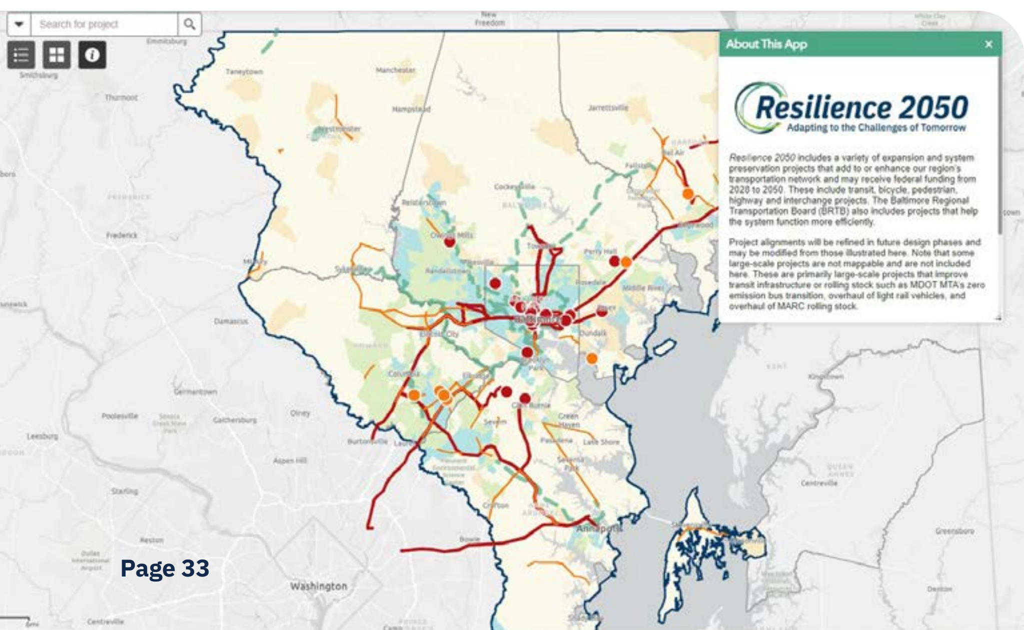
Through these comparisons, and ongoing conversations with resource and regulatory agencies, this environmental consultation process creates the opportunity to bring issues to light in advance of project planning. Analysis of natural and historic resources becomes very detailed at the short-range project 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:

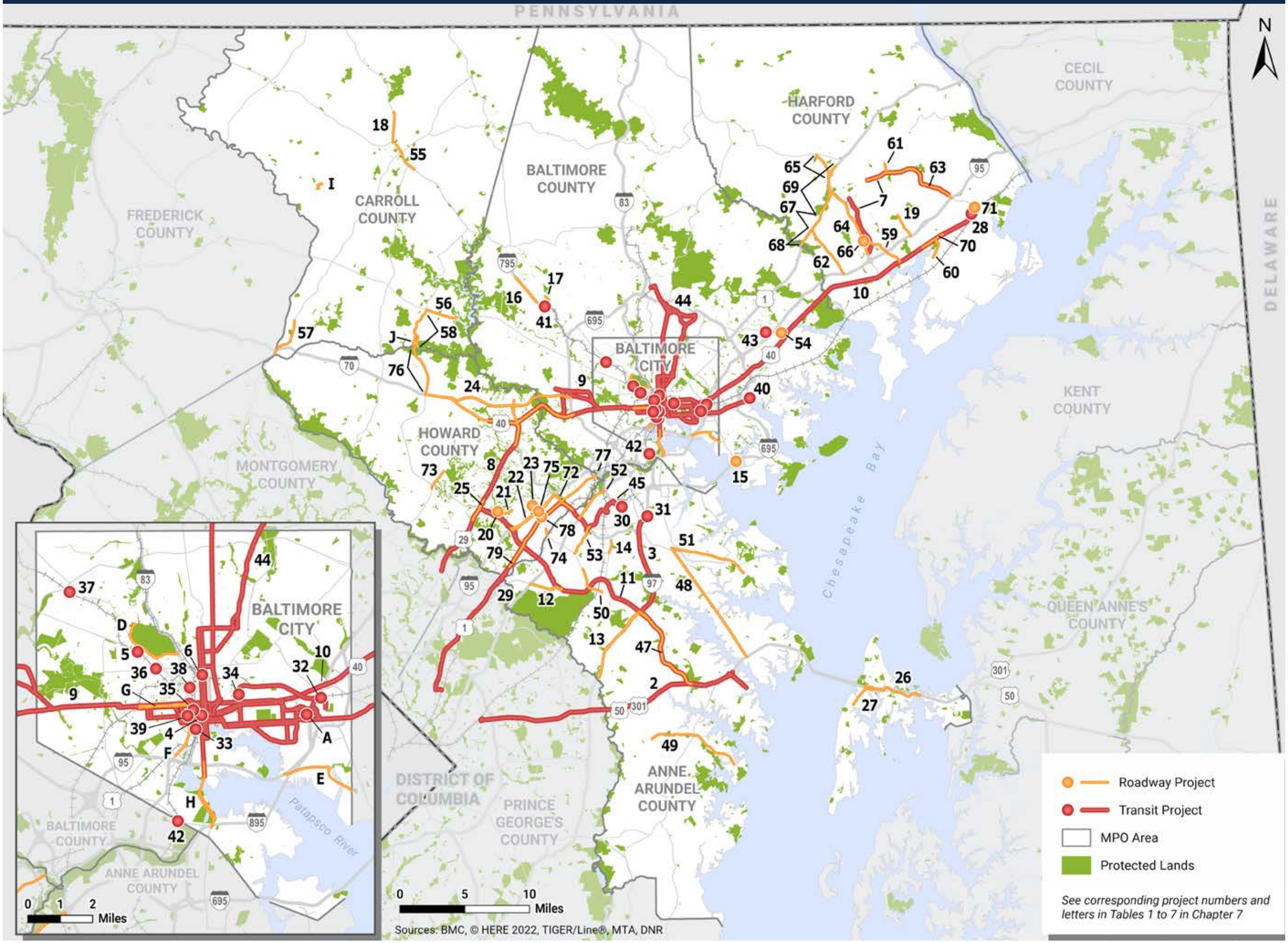
- Map 4 - Protected Lands (protected local lands, protected federal lands, and Maryland Department of Natural Resources (DNR) owned properties and conservation easements)
- Map 5 - Green Infrastructure Corridors and Hubs
- Map 6 - Chesapeake Bay Critical Area
- Map 7 - Nutrient and/or Sediment Impaired 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:

