TRANSACTION PLAN 2022 UPDATE

Technical Report

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NVTA's TransAction

Transportation Action Plan for Northern Virginia

JULY 2023

TransAction Plan 2022 Update

Technical Report

Prepared for

Northern Virginia Transportation Authority

July 2023

Cover Photo:
BeyondDC

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1.0 INTRODUCTION

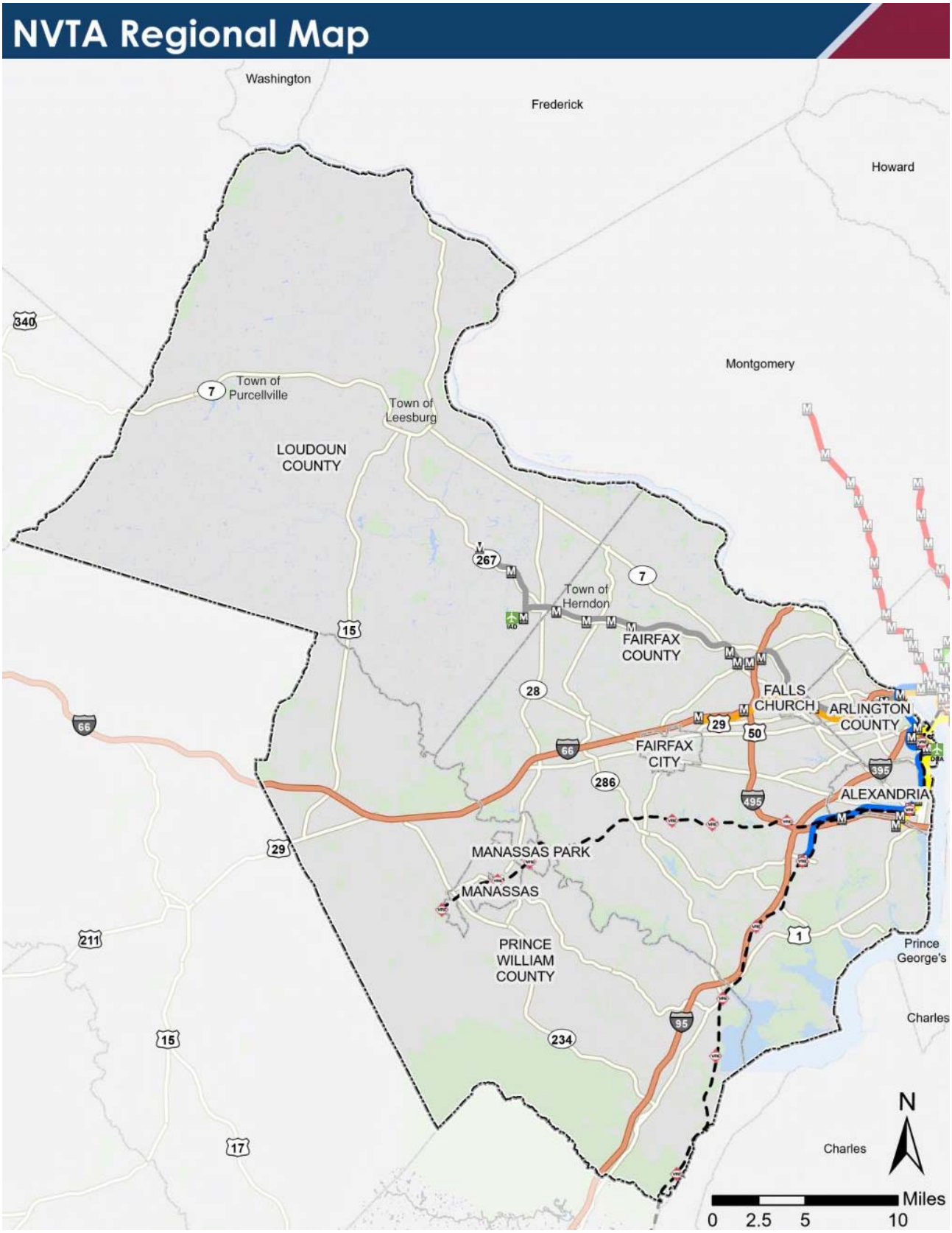
TransAction ("the Plan") is the long-range multimodal transportation plan for Northern Virginia addressing regional transportation needs through 2045. The two-part TransAction includes this plan document as well as an associated list of multimodal transportation projects identified by localities, agencies, and the Northern Virginia Transit Authority (NVTA) to reduce congestion, improve regional connectivity, and provide transportation choices throughout the region. The results of TransAction are used to inform the NVTA's Six-Year Program for regional revenue funding. TransAction is not fiscally or geographically constrained—meaning the plan addresses all transportation needs and includes more projects than can realistically be funded—and does not recommend or prioritize any projects or modes of transportation.

NVTA is a regional body that is focused on delivering transportation solutions and value for Northern Virginia's transportation dollars by bringing Northern Virginia jurisdictions and agencies together to plan and program regional multimodal transportation projects focused on relieving congestion. NVTA was created in 2002 by the Virginia General Assembly to set regional transportation policies and priorities with the primary objective of reducing traffic congestion. The member jurisdictions of the NVTA include the counties of Arlington, Fairfax, Loudoun, and Prince William; and the cities of Alexandria, Fairfax, Falls Church, Manassas, and Manassas Park. The NVTA's governing body consists of seventeen members as follows: the chief elected official, or his/her designee, of each Member Locality; two members appointed by the Speaker of the House; one member of the Senate appointed by the Senate Committee on Privileges and Elections; and two citizens who reside in Member Localities, appointed by the Governor, including a member of the Commonwealth Transportation Board. In addition, the Director of the Virginia Department of Rail and Public Transportation (DRPT), or his/her designee; the Commissioner of Highways or his/her designee; and the chief elected officer of one town in a county which is a Member Locality, will serve as non-voting members of NVTA. A map of the region is illustrated in Figure 1.

The last Plan, TransAction 2040, was developed in 2012 and updated in 2017. Since then, there have been transformations both internal and external to Northern Virginia:

- The COVID-19 pandemic has had significant effects on travel in the region, as teleworking has dramatically increased, and traditional peak-period commuting has declined. The long-range implications of this 'new normal' are still uncertain, as of the update to TransAction in 2022.
- NVTA formalized its commitment to three Core Values of Equity, Sustainability and Safety. This action comes as there is a heightened awareness and desire within the region to address climate change and promote sustainability and resiliency, and to integrate equity and safety considerations into all phases of transportation planning.
- NVTA adopted its inaugural Transportation Technology Strategic Plan (TTSP), as a tool for establishing a proactive approach to innovation, which keeps congestion reduction at the top of mind.

Figure 1 Map of the NVTA Region



1.1 NVTA's Role in Planning and Programming

The Northern Virginia Transportation Authority is responsible for long-range transportation planning, prioritization and funding of regional transportation projects in Northern Virginia. The NVTA's policies and priorities are expressed through performance-based criteria, such as the ability to reduce delays, improve travel time reliability, improve access to jobs, and improve safety and reduce emissions.

NVTA has two primary and interlinked responsibilities—Planning and Programming:

- Every five years: Update TransAction, which identifies the region's transportation needs and evaluates multimodal projects that will support NVTA's vision.
- Every two years: Program—and invest in—regional multimodal transportation projects through NVTA's Six-Year (SYP) Program.

NVTA works toward regional consensus from membership when setting regional transportation policies and priorities for transportation improvements. The entire process is geared toward developing a set of project investments, policies, and strategies to support attaining the desired transportation conditions. Some relevant considerations in the development of TransAction:

- TransAction is evaluated using the ten weighted performance measures approved by NVTA in November and December 2021.
- Throughout all phases of planning and programming, NVTA embraces and seeks equitable participation and outcomes in all aspects of planning and programming.
- NVTA has two statutory advisory committees, the Technical Advisory Committee (TAC) and the Planning Coordination Advisory Committee (PCAC). NVTA's standing committee, the Planning and Programming Committee (PPC), considered the TAC and PCAC recommendations prior to developing its own recommendations. Ultimately, TransAction advanced to the full NVTA for action.
- Process, findings, recommendations from TransAction inform the NVTA SYP and project prioritization, programs, and policies. NVTA's SYP includes selected TransAction projects, funded with NVTA's regional revenues. NVTA updates the SYP every two years, primarily adding regional revenues for the fifth and sixth years. Figure 2 illustrates the planning, programming, and funding process.

TransAction

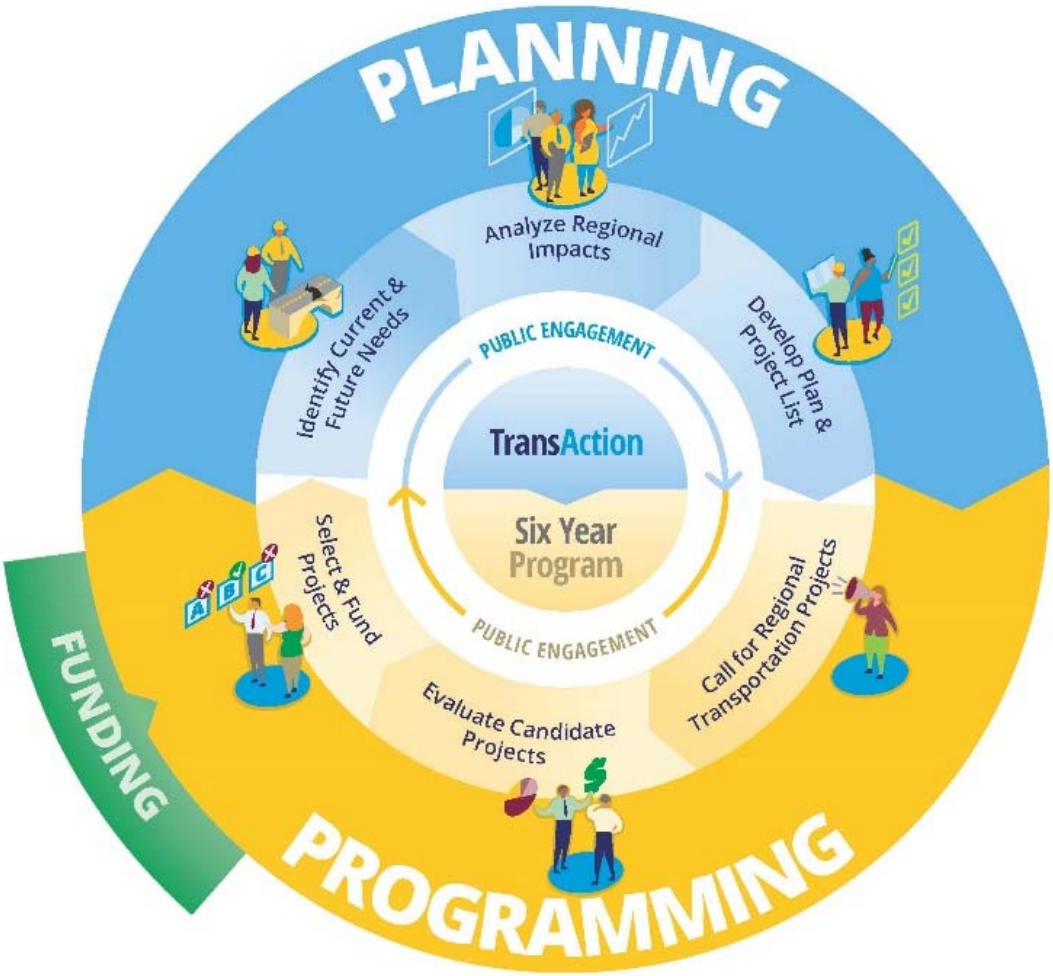
- *Long-Range Transportation Plan for NoVA*
- *Updated every five years*
- *Plan last updated and adopted in October 2017*

Six Year Program (SYP)

- *Allocates NVTA's Regional Revenues to regional transportation projects*
- *Updated every two years*
- *FY2022–2027 SYP adopted in July 2022*

- Per Virginia Code, NVTA distributes its revenues between the Regional Revenue Fund (70 percent of revenue) and the Local Distribution Fund (30 percent of revenue). NVTA funds the Six-Year Program from the Regional Revenue Fund deploying 70 percent of revenues received to projects determined solely by NVTA. NVTA allocates the Local Distribution Fund revenue to member jurisdictions (counties and cities in Northern Virginia) for transportation purposes of their choice.
- TransAction is fully compliant with the Code of Virginia.
- As NVTA looks ahead to 2045, the TransAction Plan update is relying on the latest approved long-range Cooperative Forecasts of population, employment and household growth prepared by the Metropolitan Washington Council of Governments (MWCOG). TransAction also acknowledges the bi-directional relationship between land use and transportation. However, TransAction is not a land use planning document. Land use planning is the sole responsibility of NVTA's member jurisdictions.
- Inclusion of projects in TransAction does not represent a funding commitment but does provide an initial eligibility filter for projects located in Northern Virginia (NoVA) that may eventually be considered for NVTA's regional revenues as part of NVTA's separate Six-Year Program process.