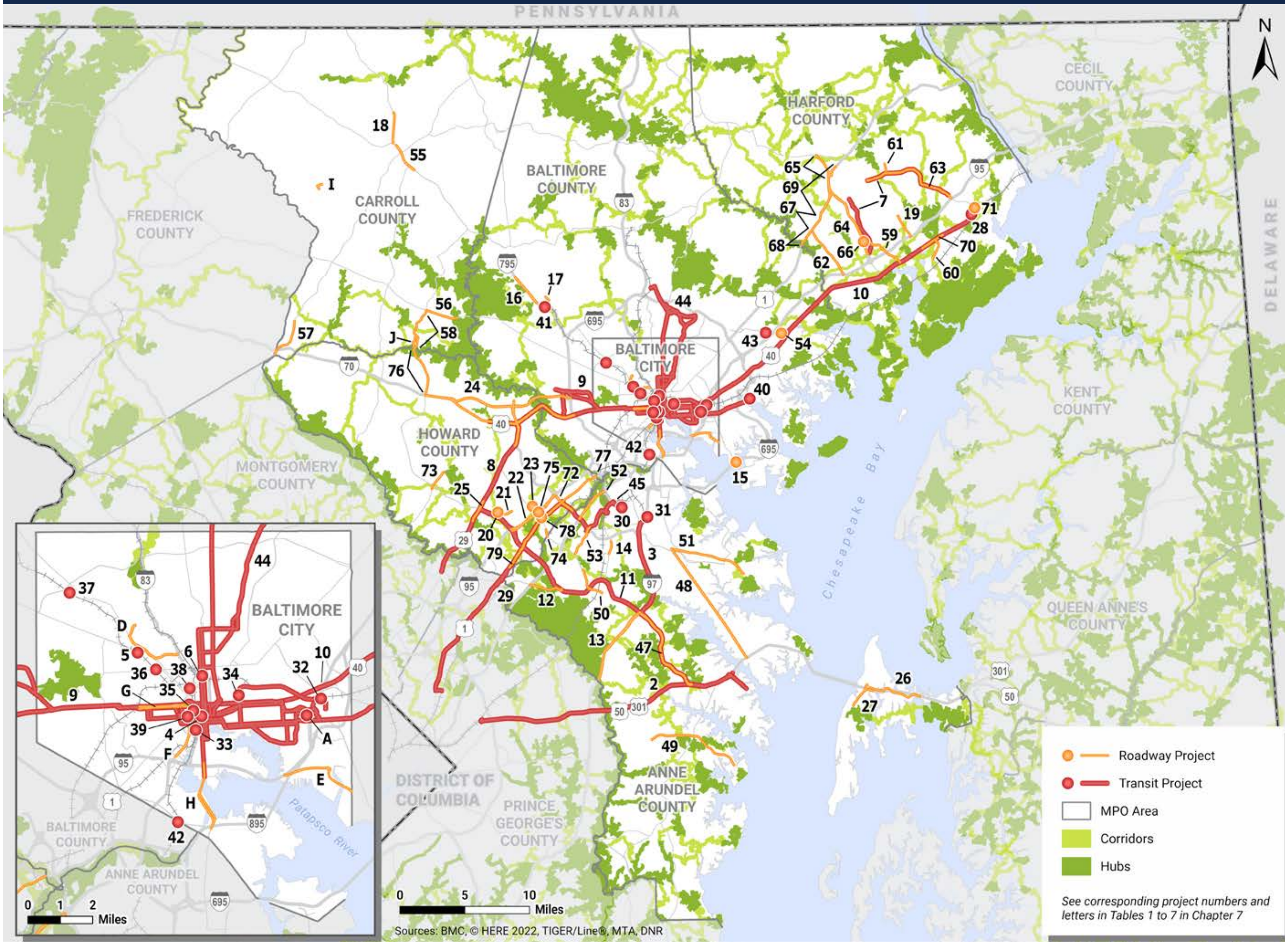
- Maryland Dams Inventory
- Maryland DNR Coldwater Trout Watersheds
- EJ TAZs