Figure 2 NVTA's Planning and Programming Process



1.2 Performance-Based Planning

Transportation is a major issue in Northern Virginia, affecting everyday life for millions of residents and the economic health of our businesses. To help address these issues, NVTA developed a vision for the future of transportation in the region:

TransAction Vision Statement
(Adopted December 2020)

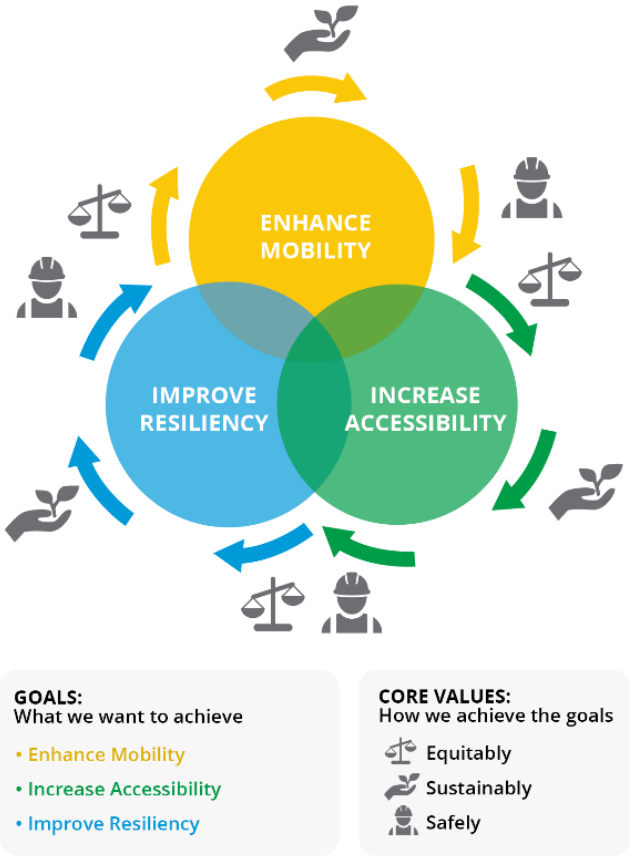
"Northern Virginia will plan for, and invest in, a safe, equitable, sustainable, and integrated multimodal transportation system that enhances quality of life, strengthens the economy, and builds resilience."

TransAction uses a performance-based planning approach that allows policies and goals to be expressed in quantifiable terms and applies an analytical framework to determine the degree to which different projects and investment packages meet the goals. The TransAction performance-based planning approach, while not directly governed by Federal performance management requirements specified in the 23 CFR 450 (Planning Assistance and Standards) and 23 CFR 490 (National Performance Management Measures), does follow standards for stakeholder coordination, public engagement, transportation planning, programming, and performance management that is consistent with Federal requirements.

To achieve NVTA's vision for the future of transportation in the region, NVTA adopted the goals of improving **mobility, accessibility and resiliency** across all modes, including roads, transit, walking, bicycling and more.

There are many ways to achieve the TransAction goals, while aligning with NVTA's Core Values to ensure that they will be achieved **equitably, sustainably and safely**. The goals express what the region wants to achieve, and the Core Values indicate how the region will achieve the goals.

Figure 3 TransAction Goals and Core Values



Potential transportation improvement projects are evaluated based on their ability to improve the region's transportation system across the three TransAction goals, which are further defined by a more specific set of seven objectives and ten performance measures. In December 2021, NVTA adopted the set of performance measures and corresponding weights, as shown in Table 1 on the next page, that are combined into a single evaluation method that helps to ensure that the projects included in TransAction together achieve the region's goals. Ultimately, NVTA is pursuing a set of projects that have broad benefits and are modally balanced, in addition to helping achieve the regional transportation vision.

Table 1 TransAction Performance Measures[1]

Goal	Objective	Performance Measure	Weight	Alignment with Core Values
Mobility: Enhance quality of life of Northern Virginians by improving performance of the multimodal transportation system	A. Reduce congestion and delay	A1. Total person-hours of delay in autos	10	
		A2. Total person-hours of delay on transit	10	
	B. Improve travel time reliability	B1. Duration of severe congestion	10	
		B2. Transit person-miles in dedicated/priority ROW	10	
Accessibility: Strengthen the region's economy by increasing access to jobs, employees, markets and destinations for all communities	C. Improve access to jobs	C1. Access to jobs by car, transit and bike	10	
		C2. Access to jobs by car, transit and bike for Equity Emphasis Area (EEA)[1] populations	10	
	D. Reduce dependence on driving alone by improving conditions for people accessing transit and using other modes	D1. Quality of access to transit and the walk/bike network	15	
Resiliency: Improve the transportation system's ability to anticipate, prepare for and adapt to changing conditions and withstand, respond to and recover rapidly from disruptions.	E. Improve safety and security of the multimodal transportation system	E1. Potential for safety and security improvements	10	
	F. Reduce transportation related emissions	F1. Vehicle emissions	10	
	G. Maintain operations of the regional transportation system during extreme conditions	G1. Transportation system redundancy	5	

Note: Transit may include HOV.

[1] *For TransAction, an Equity Emphasis Area (EEA) is defined as any Traffic Analysis Zone (TAZ) that is defined as either a MWCOG EEA or as a Northern Virginia EEA. The MWCOG EEAs were defined using average low-income and minority concentrations for the whole metropolitan region, while the Northern Virginia EEAs were identified using Northern Virginia specific averages.*

1.3 Plan Overview

The TransAction Technical Report provides an overview of the region's long-range transportation needs, the multimodal TransAction project list intended to address those needs, the impacts and benefits of the TransAction projects, and next steps for how TransAction will be used.

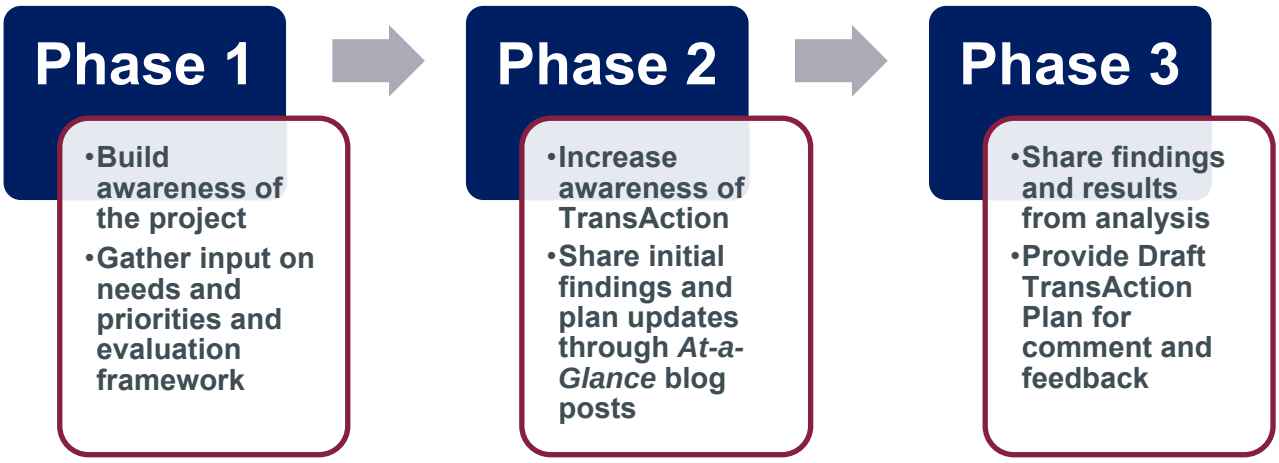
- *Chapter 2—Public Engagement Process:* reviews the public engagement process that supported the TransAction Plan development;
- *Chapter 3—Current and Future Travel Needs:* describes existing and future travel patterns that underly the need for future transportation improvements;
- *Chapter 4—Needs Assessment:* covers the analysis of existing and future transportation performance informed multimodal needs across the three goals—mobility, accessibility and resiliency;
- *Chapter 5—Plan Elements:* describes the projects included on the TransAction project list;
- *Chapter 6—Analysis of the Plan's Impacts*: presents the travel modeling and evaluation results on the impacts of the TransAction projects at the regional and subregional levels and by mode;
- *Chapter 7—Managing Uncertainty with Scenarios:* analyzes scenarios to better understand the potential for disruption and uncertainty in the long-range transportation planning process; and
- Chapter 8—Key Findings: summarizes the TransAction Plan's impact on the region's mobility, accessibility and resiliency goals and discusses other key findings that emerged from the planning process.

The full TransAction Project List is available in a separate document (Appendix E).

2.0 PUBLIC ENGAGEMENT PROCESS

Public and stakeholder engagement played a key role throughout the update of the TransAction Plan. Three phases of public engagement aligned with the technical work of the planning process as shown in Figure 4. In Phase 1, input was solicited through multiple methods from a diverse range of perspectives to understand the transportation experiences and needs of people traveling throughout the region. In Phase 2, the project team shared initial findings from the needs assessment through the *TransAction At-a-Glance* blog posts on the website and provided updates on the plan development process and timeline. In Phase 3, the draft TransAction Plan and Project List were released for public comment and a detailed on-line comment form was used to gather specific feedback on the plan contents and the overall planning process.

Figure 4 TransAction Engagement Objectives by Phase



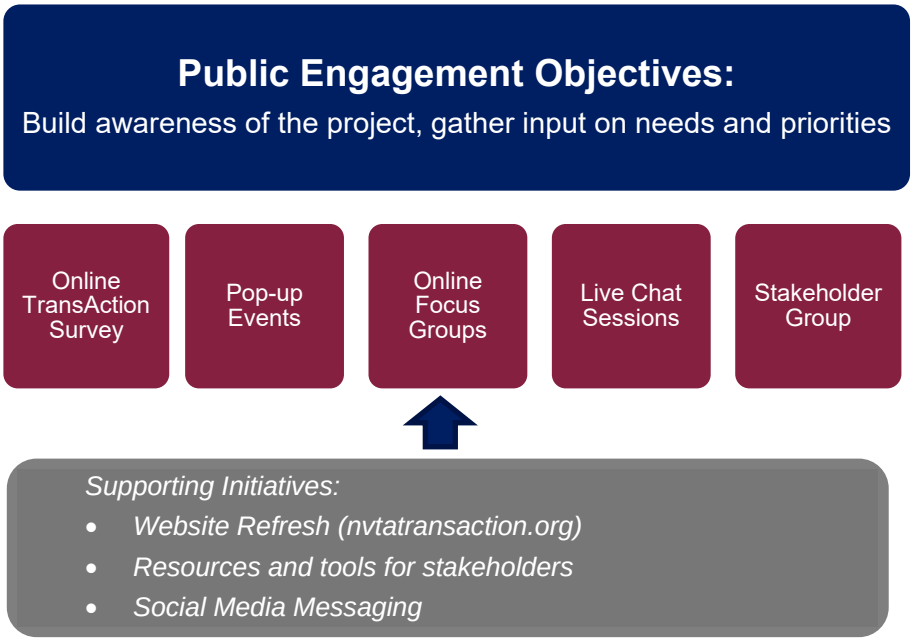
2.1 Community Input on Needs and Priorities

Between July and October 2021, the NVTA conducted a full public outreach program with the objectives of building awareness of the project and gathering input on regional needs and priorities. This program included several engagement strategies, including focus groups and a public survey, which are summarized in Figure 5.

The public input was incorporated into a number of steps in the Plan development process. Feedback was used to finalize the structure and wording of the TransAction goals, objectives and performance measures. The priorities that survey respondents placed on different performance factors were tabulated and shared with the Statutory and Standing Committees and Authority prior to adoption of the performance measure weights. Public input on the transportation needs and potential improvement strategies was documented in the needs assessment phase of the study and helped identify additional types of projects for inclusion in the TransAction project list.

Due to the continuation of the COVID-19 pandemic, there were both in-person activities, such as pop-up events at Metrorail stations and other highly trafficked areas, as well as virtual activities, such as a public survey, live chats, and targeted social/digital media outreach, that allowed the public to participate in whichever format was most convenient for them. With this public outreach program, NVTA was able to collect valuable feedback from a significant number of Northern Virginians, including those in traditionally underserved communities and with low-English proficiency.

Figure 5 Phase 1 Public Engagement Methods



The first phase of public engagement for NVTA's TransAction Update provided NVTA staff with multiple opportunities to interact directly with the public and was highly successful in driving participation in the public survey. With the survey and focus groups (details available in Appendix A: Phase 1 Public Engagement Summary Report) serving as the primary channels for collecting public input during Phase 1, the public engagement team was focused on raising both awareness of and participation in the public survey—particularly in areas of Northern Virginia that have significant concentrations of low-income, minority populations, or both. In all, more than 2,300 people participated in the survey. The survey and its supporting social and digital media outreach were offered in English, Spanish, and Korean, and language interpreters assisted Amharic and Vietnamese speakers complete the survey live at in-person pop-up events. Between the survey and the focus groups and the supporting efforts described in this report, the outreach efforts during Phase 1 of the TransAction Update succeeded in helping the NVTA achieve equitable, accessible, and inclusive public engagement and the input received during this phase were used to inform the NVTA's technical work throughout other phases of the TransAction Update.

There were several key takeaways from the first phase of the public outreach process:

- The pandemic has changed how many people travel and will continue to affect how they travel in the future. About one-quarter of respondents to the TransAction survey indicated that new workplace rules, such as telework, will influence their mode choices once the pandemic is over.
- There is considerable interest in travel modes other than driving, reflected in both survey and focus group responses. The top transportation priority of respondents on the survey was "more transit, walking, and biking options" however, the overwhelming majority of focus group participants use their personal car for commuting and discretionary purposes in the region. This is largely attributed to the perception that single occupancy vehicle (SOV) use is more reliable and flexible than other transportation options, even if they live close to a Metrorail station.

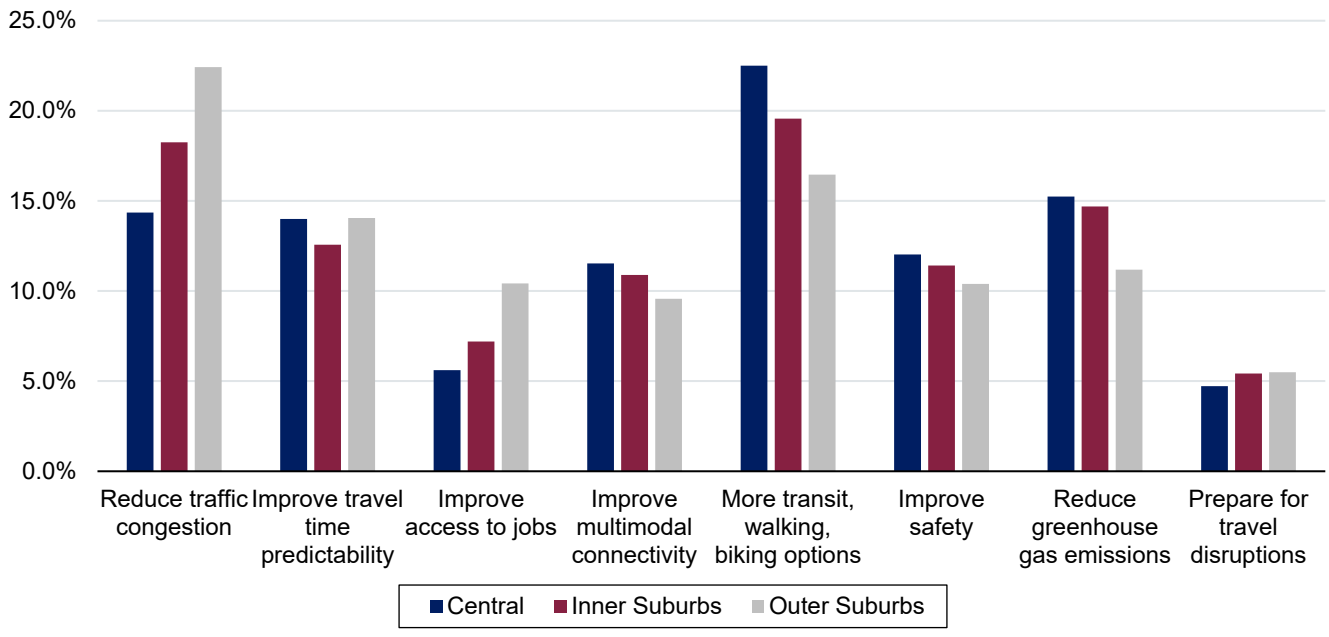
- The survey results emphasized the diverse aspirations of the region depending on where the respondent lived. The top priorities across the region were "more transit, walking, biking options," "reduce traffic congestion" and "improve travel time predictability," but the order varied by geographic area as shown in Figure 6:
  - » Residents of central jurisdictions, including Arlington County and City of Alexandria, selected "more transit, walking, biking options" as the top priority.
  - » Residents of outer suburban jurisdictions, including Prince William County, Loudoun County, and cities of Manassas and Manassas Park, selected "reduce traffic congestion" as top priority.
  - » Other objectives showed less variability between different geographic areas—"improve travel time predictability" and "improve safety" were generally supported by all geographic areas.

Source: NVTA

- The majority of survey and focus group respondents were open to owning an electric vehicle (EV) in the future and saw cost and infrastructure as the current barriers to EV usage.
- Less than one-half of respondents indicated that they would consider owning or using an autonomous vehicle (AV), with safety as the primary concern. On the survey, participants rated "Get roads ready for automated vehicles" as a low priority but also pointed out that it should be a priority for the future (10 to 20 years into the future at least).

The feedback collected during Phase 1 was used to inform the rest of the TransAction Update phases.

Figure 6 TransAction Survey Results: Transportation Priorities by Subregion



3.0 CURRENT AND FUTURE TRAVEL PATTERNS

The movement of people and goods in Northern Virginia is directly related to the scale and distribution of population and jobs throughout the region. TransAction's travel demand forecasts rely on these critical inputs to estimate existing and future travel in the region. A significant portion of recent and future growth in the region has focused on activity centers, the locations of concentrated development in towns, urban centers, and transit hubs that often support increased use of public transportation and active transportation modes. Understanding recent land use changes in the region and forecasts of future growth is a critical step in the development of TransAction.

Over the last decade, population growth in Northern Virginia has significantly outpaced growth in the rest of Virginia due to net immigration from across the Nation, attracted by the high quality of employment opportunities. Northern Virginia grew by 14.3 percent between 2010 and 2020 to a population of 2.55 million people. By comparison, the statewide population grew 7.9 percent over the past decade. Even with population increases throughout NoVA, growth rates varied across the region. For instance, Loudoun County's population increased by more than 35 percent, while Fairfax County's population increased by 7 percent from 2010 to 2020.

As NVTA looks ahead to 2045, the TransAction Plan update is relying on the latest approved long-range Cooperative Forecasts of population, employment and household growth prepared by the MWCOG, *Cooperative Regional Forecasts Round 9.1a*. The Cooperative Forecasts are compiled by MWCOG based on the land use plans and growth forecasts of local jurisdictions.

The population of Northern Virginia is projected to grow from nearly 2.55 million in 2020 to 3.13 million by 2045 (approximately 23 percent growth). The number of households will grow slightly more than population, projected to grow by almost 28 percent, or an additional 282,000 households in the region by 2045. This reflects a continuing shift to smaller average household sizes within Northern Virginia.

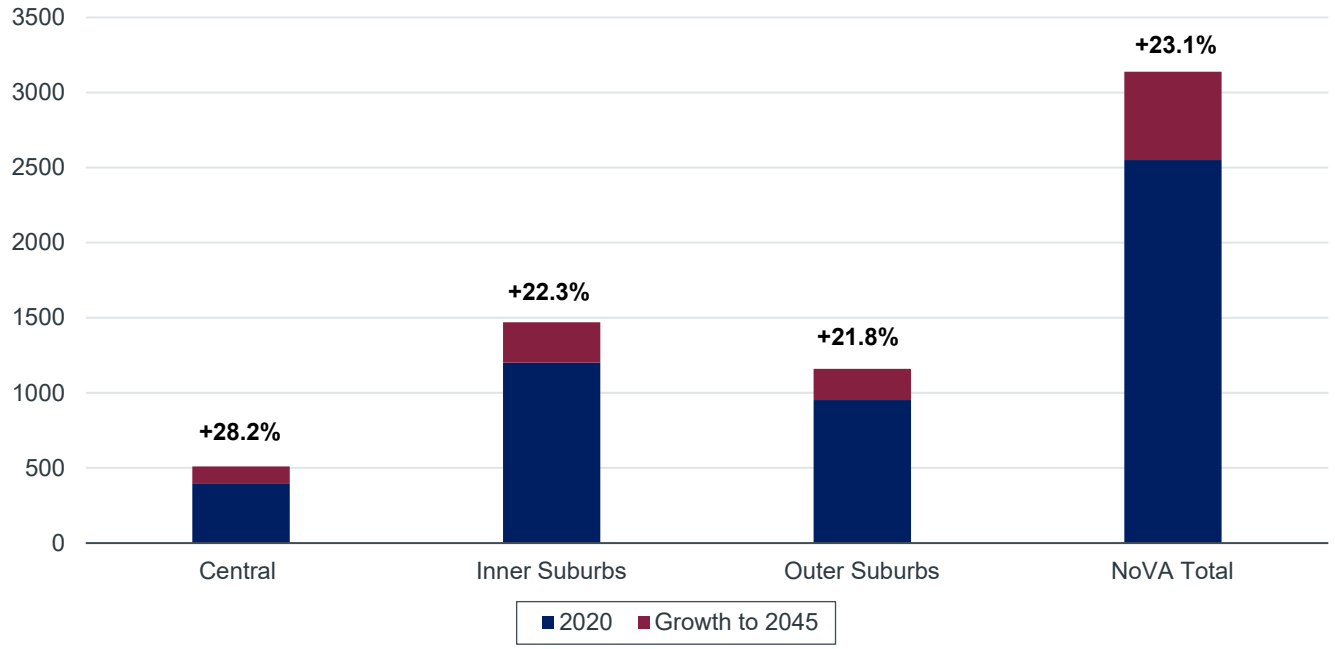
Table 2 presents jurisdictional population and household growth forecasts. Figure 7 shows the difference in population growth by subregion with the Central jurisdictions having the highest percent increase but the Inner Suburbs having the largest absolute change in population.