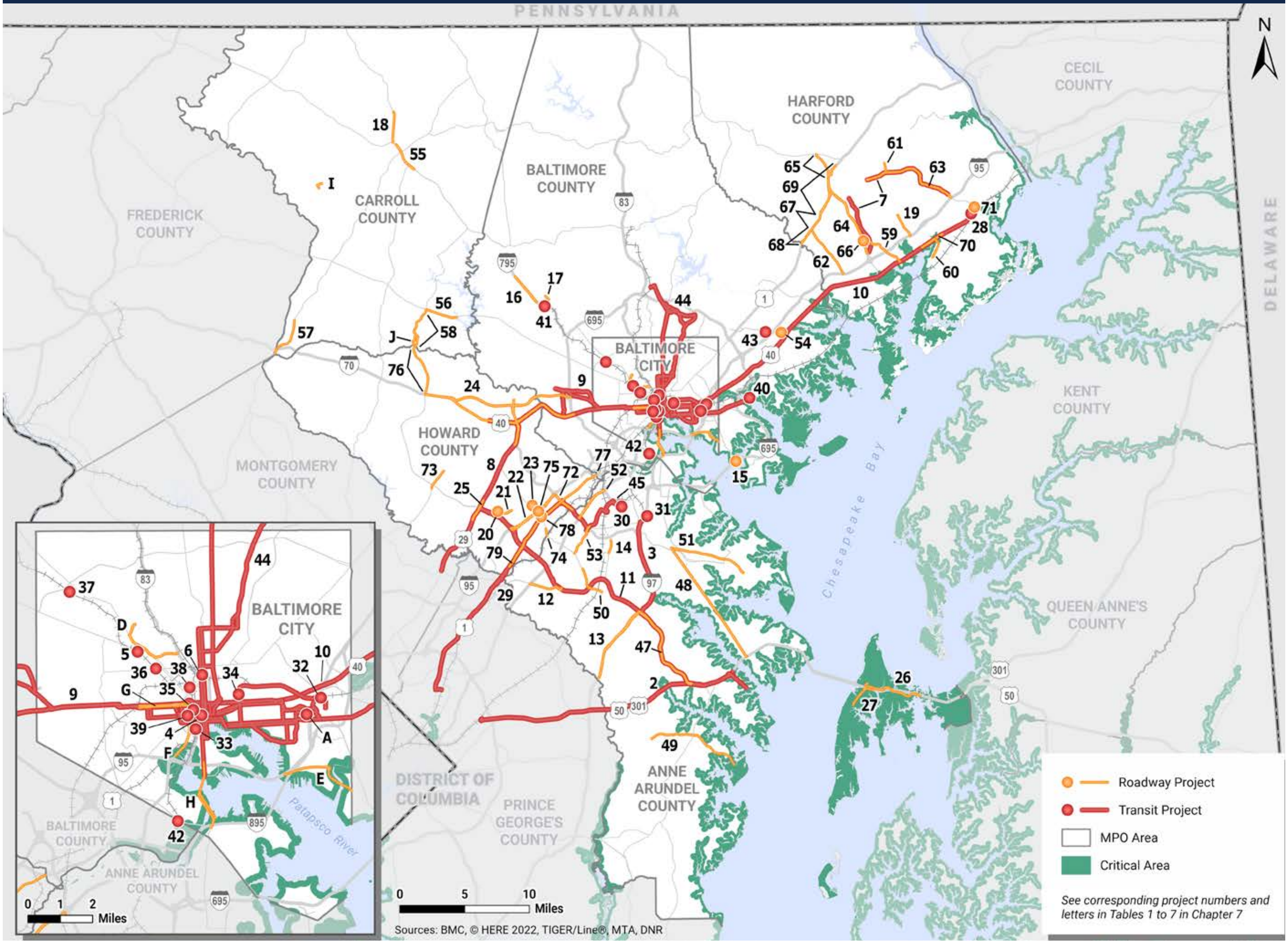
Map 4 – Protected Lands



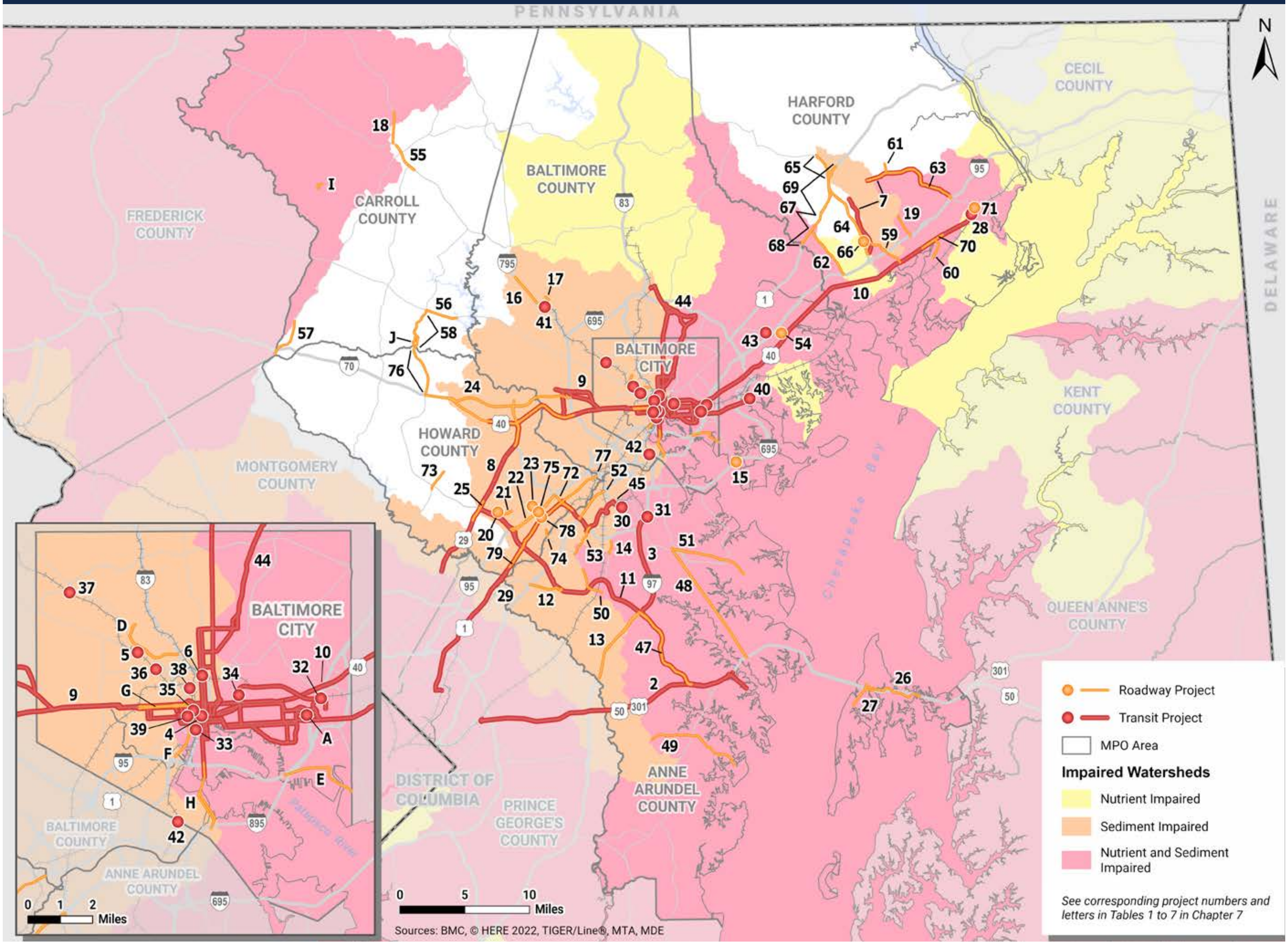
Map 5 - Green Infrastructure Corridors and Hubs



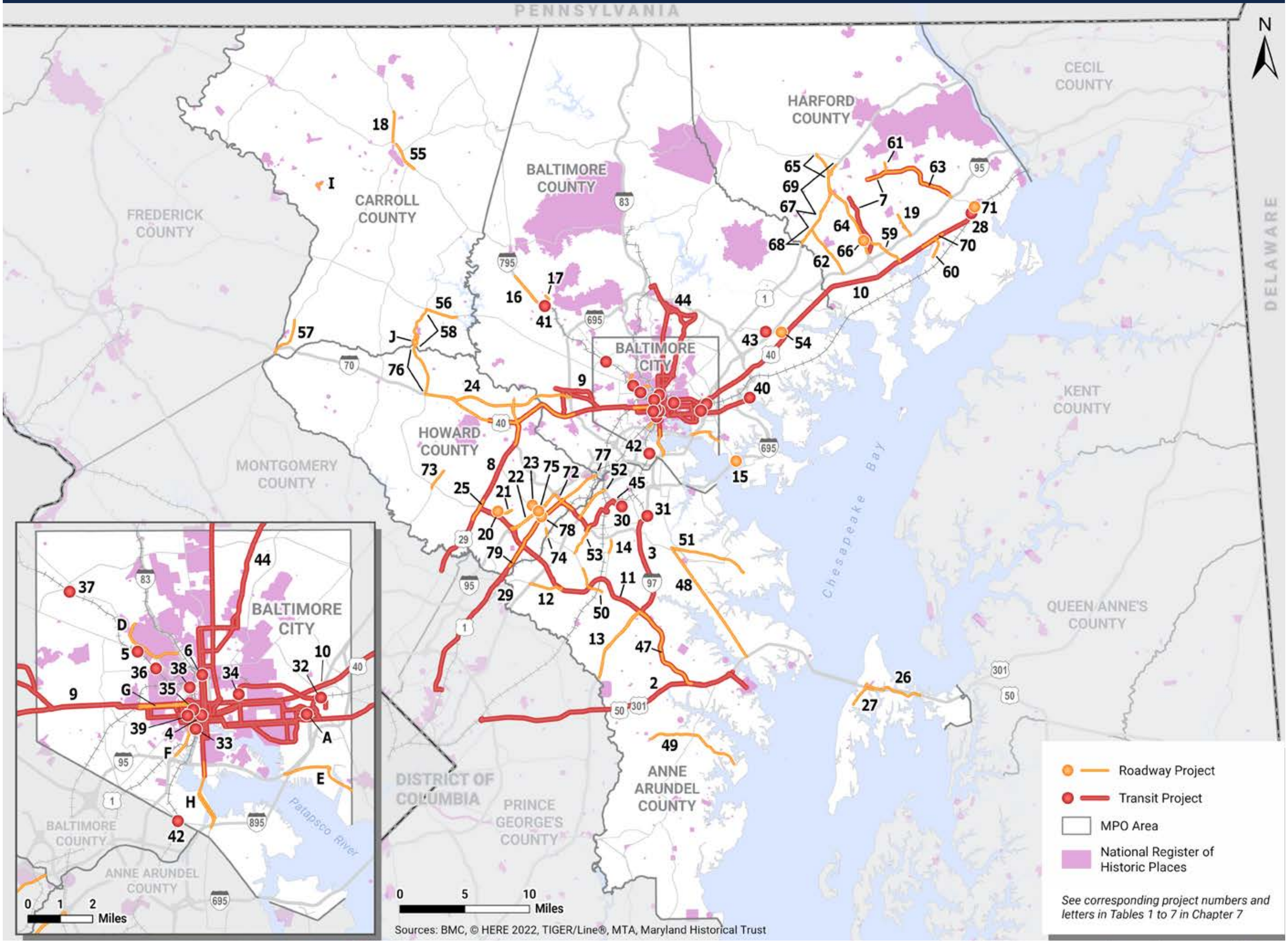
Map 6 - Chesapeake Bay Critical Area



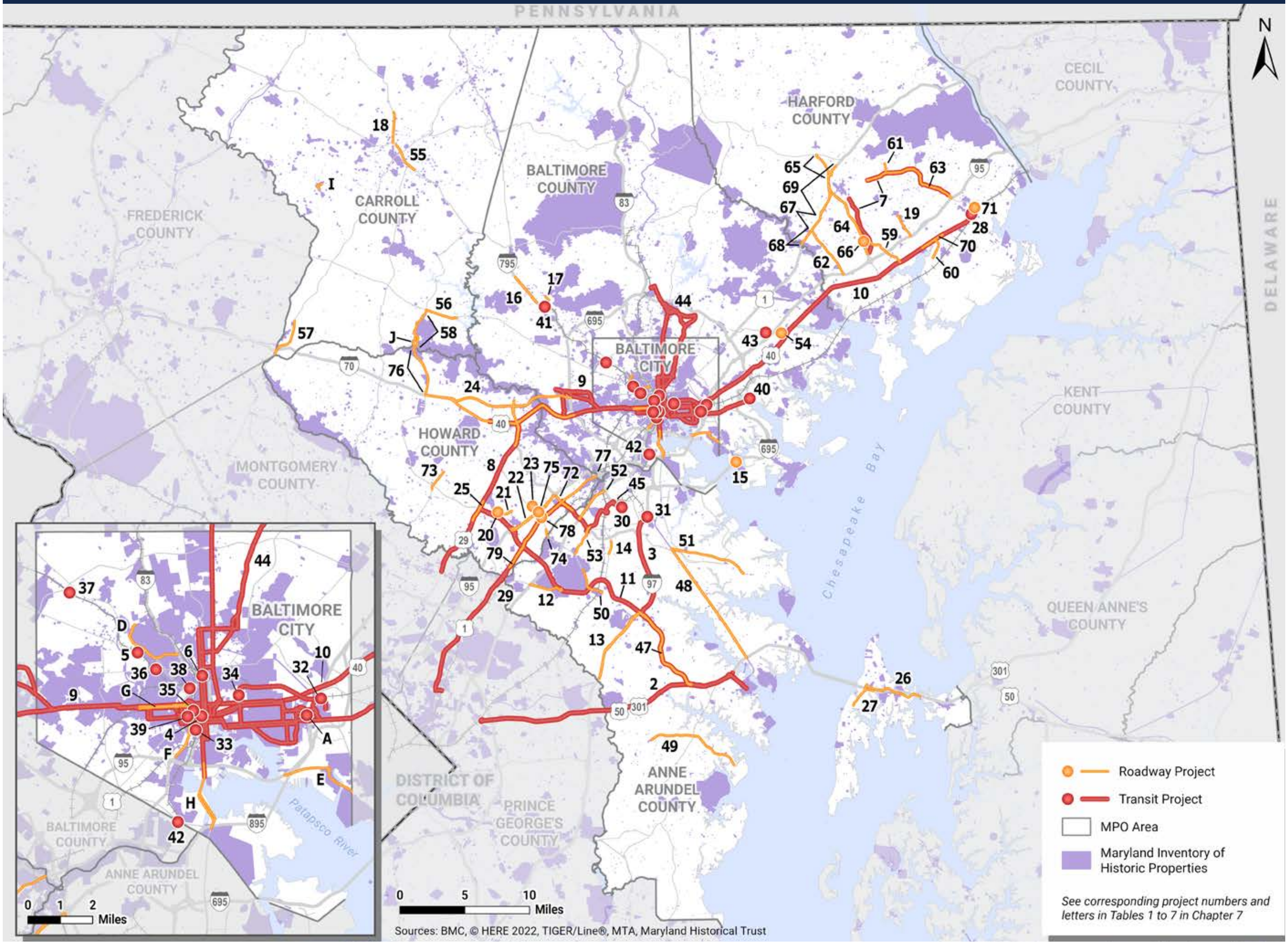
Map 7 - Nutrient and/or Sediment Impaired Watersheds