Table 2 Population and Household Growth Forecasts (2020–2045)

	Population (Thousands)				Households (Thousands)			
			2020 to 2045				2020 to 2045	
	2020	2045	Number	% Change	2020	2045	Number	% Change
Arlington County	238.3	301.2	62.9	26.4%	112.0	141.8	29.8	26.6%
City of Alexandria	159.2	208.5	49.3	31.0%	75.7	107.1	31.4	41.5%
Fairfax County	1,161.8	1,416.8	255.1	22.0%	414.5	528.1	113.6	27.4%
City of Fairfax	25.6	35.2	9.6	37.4%	9.6	13.5	3.9	40.6%
City of Falls Church	14.2	17.6	3.4	23.9%	6.2	8.2	2	32.3%
Loudoun County	424.0	507.4	83.4	19.7%	137.9	168.7	30.8	22.3%
Prince William County	467.9	584.0	116.1	24.8%	153.9	197.2	43.3	28.1%
City of Manassas	43.8	52.1	8.3	19.0%	14.2	16.4	2.2	15.5%
City of Manassas Park	15.9	15.9	0.0	0.0%	5.0	5.0	0	0.0%
NVTA Jurisdictions	2,550.6	3,138.6	588.1	23.1%	929.1	1,186.0	282.0	27.7%
COG/TPB Planning Area	5,690.0	6,925.7	1,235.7	21.7%	2,133.1	2,659.9	526.8	24.7%

Source: MWCOG Cooperative Land Use Forecasts Round 9.1a

Figure 7 Population Forecasts by Subregion (in Thousands)[1]



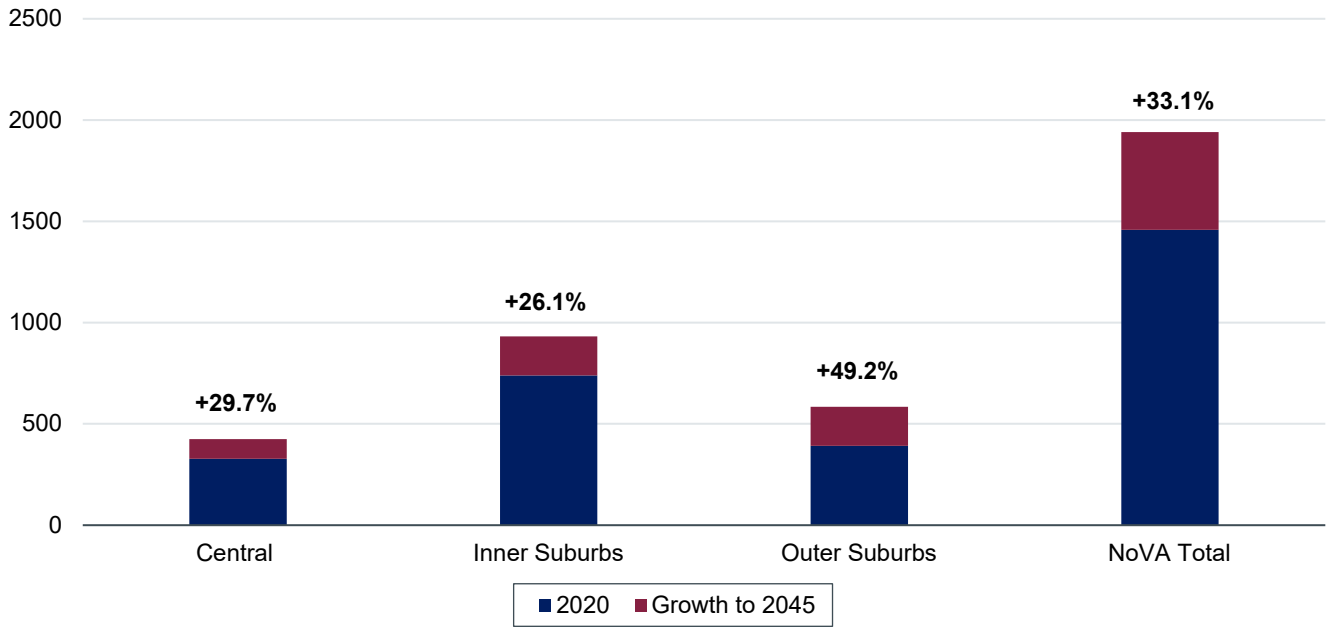
[1] *Central: Arlington County, City of Alexandria; Inner: Fairfax County, Cities of Falls Church and Fairfax; Outer: Loudoun County, Prince William County, Cities of Manassas and Manassas Park.*

Total employment in Northern Virginia is projected to grow by 33 percent through 2045, to 1.94 million jobs. Employment growth in Northern Virginia outpaces overall regional employment growth, with Northern Virginia increasing from 43 percent to 45 percent of regional employment between 2020 and 2045. Table 3 presents jurisdictional employment growth forecasts. Figure 8 shows the difference in employment growth by subregion with the Outer Suburb jurisdictions having the highest percent increase, but the Inner Suburbs and Outer Suburbs have roughly the same absolute increase in employment totals.

Table 3 Employment Growth Forecasts (2020–2045)

	Employment (Thousands)			
			2020 to 2045	
	2020	2045	Number	% Change
Arlington County	216.9	269.1	52.2	24.1%
City of Alexandria	110.1	155.1	45.0	40.8%
Fairfax County	701.7	889.9	188.2	26.8%
City of Fairfax	22.9	23.4	0.5	2.2%
City of Falls Church	14.3	18.6	4.3	30.1%
Loudoun County	195.2	291.2	96.0	49.2%
Prince William County	164.8	257.0	92.2	55.9%
City of Manassas	26.9	31.0	4.2	15.5%
City of Manassas Park	4.7	5.2	0.5	10.3%
NVTA Jurisdictions	1,457.5	1,940.5	483.0	33.1%
COG/TPB Planning Area	3,360.6	4,273.8	913.2	27.2%

Figure 8 Employment Forecasts by Subregion (in Thousands)



This growth will be one of the most prominent factors influencing travel patterns in the region through 2045, increasing the number of travelers in and through Northern Virginia while simultaneously impacting where and how those people choose to travel. Overall, growth trends may influence travel patterns in a number of ways:

- Trip lengths could be reduced as the growth in suburban jobs may reduce the need for longer-distance commutes to Washington, D.C.;
- Job growth in the outer suburbs may lead to more reverse-commuting;
- Suburb-to-suburb trip-making may be impacted as changes in Northern Virginia growth, predicted to outpace Maryland, could affect cross-Potomac trips; and
- Growth trends, including increased density in population, employment centers and residential areas, could be supportive of transit where it already exists or is planned and lead commuters to shift from driving to taking transit.

Other key characteristics of the expected growth trends include:

- Northern Virginia population and employment forecasts continue to reflect the existing dichotomy of lower-density suburban growth on the region's periphery, coupled with increased densification of activity centers with good transit access and an increasingly diverse mix of development types and employment.
- Northern Virginia will continue to be one of the most affluent areas in the country while the share of low-income households, low-English proficiency population, and people of color will continue to increase.
- People with unique transportation needs, including people with disabilities and the elderly, will also increase in the region, requiring unique transportation services providing equitable access to important destinations.
- Together, these continuing changes will pressure the efficient operation of the existing multimodal transportation system, increasing demand on all modes, while placing unique and changing demand on alternatives to driving alone as the population's travel needs become more diverse.

3.1 Total Daily Travel

Population growth of 23 percent and employment growth of 33 percent through 2045 result in a 27 percent increase in total daily trips.

Table 4 presents total average weekday trips that start or end in the region in 2017 and 2045, segmented by trip type. Weekday person trips increase by 27 percent, while commercial vehicle trips increase by 38 percent, consistent with consumer demand outpacing personal travel demand. Work trips increase 31 percent over 2017 commuting levels, reflecting a return and growth from pre-COVID commuting.

TransAction uses scenario analysis to better understand the potential for disruption and uncertainty in the long-range transportation planning process. In addition to a 'standard' travel forecast of the future in 2045, which is represented by the travel patterns presented in this section of the report, this scenario analysis identifies multiple 'alternate' futures that incorporate one or more plausible disruptions—behavioral, technological, or policy. These disruptions could have significant impacts on individual travel choices, including the daily travel trends presented in this section as well as the operation of the multimodal transportation network in the future.

Table 4 Total Regional Weekday Person Trips

	Weekday Person Trips (Millions)		
Northern Virginia Trip Totals	**2017**	**2045**	**Percent Change**
Weekday Person Trips	7.857	9.967	27%
Work Trips	1.374	1.798	31%
Non-Work Trips	6.483	8.169	26%
Weekday Commercial Vehicle Trips	0.406	0.559	38%

Source: NVTA TransAction Model

3.2 Regional Weekday Travel Patterns

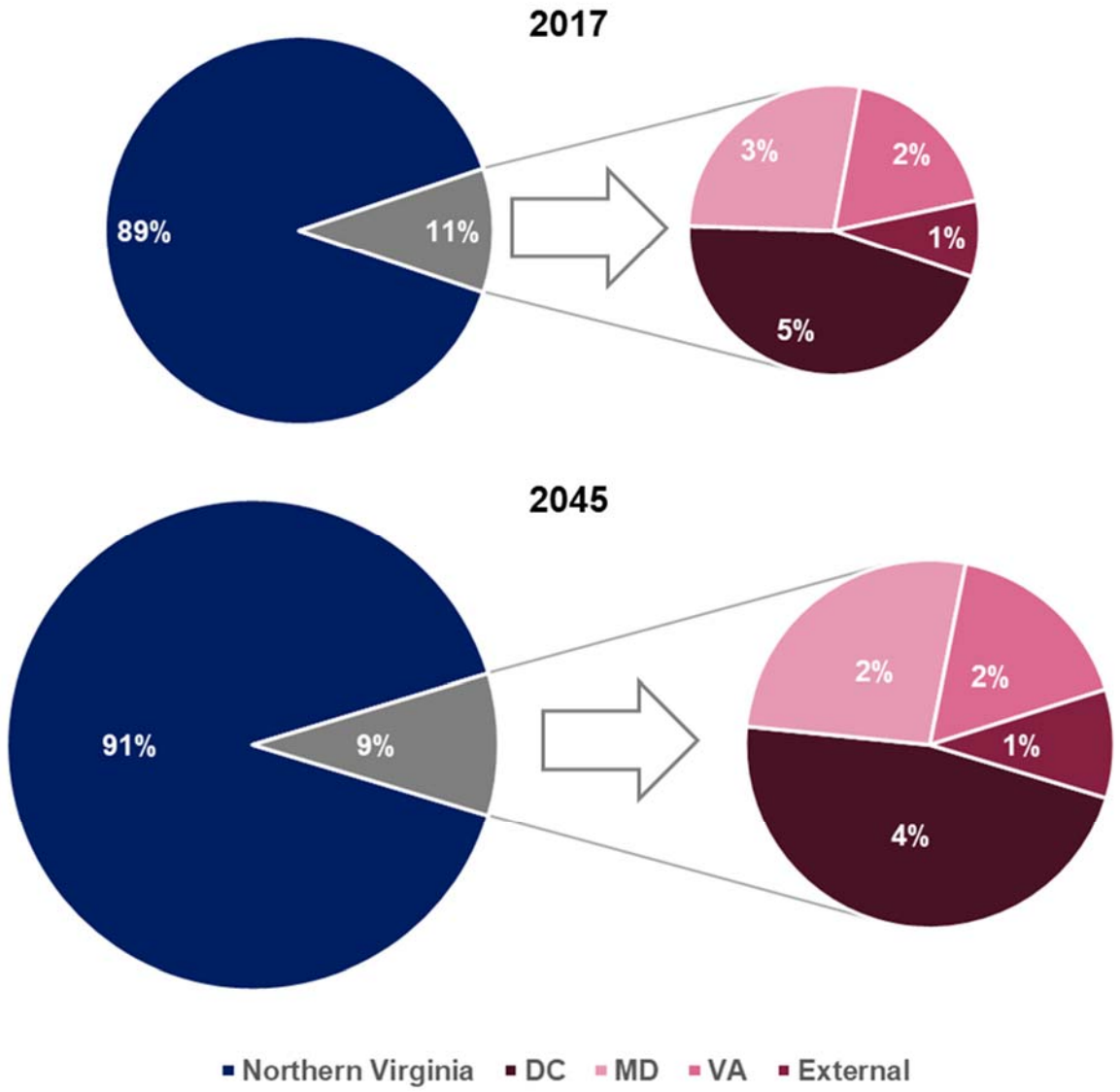
Figure 9 presents total regional weekday trip productions (daily trips that start in the Northern Virginia region) based on the MWCOG/Transportation Planning Board (TPB) regional travel model, version 2.4. In 2017, 89 percent of those trips start and end in Northern Virginia. For the remaining 11 percent, 5 percent go to Washington D.C. (D.C.), 3 percent to Maryland, 2 percent to the rest of Virginia (including Fauquier County and the Fredericksburg region), and 1 percent outside the metropolitan Washington region. **By 2045, the share of daily trips remaining in Northern Virginia increases to 91 percent. This increase is driven by the strong growth of employment within Northern Virginia compared to the rest of the region.**

Average trip lengths are twice as long for commute-to-work trips as for non-commute trip purposes for trips with a start or end in Northern Virginia through 2045. Trip length distance (in miles) is expected to decrease slightly by 2045, while trip time (in minutes) is expected to increase, reflecting the increase in traffic congestion (discussed more in Mobility Needs):

- Commute Trips—14 miles and 33 minutes in 2017 to 13 miles and 37 minutes in 2045; and
- Non-Commute Trips—7 miles and 13 minutes in 2017 to 7 miles and 15 minutes in 2045.