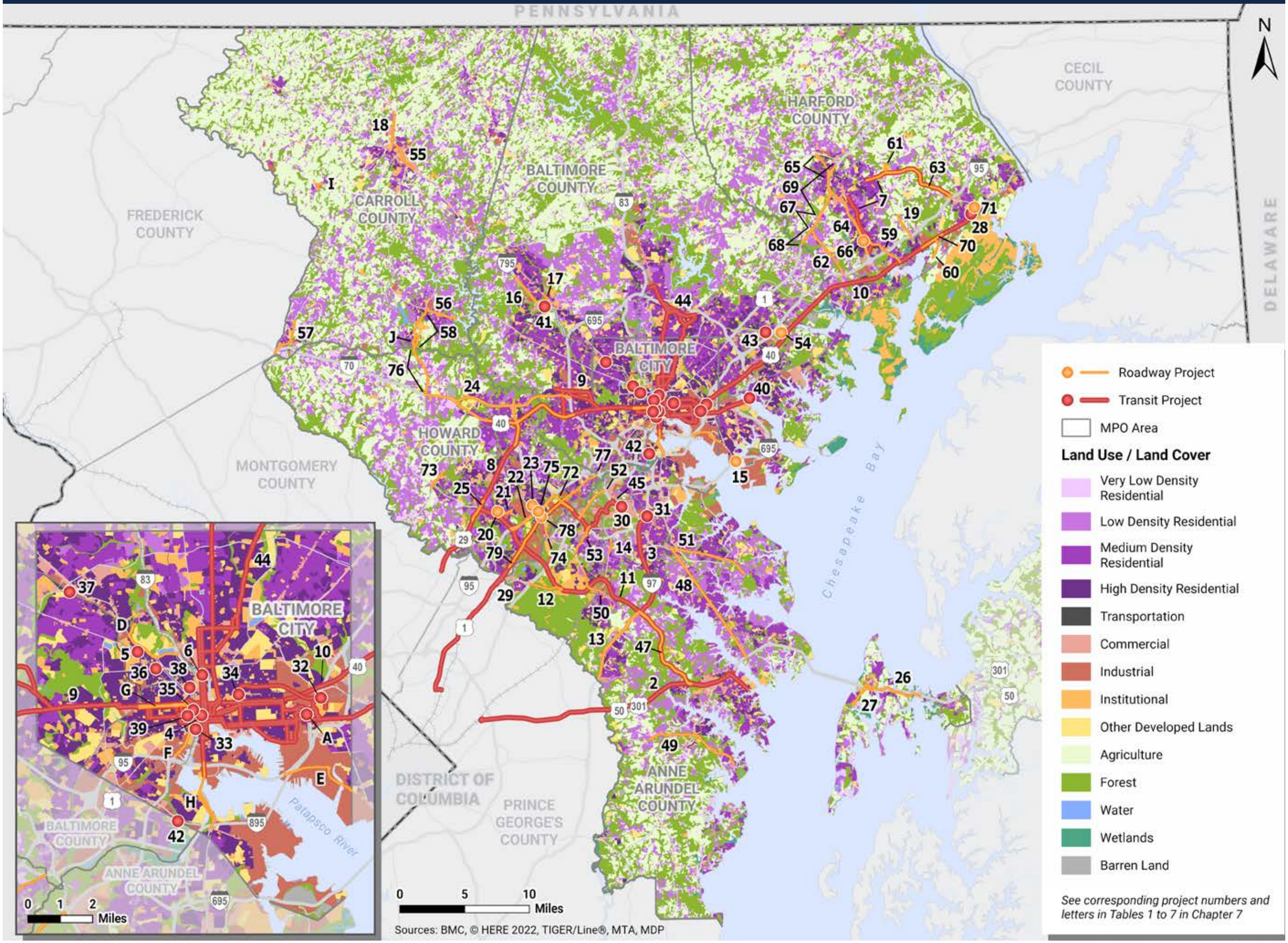
Map 8 - National Register of Historic Places



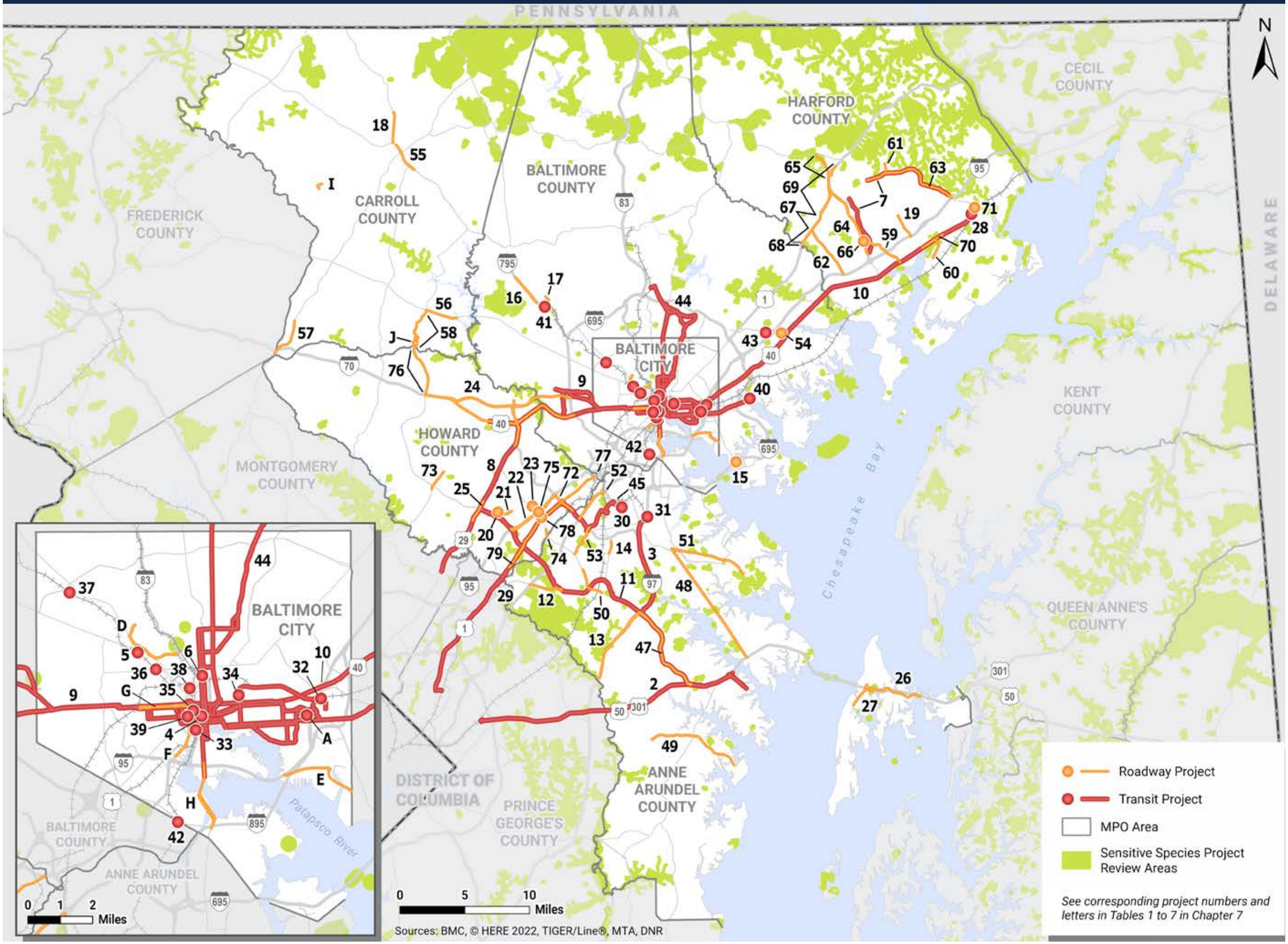
Map 9 - Maryland Inventory of Historic Properties



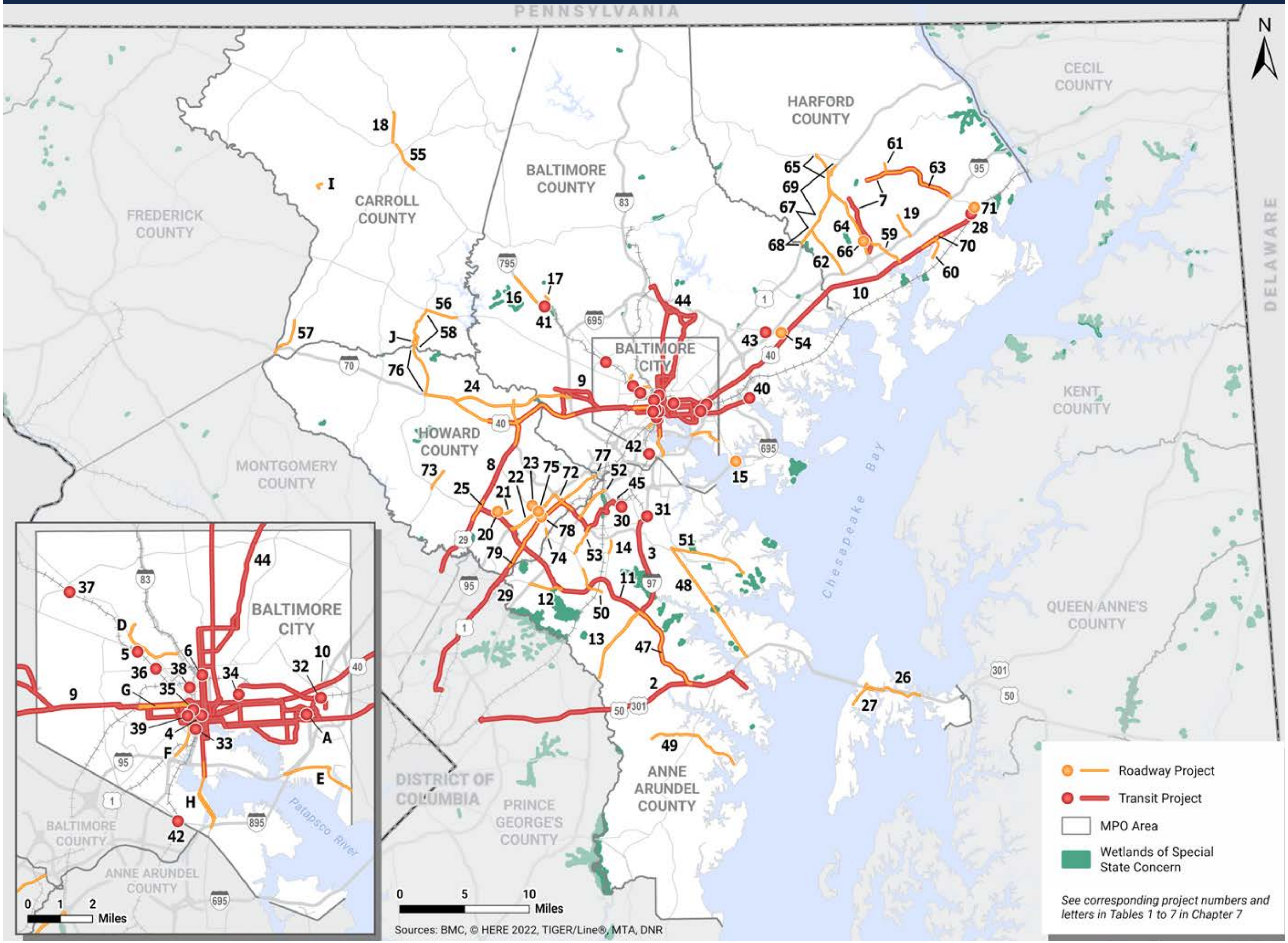
Map 10 - Maryland Department of Planning Land Use / Land Cover Data