Compared to the metropolitan Washington region, current average commute trip length in Northern Virginia is shorter (14 miles compared to 15 miles) while average commute time is the same (33 minutes in 2017). In 2045, average commute trip length in the region remains longer (15 miles compared to 12 miles), while average commute time is less (37 minutes in Northern Virginia compared to 39 minutes in the metropolitan Washington region). Non-work average trip length and time is similar within and outside Northern Virginia in both 2017 and 2045.

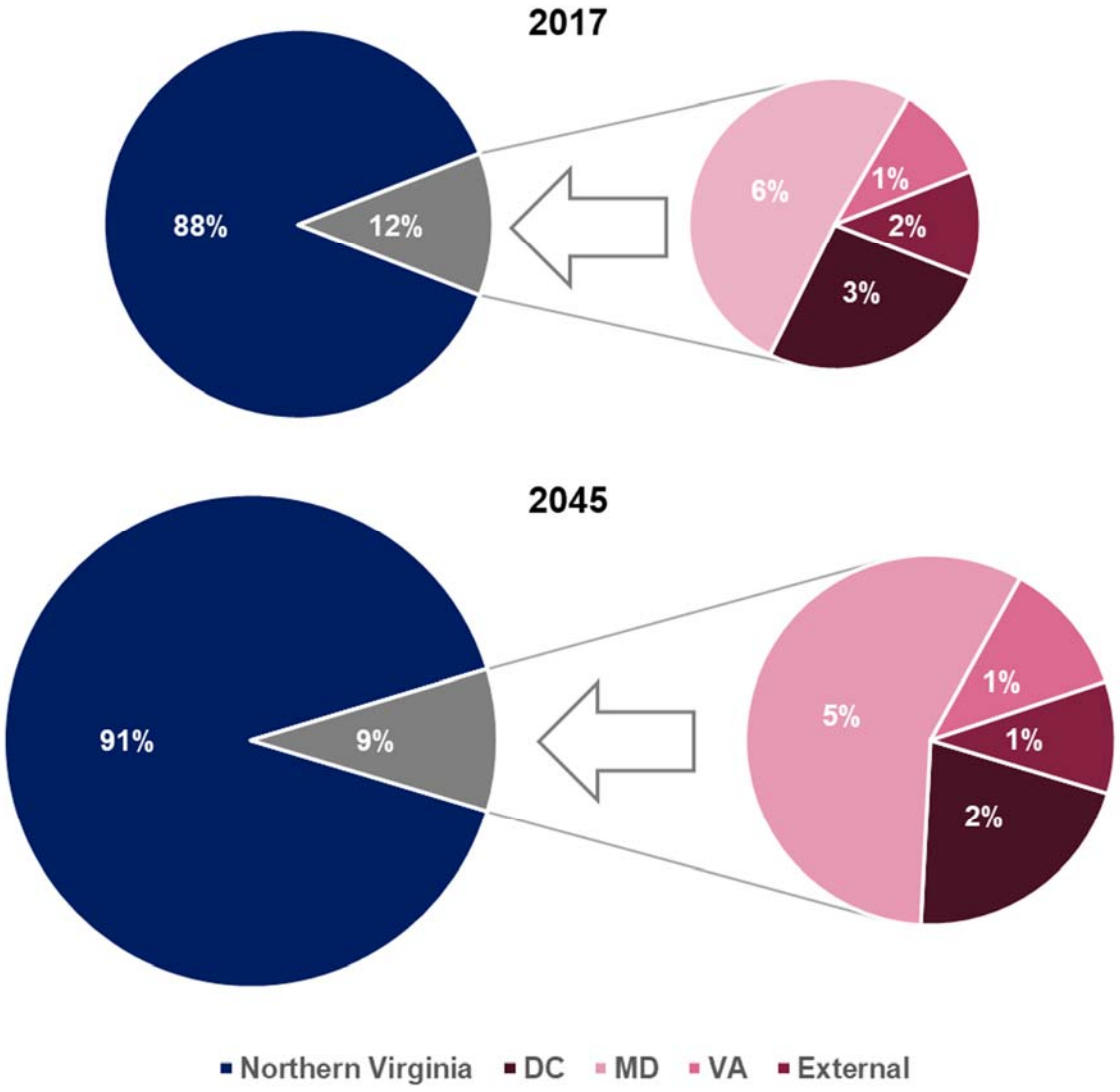
Figure 9 Total Regional Weekday Person Trip Productions



Source: COG/TPB Model, Version 2.4

Figure 10 presents total regional weekday person trip attractions (daily trips that end in the Northern Virginia region). **88 percent of total trip attractions in 2017 were for trips with a trip start and end in Northern Virginia. This share increases to 91 percent by 2045.** Most trips coming into the region are from D.C. and Maryland, and while the magnitude of those trips is increasing, the share of these trips is decreasing through 2045.

Figure 10 Total Regional Weekday Person Trip Attractions



Source: COG/TPB Model, Version 2.4

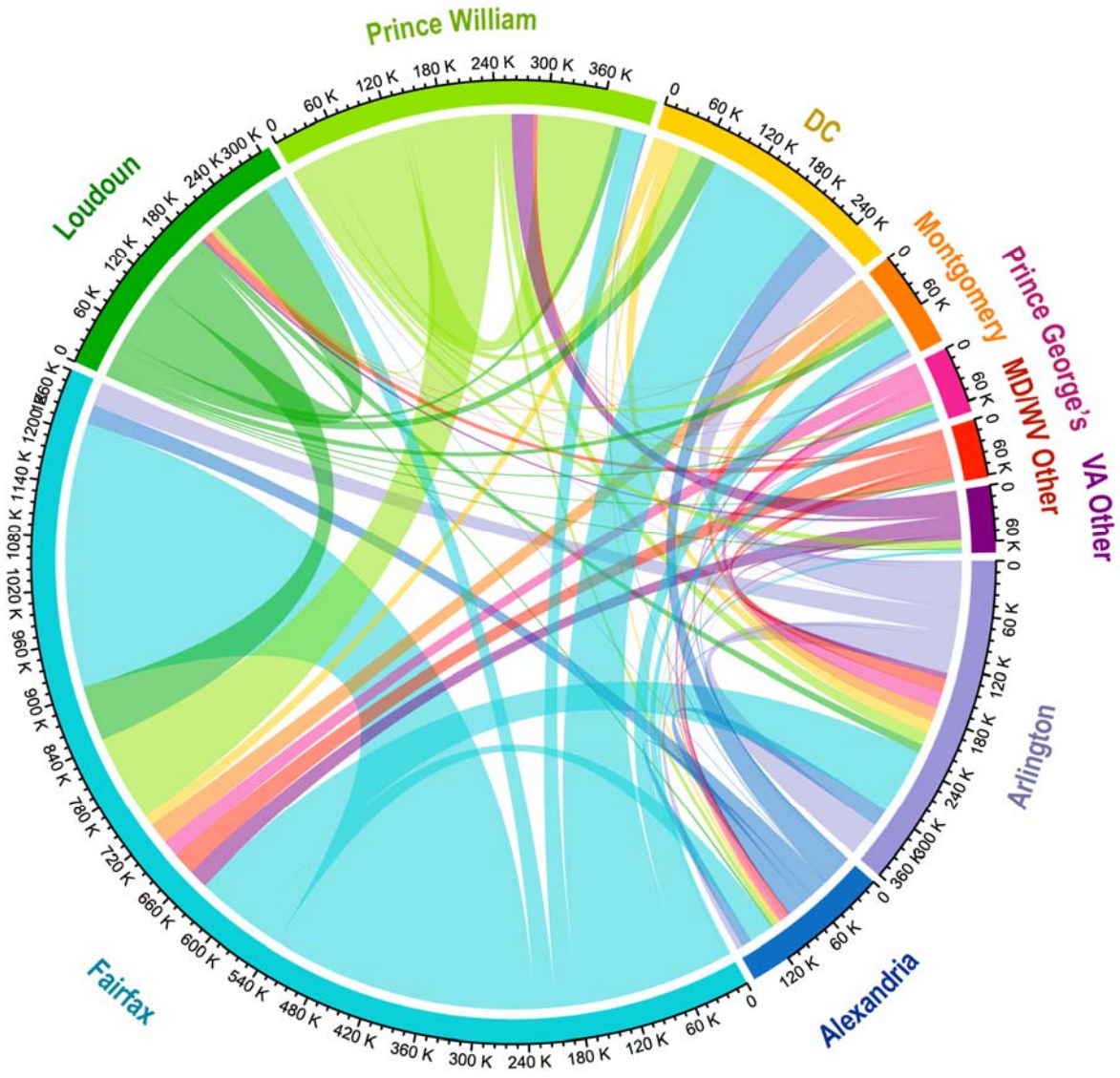
3.2.1 Commute Person Trip Patterns

In 2017 and 2045, commute trips represent approximately 18 percent of daily person trips in Northern Virginia. Figure 11 and Figure 12 present chord diagrams showing total daily commute trips in 2017 and 2045 between jurisdictions (or groups of jurisdictions) within the TPB modeling domain.

Following the two figures are summary statistics in Table 5 and Table 6 which summarize total commute trips origins and destinations by jurisdiction and subregion, along with key regional and jurisdiction conclusions. The 2045 data are model derived-estimates.

- **Regional-Level Observations:**
  - » Total commuting trips to and from Northern Virginia are expected to increase by 31 percent from 2017 to 2045.
  - » In 2017, 73 percent of commute trips starting in the region remain in the region. This is expected to increases to 76 percent by 2045 (Table 5). 19 percent of the 27 percent of trips that leave the region in 2017 are destined to D.C., with another 6 percent destined to Montgomery and Prince George's counties.
  - » Daily commute trips staying within the region are expected to increase 35 percent from 2017 to 2045, while daily commute trips leaving the region are only expected to increase 14 percent.
  - » In 2017, 69 percent of commute trips leaving the region are destined for D.C., and 70 percent in 2045 are expected to be destined for D.C. Trips from Northern Virginia to D.C. are expected to increase by nearly 40,000 daily trips from 2017 to 2045 (totaling over 287,000 daily trips in 2045).
  - » Northern Virginia continues to attract more commute trips from neighboring jurisdictions beyond the District. From 2017 to 2045, total expected commute trips from jurisdictions outside Northern Virginia and D.C. increase by over 103,000 trips daily (a 43 percent increase).
- **Jurisdiction-Level Observations:**
  - » In 2045, there are expected to be nearly 110,000 daily commute trips between Fairfax County and Montgomery—Prince George's counties (Figure 12). Many of these trips are expected to continue to use the American Legion Bridge and Woodrow Wilson Bridge to make the daily trip into and out of Northern Virginia.
  - » In 2045, there are approximately 275,000 expected daily commute trips between Arlington County—Alexandria—Fairfax County and D.C., many of which are expected be completed on Metrorail (Figure 12).
  - » While Fairfax County remains the largest origin and destination for work trips, the most significant expected increases are occurring in Loudoun and Prince William counties, both with over 30 percent increases in trip origins and over 50 percent increases in trip destinations from 2017 to 2045.
  - » Between 2017 and 2045, there is over a 70 percent expected increase in trips between the Fredericksburg region and Northern Virginia, from approximately 42,000 daily trips in 2017 to 73,000 daily trips in 2045 (Figure 11 and Figure 12). Many of these trips are expected to use the I-95 corridor and VRE to access work destinations in Northern Virginia.

Figure 11 2017 Home Based Work Trip Patterns



Notes:

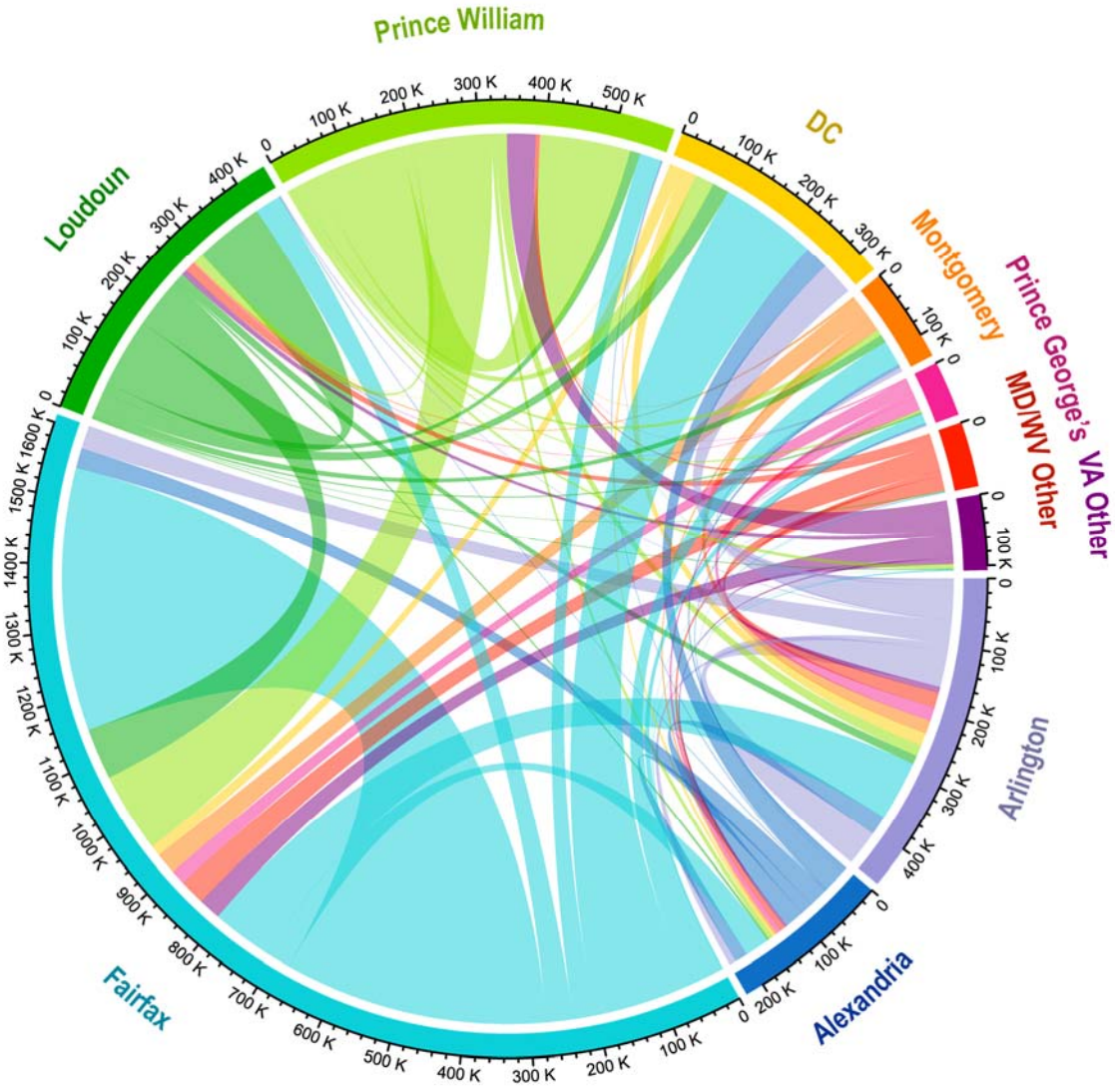
Source: COG/TPB Model, Version 2.4

MD/WV Other = remainder of central and southern Maryland and Jefferson County, WV.

VA Other = Fauquier, Stafford, Spotsylvania, and King George counties, and City of Fredericksburg.

Trips outside the Transportation Planning Board modeling domain are not included in this graphic. More information on the model domain is available here (see Figure 2.1).

Figure 12 2045 Home Based Work Trip Patterns



Notes:

Source: COG/TPB Model, Version 2.4

MD/WV Other = remainder of central and southern Maryland and Jefferson County, WV

VA Other = Fauquier, Stafford, Spotsylvania, and King George counties, and City of Fredericksburg

Trips outside the Transportation Planning Board modeling domain are not included in this graphic. More information on the model domain is available here.

Table 5 Commute Trip Patterns (Trips Starting in Northern Virginia)

Northern Virginia Trip Origins			Regional Trip Destinations		
	2017	2045		2017	2045
NoVA Total	1,318,200 (100%)	1,700,800 (100%)	NoVA	958,600 (73%)	1,291,400 (76%)
Arlington	129,700 (10%)	164,400 (10%)	D.C.	247,900 (19%)	287,200 (17%)
Alexandria	90,700 (7%)	123,600 (7%)	Suburban MD[1]	83,100 (6%)	97,600 (6%)
Fairfax	645,300 (49%)	810,300 (48%)	Other MD[2]	5,000 (0.4%)	3,200 (0.2%)
Loudoun	191,900 (15%)	258,000 (15%)	Other VA[3]	14,900 (1%)	9,900 (1%)
Prince William	260,600 (20%)	344,400 (20%)	External[4]	8,700 (1%)	11,400 (1%)

Table 6 Commute Trip Patterns (Trips Ending in Northern Virginia)

Regional Trip Origins			Northern Virginia Trip Destinations		
	2017	2045		2017	2045
NoVA	958,600 (78%)	1,291,400 (77%)	NoVA Total	1,233,100 (100%)	1,679,800 (100%)
D.C.	31,800 (3%)	42,300 (3%)	Arlington	234,200 (19%)	299,500 (18%)
Suburban MD[1]	92,800 (8%)	113,100 (7%)	Alexandria	72,400 (6%)	104,200 (6%)
Other MD[2]	57,400 (5%)	88,000 (5%)	Fairfax	632,000 (51%)	823,100 (49%)
Other VA[3]	57,500 (5%)	96,800 (6%)	Loudoun	130,700 (11%)	203,800 (12%)
External[4]	34,900 (3%)	48,200 (3%)	Prince William	163,800 (13%)	249,300 (15%)

Notes:

Source: COG/TPB Model, Version 2.4

Fairfax includes City of Fairfax and Falls Church. Prince William includes Manassas and Manassas Park.

1) Suburban MD = Montgomery County and Prince George's County

2) Other MD = remainder of central and southern Maryland and Jefferson County, WV

3) Other VA = Fauquier, Stafford, Spotsylvania, and King George Counties, and City of Fredericksburg

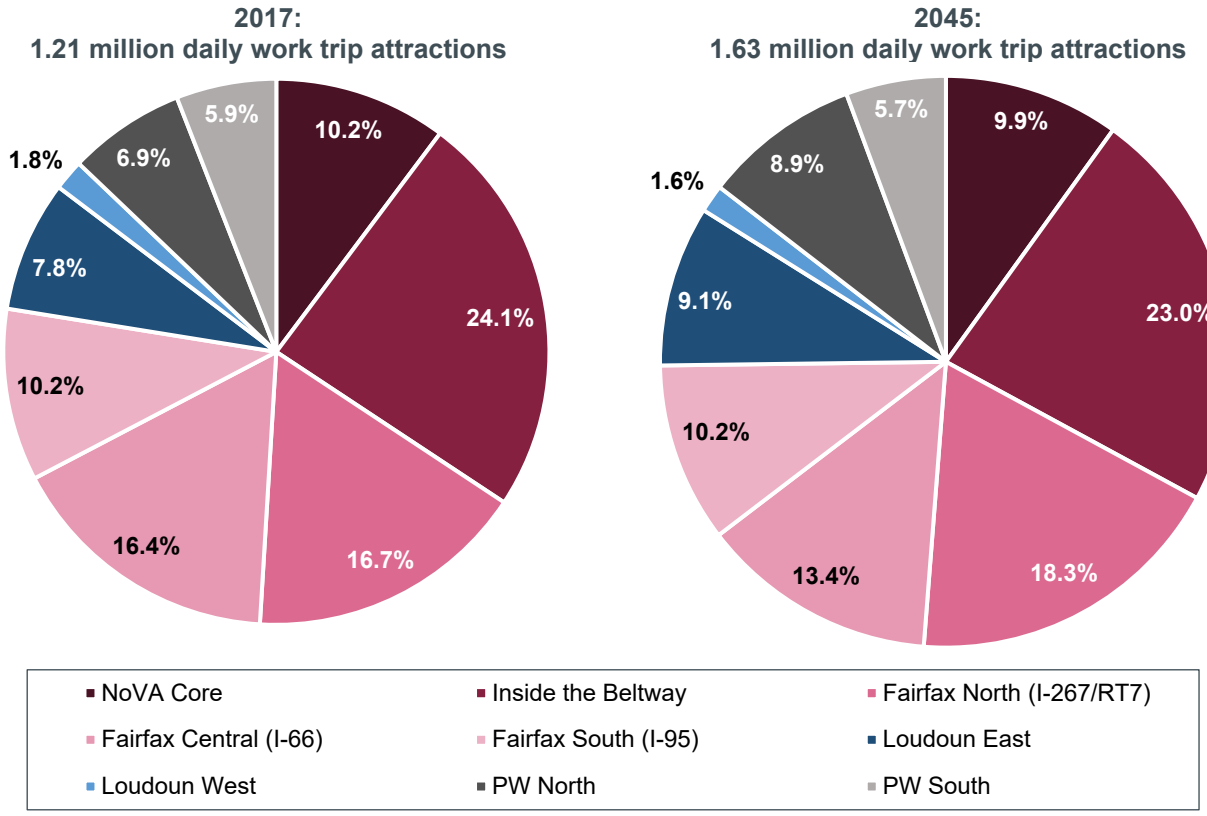
4) External = outside of the Transportation Planning Board modeling domain, more information here

Total daily commute trips to the region and from the region are subdivided into smaller districts to understand more targeted travel patterns and potential corridor impacts. Figure 13 presents the share of total daily commute trip

destinations for these nine districts in 2017 and 2045. While total daily trips destined to these areas increase 35 percent from 2017 to 2045, the increase varies across the region. For example:

- Total work trips destined for locations inside the Beltway represented 34.3 percent of total daily commute trips to the region in 2017. This share will decrease to 32.9 percent in 2045. Even though the share will decrease, total trips still increase significantly, to over 123,000 daily trips.
- Total work trips destined for north Fairfax County increase from 16.7 percent in 2017 to 18.3 percent in 2045 (the single largest magnitude trip increase in Northern Virginia at over 98,000 daily trips).
- The single largest percent increase is to northern Prince William County, with an increase from a 6.9 percent share to an 8.9 percent share (an increase of over 61,000 daily trips).
- The single largest percent decrease is to Central Fairfax County, with a decrease from 16.4 percent to 13.4 percent (an increase of over 21,000 daily trips from 2017 to 2045).

Figure 13 Total Regional Weekday Commute Trip Attractions



Notes: Trips from external locations were excluded from the summary.

3.2.2 Non-Commute Person Trip Patterns

In 2017 and 2045, non-commute trips, including trips for shopping, school, health and other services, and trips for social or recreational activities represent approximately 82 percent of daily person trips in Northern Virginia. Table 7 and Table 8 present tabular summaries showing total daily non-commute trips in 2017 and 2045 between jurisdictions (or groups of jurisdictions) within the TPB modeling domain.

For non-commute trips that start in Northern Virginia, in both 2017 and 2045, 94 percent of the trips remain in Northern Virginia. Non-commute trips tend to be highly local in nature and are therefore much more likely to stay within Northern Virginia than commute trips. As noted earlier, average non-commute trip length is 7 miles for the region in both 2017 and 2045, with average travel time increasing slightly (from 13 minutes to 15 minutes).

Some general observations about expected changes in non-commuter trip patterns:

- Non-commuter trips starting in Northern Virginia will increase by 22 percent, from 5.6 million in 2017 to 6.9 million trips in 2045.
- Fairfax will continue to account for the largest share of non-commuter trips, but that share will drop slightly from 49 percent to 47 percent of the region's trips.
- A greater share of the region's non-commuter trips will start from and end in Loudoun and Prince William Counties in 2045 than in 2017, reflecting the higher population growth rates in those jurisdictions.
- Non-commuter trips continue to grow in Arlington and Alexandria, but at a lower rate than in the outer suburbs, reduce the central jurisdictions' share of regional trips.