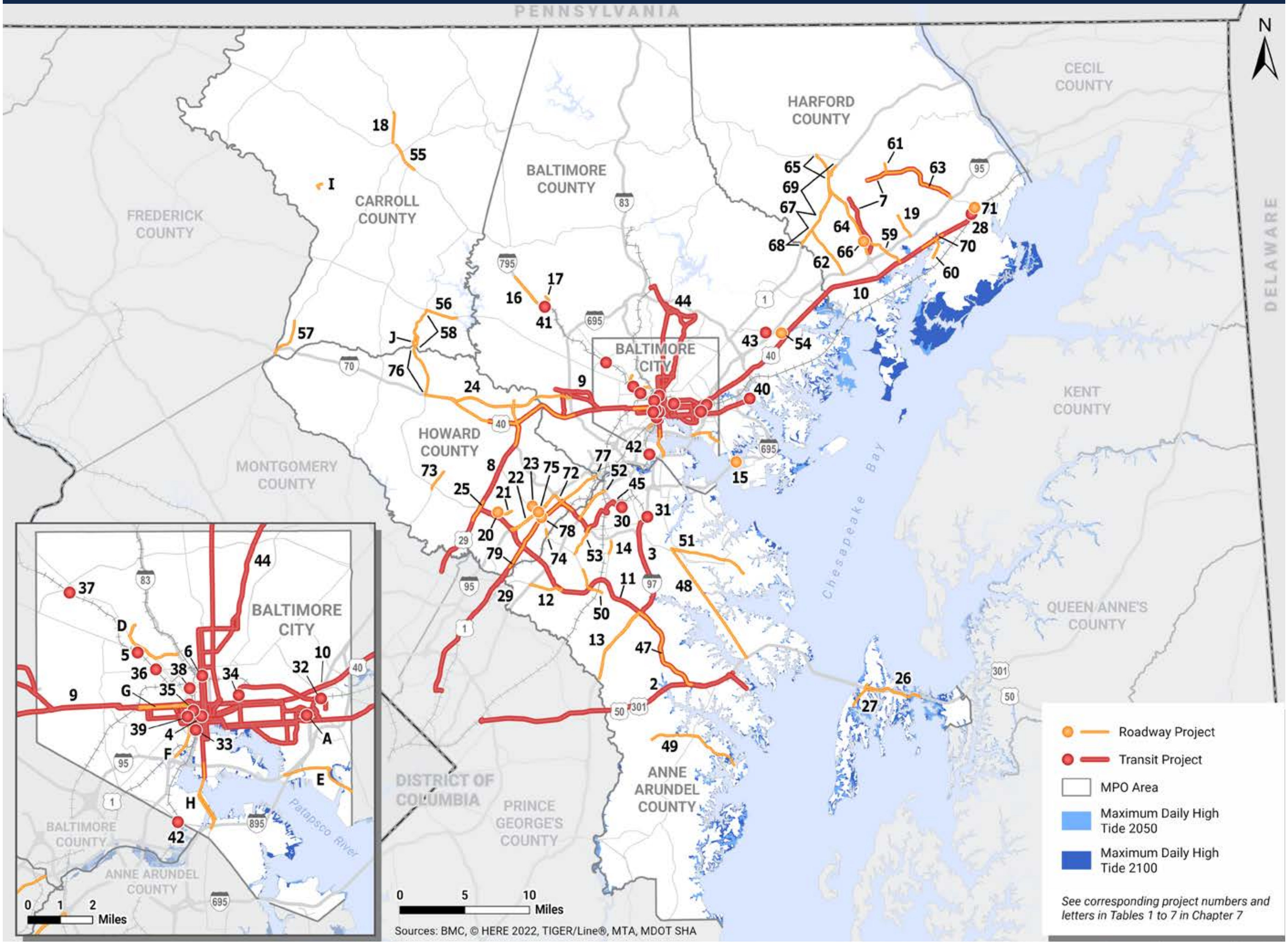
Map 11 - Sensitive Species Project Review Areas



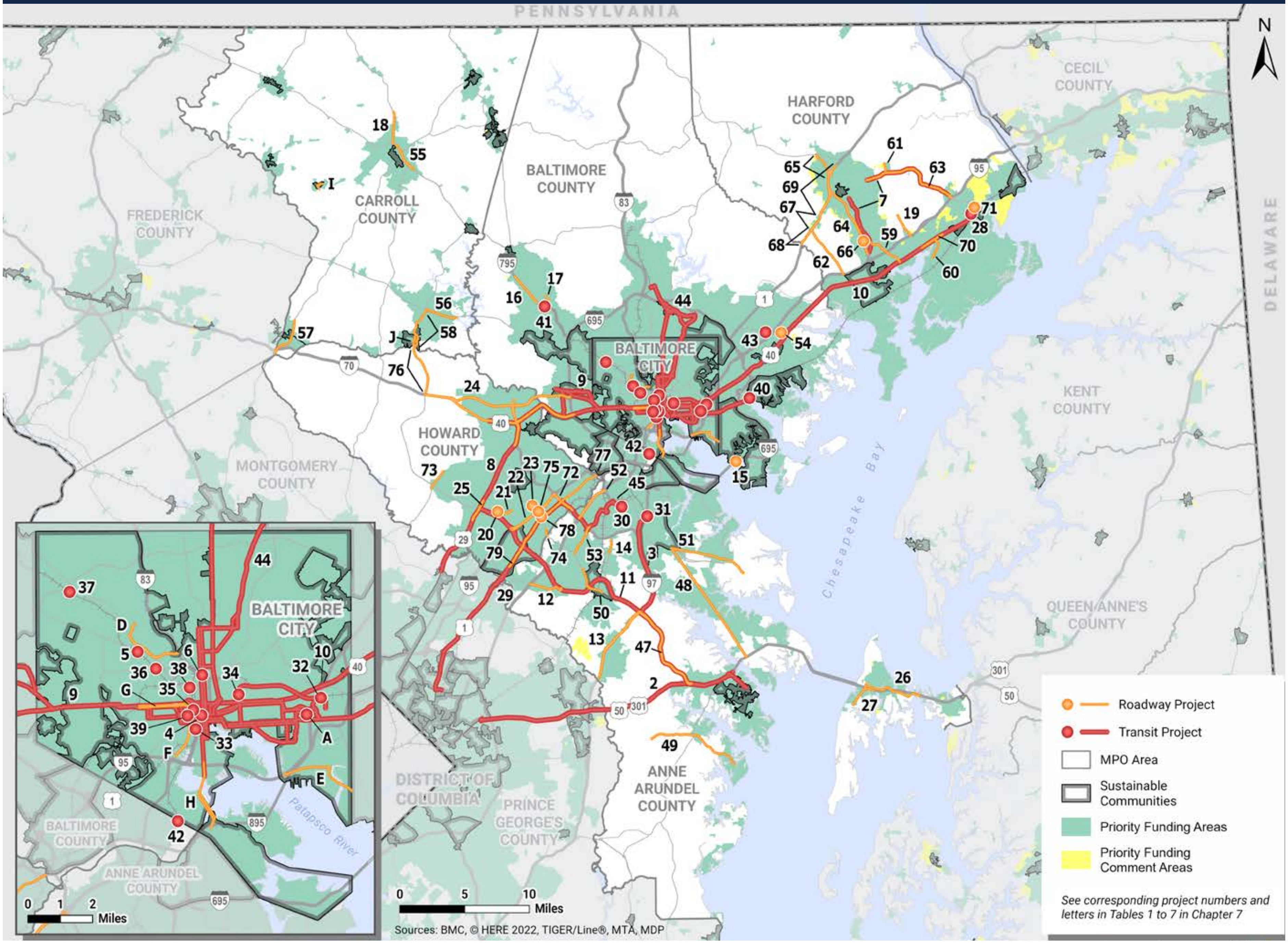
Map 12 - Wetlands of Special State Concern



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.