Table 7 Non-Commute Trip Patterns (Trips Starting in Northern Virginia)

Northern Virginia Trip Origins			Regional Trip Destinations		
	2017	2045		2017	2045
NoVA Total	5,648,000 (100%)	6,898,000 (100%)	NoVA	5,296,000 (94%)	6,518,000 (94%)
Arlington	442,000 (8%)	501,000 (7%)	D.C.	83,354 (1%)	92,000 (1%)
Alexandria	316,000 (6%)	379,000 (5%)	Suburban MD[1]	80,000 (1%)	79,000 (1%)
Fairfax	2,793,000 (49%)	3,275,000 (47%)	Other MD[2]	20,000 (0.4%)	22,000 (0.3%)
Loudoun	894,000 (16%)	1,164,000 (17%)	Other VA[3]	124,000 (2%)	127,000 (2%)
Prince William	1,204,000 (21%)	1,579,000 (23%)	External[4]	45,000 (1%)	61,000 (1%)

Table 8 Non-Commute Trip Patterns (Trips Ending in Northern Virginia)

Regional Trip Origins			Northern Virginia Trip Destinations		
	2017	2045		2017	2045
NoVA	5,296,000 (93%)	6,518,000 (93%)	NoVA Total	5,711,000 (100%)	7,020,000 (100%)
D.C.	110,000 (2%)	119,000 (2%)	Arlington	492,000 (9%)	564,000 (8%)
Suburban MD[1]	146,000 (3%)	160,000 (2%)	Alexandria	361,000 (6%)	440,000 (6%)
Other MD[2]	70,000 (1%)	97,000 (1%)	Fairfax	2,827,000 (50%)	3,326,000 (47%)
Other VA[3]	42,000 (1%)	63,000 (1%)	Loudoun	896,000 (16%)	1,176,000 (17%)
External[4]	46,000 (1%)	63,000 (1%)	Prince William	1,135,000 (20%)	1,514,000 (22%)

Notes:

Source: COG/TPB Model, Version 2.4

Fairfax includes City of Fairfax and Falls Church. Prince William includes Manassas and Manassas Park.

1) Suburban MD = Montgomery County and Prince George's County.

2) Other MD = remainder of central and southern Maryland and Jefferson County, WV.

3) Other VA = Fauquier, Stafford, Spotsylvania, and King George Counties, and City of Fredericksburg.

4) External = outside of the Transportation Planning Board modeling domain, more information here.

3.2.3 Commercial Vehicle Trip Patterns

Total weekday commercial vehicle trips with an origin or destination in Northern Virginia increase from 409,000 trips in 2017 to nearly 560,000 trips by 2045 (representing a 38-percent increase). The 2017 and 2045 commodity flows are available through data extracted from the TRANSEARCH planning tool by the Virginia Office of Intermodal Planning and Investment (OIPI) for VTrans. More information on the source of this data and assumptions is available here.

Based on a scan of the top 30 origin and destination commodity flows on trucks to and from Northern Virginia, the anticipated change in total truck tonnage from and to Northern Virginia is forecasted to be 83 percent, as shown in Table 9. This is a dramatic shift in total annual truck tonnage inbound to and outbound from Northern Virginia, (which includes domestic trading partners and cross border with Canada and Mexico).

Table 9 Total Annual Truck Tonnage by Top 30 Origins and Destinations (2017, 2045)

Total Annual Truck Tonnage (Billions)	2017	2045	Percent Change
Inbound Tonnage	26.58	53.26	100%
Outbound Tonnage	18.09	28.47	57%
Total Tonnage	44.67	81.73	83%

Source: IHS Global Insight

Northern Virginia will continue and expand its position as a net importer of goods through 2045. From the inbound goods perspective, around 60 percent of truck-based commodities are coming from nearby trading partners, including D.C., Maryland, West Virginia, Delaware, and Pennsylvania. From the outbound goods perspective, roughly 65 percent of truck-based commodities are going to D.C., West Virginia, Delaware, and Pennsylvania, and an additional 17 percent are destined to other locations in Virginia.

Figure 14 presents average weekday truck volume change from 2017 to 2045. This includes the change only in commercial vehicles (or heavy and medium duty trucks). Figure 15 presents the projected 2045 truck volumes for an average weekday. The most substantial commercial vehicle volume increases are on I-95, I-495, and I-395. There are other links around Washington Dulles International Airport (Dulles) with high truck volume increases (an additional 1,000 or more commercial vehicles per day). I-95, I-495, I-395, and I-66 outside the Beltway will continue to have the highest daily volumes through 2045, in addition to Route 28 and Route 267, as the primary access points to Dulles and warehouse facilities north of the airport. Total landed cargo weight (pounds) at Dulles has increased over 17 percent from 2016 to 2020, to over 541 million pounds of cargo.[1] According to the World Air Cargo Forecast: 2020–2039 developed by Boeing, average annual revenue air cargo tonne-kilometer growth is estimated at 4 percent, which appears consistent with the prior five-year trend at Dulles.[2]

[1] The Federal Aviation Administration (FAA) releases passenger boarding and cargo data extracted from the Air Carrier Activity Information System (ACAIS), a database that contains revenue passenger boarding and all-cargo data by calendar year.

[2] https://www.boeing.com/commercial/market/cargo-forecast/.

Figure 14 Total Daily Truck Volume Change (2017 to 2045)

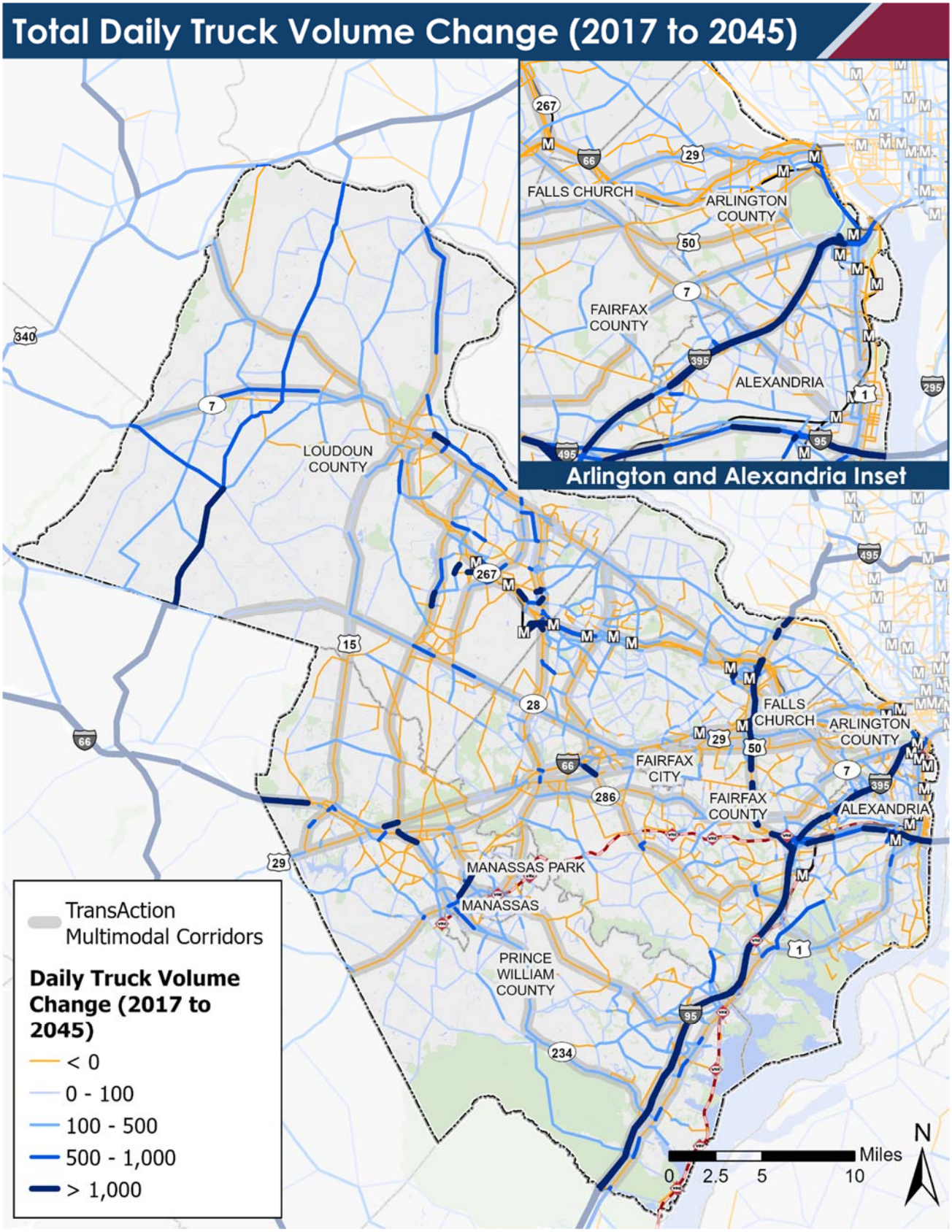
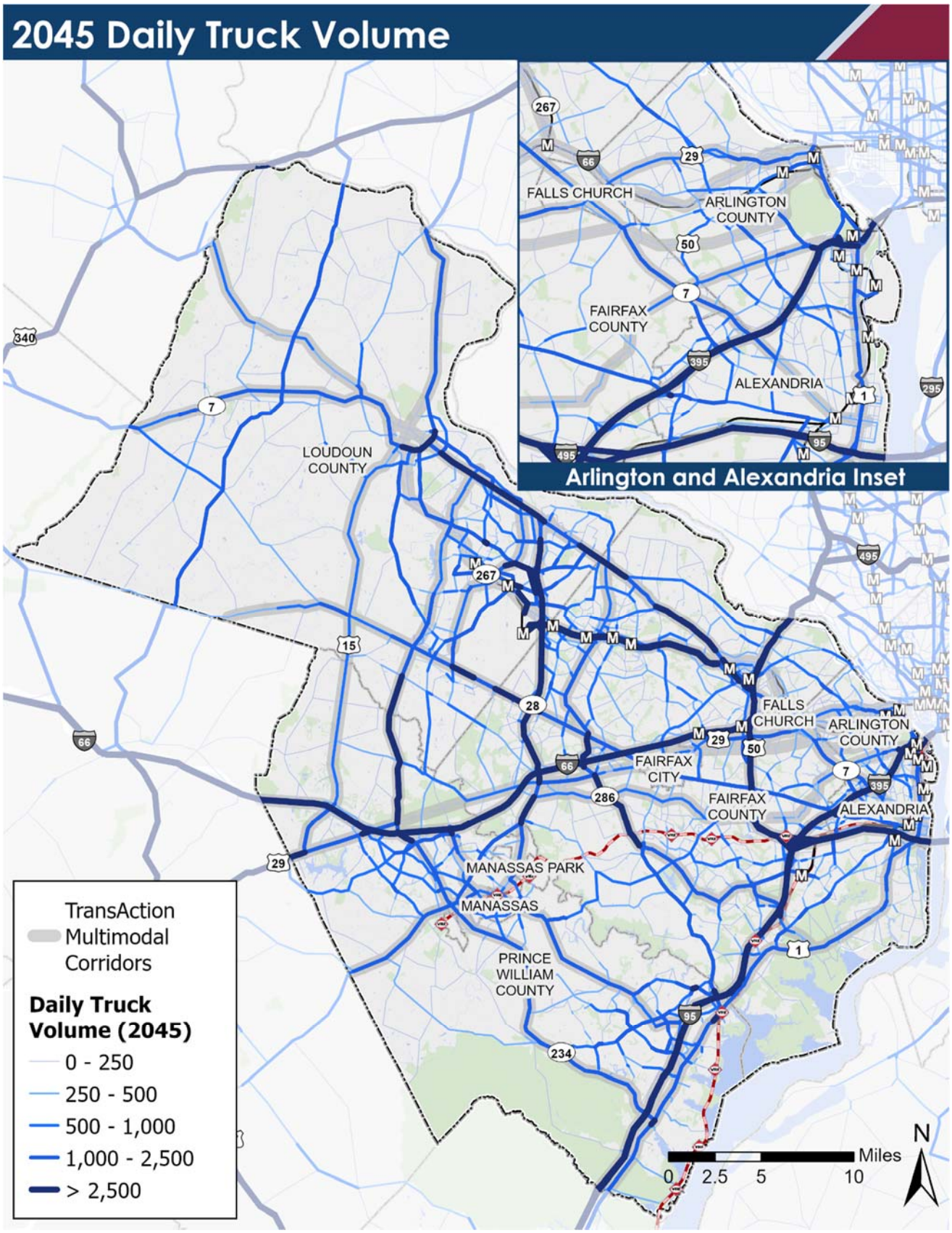