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

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

Resource	Examples of Mitigation Measures	Regulation
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
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; Code of Maryland Regulations (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

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:

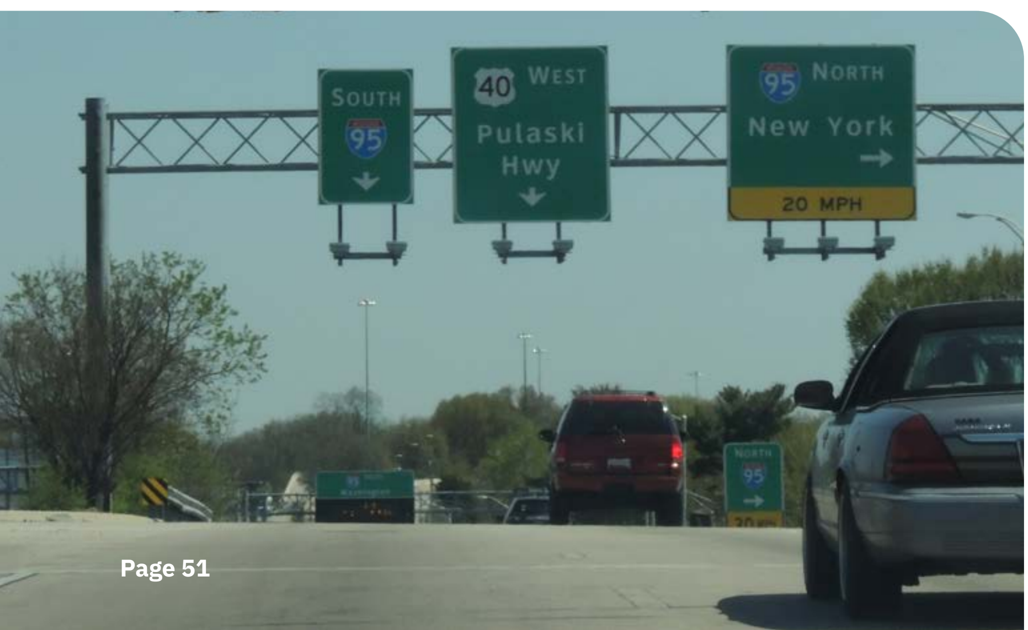
- design refinement to ensure avoidance of impacts where possible,
- sensitivity and compatibility with historic contexts,
- the recovery of significant information through the excavation of archaeological sites,
- Historic American Buildings Survey (HABS) and Historical American Engineering Record (HAER) 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 serves as the STRAHNET connector. For Aberdeen Proving Ground, I-95 is also the primary STRAHNET link with MD 22 serving as the connector.

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.

Map 15 – Maryland STRAHNET and DOD Facilities

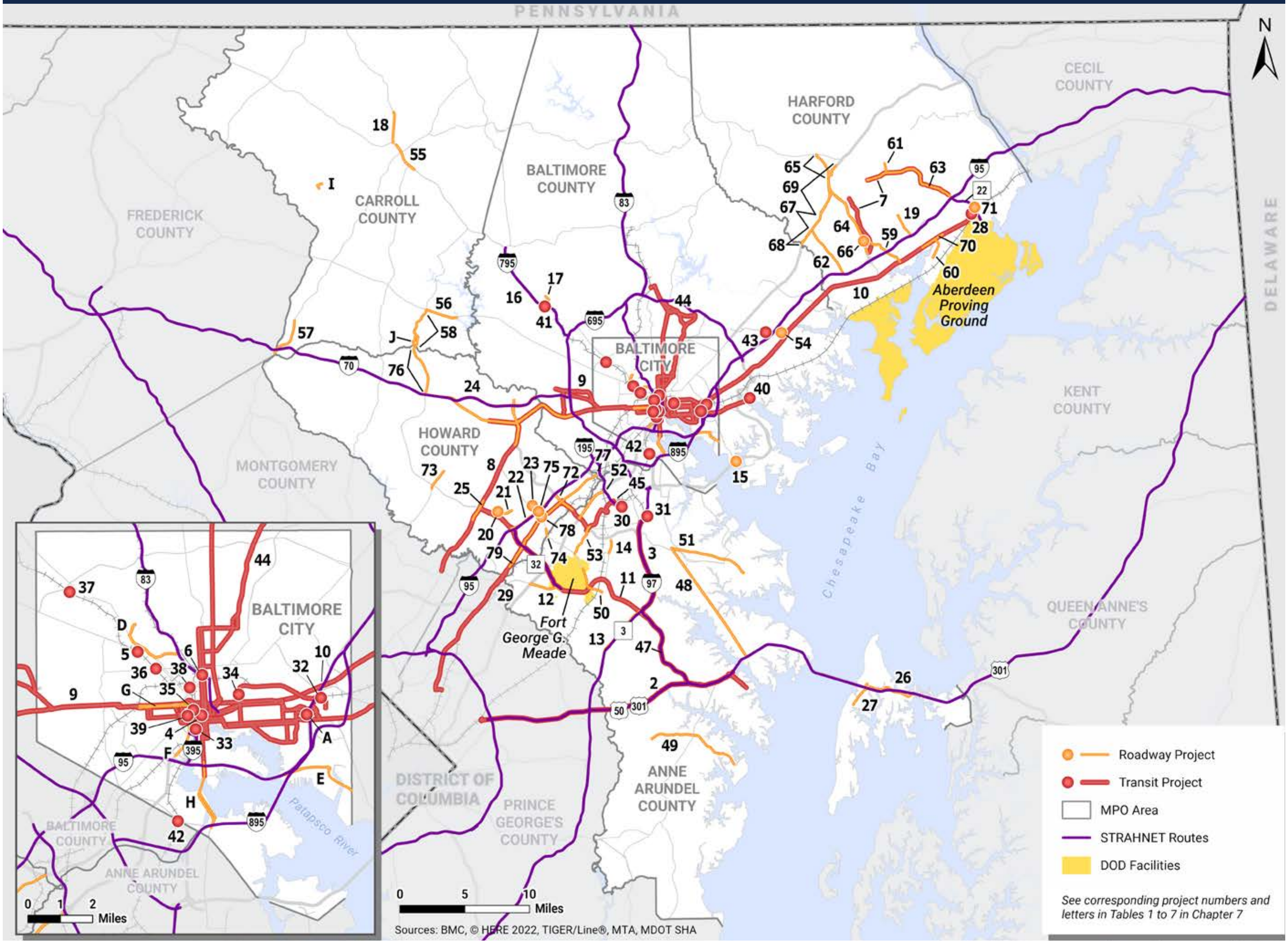


Table 17 - *Resilience 2050* Preferred Alternative Projects on the STRAHNET or STRAHNET Connectors

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 to 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 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	Roadway	2040-2050
16	MDOT SHA (Baltimore Co)	I-795	Owings Mills Boulevard to Franklin Boulevard (2.6 miles)	Widen from 4 to 6 lanes and construct a full interchange at Dolfield Boulevard, including TSMO strategies.	$155,000,000	Roadway	2028-2039
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

Map ID	Operating Agency (Jurisdiction)	Name	Limits (Length)	Description	Estimated Cost (YOE)	Project Type	Time Period
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 miles	Improve existing full interchange consistent with preferred options in the MDOT SHA MD 175 Improvement Study.	$196,000,000	Roadway	2040-2050