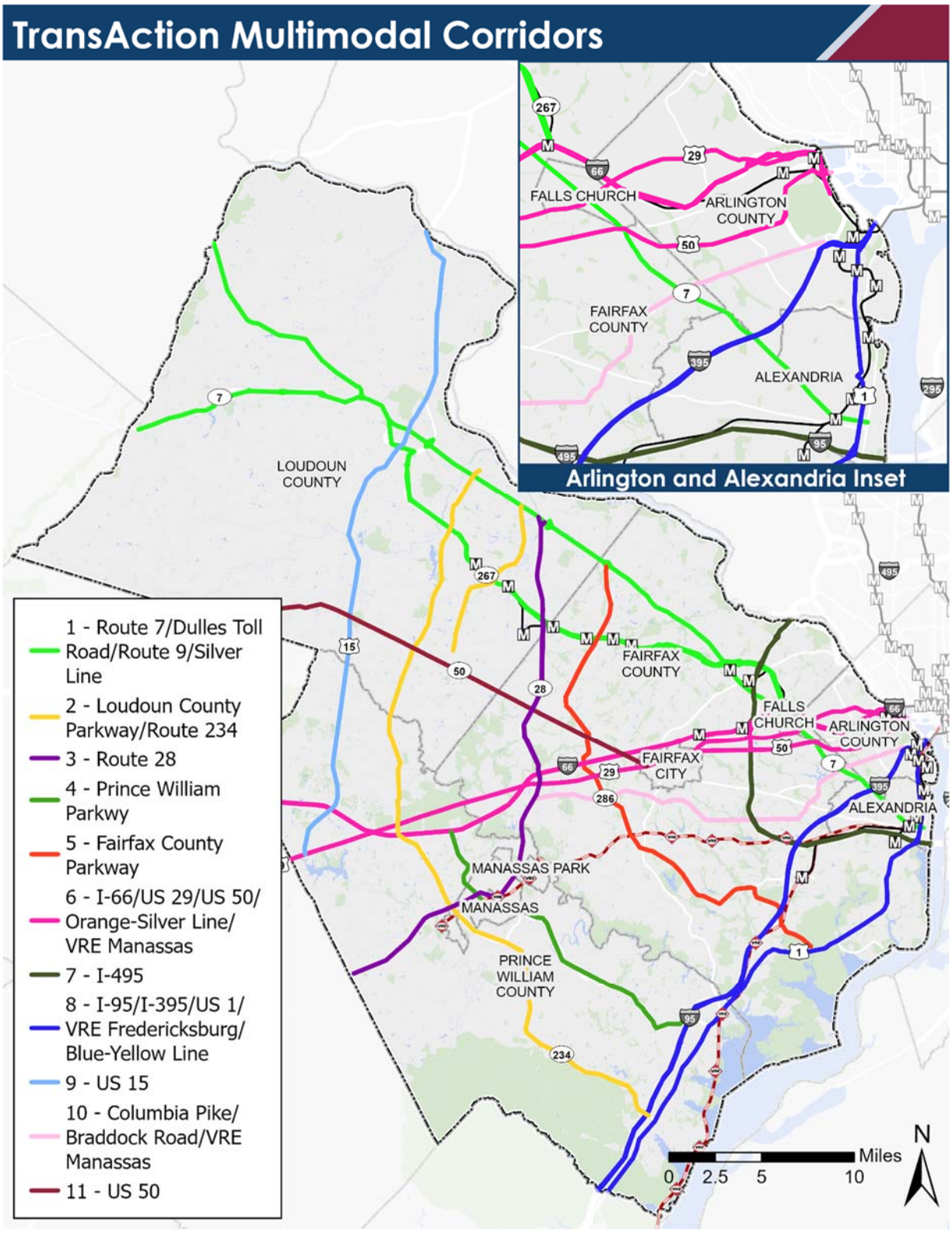
Figure 15 Total Daily Truck Volume (2045)



3.2.4 Multimodal Corridors

Figure 16 presents the 11 multimodal corridors within Northern Virginia, which include the roadways and transit lines for the corridors centered on the highlighted lines. These heavily traveled and/or anticipated high travel growth corridors facilitate travel for interstate, interregional, and local trips, as well as most of the truck freight coming into and leaving the region. **While they constitute approximately 5 percent of the region's roadway mileage, they carry about 56 percent of regional VMT**. These facilities include designated Primary Highway Freight System routes representing **61 percent** of regional freight VMT (2017) and forecasted to carry **59 percent** of regional freight demand by 2045.

Figure 16 TransAction Multimodal Corridors



4.0 TRANSPORTATION NEEDS

4.1 Mobility Needs Assessment

Enhance quality of life of Northern Virginians by improving performance of the multimodal transportation system.

Objective: Reduce congestion and delay

Objective: Improve travel time reliability

4.1.1 Total Vehicle Travel

Regional average weekday VMT in 2017 and 2045 is presented in Table 10. **Total average daily VMT increases 27 percent from 2017 to 2045 within Northern Virginia.** VMT growth is occurring at different rates in each jurisdiction with the highest growth occurring in Loudoun and Prince William Counties.

Table 10 Average Weekday Vehicle Miles Traveled (2017–2045), in Millions

	2017	2045	% Growth
NoVA Total	51.6	65.5	27%
Arlington	4.1	4.7	13%
Alexandria	1.9	2.2	19%
Fairfax	28.0	34.4	23%
Loudoun	7.3	10.1	39%
Prince William	10.3	14.2	38%

Source: COG/TPB Model, Version 2.4

COVID-19 Impact

*Average weekday VMT in Northern Virginia totaled **52.78 million in 2019**. As a result of travel impacts from the COVID-19 pandemic, average weekday VMT in Northern Virginia decreased to **40.35 million VMT in 2020** (a 24-percent decrease).*

Source: VDOT Traffic Data

The change in travel patterns between 2017 and 2045 results in shifts in daily VMT per household as shown in Table 11. While the VMT totals include through traffic and commercial vehicle VMT, the results still provide an indication of how overall demand for vehicle travel varies by jurisdiction and may change over time. **An overall decrease for the region, from 58 miles per household per day in 2017 to 55 miles per day in 2045 is an indication of shorter trip lengths, fewer vehicle trips, and more use of alternative modes.**

Table 11 Average Weekday VMT per Household

	2017	2045
NoVA Total	58	55
Arlington	38	33
Alexandria	29	23
Fairfax	67	63
Loudoun	56	59
Prince William	61	63

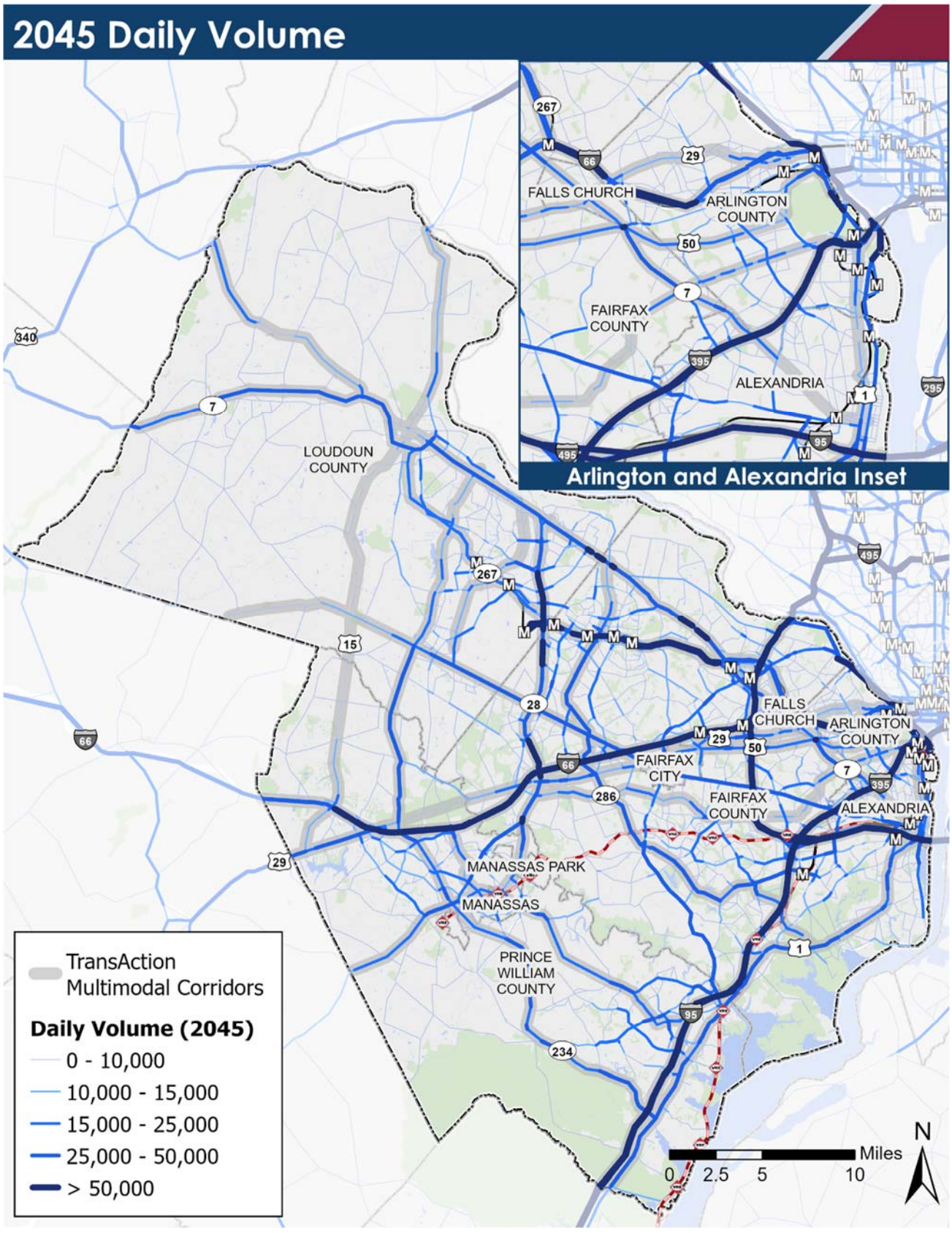
Decreases are more significant in Arlington and Alexandria, where development patterns and travel options are more favorable for the use of non-driving modes. On the other hand, Loudoun and Prince William Counties are anticipated to see increases in VMT per household, as their populations continue to grow in lower density suburban and outer suburban residential and often single-use development patterns.

Table 12 presents the change in total average daily corridor VMT for the priority corridors. Total daily vehicle volume in 2045 is presented in Figure 17. **Growth in VMT by corridor is variable across the region. Corridors in faster growing areas of the region, like western Loudoun and western/southern Prince William experience the highest percentage growth.** Many of these corridors also include new capacity through 2045, including managed lanes, helping to facilitate more efficient vehicle travel. These corridors include Route 28, Fairfax County Pkwy., Prince William Pkwy., and Loudoun County Pkwy/Route 234. **Four of the top five VMT growth priority corridors (including I-495) are circumferential—reflecting the continued growth in travel demand between and within suburbs.**

Table 12 Average Daily VMT by Priority Corridor (2017–2045)

	Average Daily VMT		
Corridor	**2017**	**2045**	**% Growth**
Columbia Pike/Braddock Road	680,000	742,000	9%
VA 28	1,667,000	2,166,000	30%
VA 267/VA 7/VA 9	4,691,000	5,983,000	28%
I-95/I-395/U.S. 1	7,218,000	8,838,000	22%
I-66/U.S. 29/U.S. 50 Inner	6,249,000	8,699,000	39%
I-495 Beltway	3,618,000	5,306,000	47%
Prince William Pkwy.	647,000	834,000	29%
Fairfax County Pkwy.	1,301,000	1,949,000	50%
U.S. 50 Outer	1,042,000	1,170,000	12%
U.S. 15 Corridor	698,000	766,000	10%
Loudoun County Pkwy /VA 234	1,305,000	2,385,000	83%
Total	**29,118,000**	**38,837,000**	**33%**

Figure 17 Total Daily Highway Vehicular Volume (2045)



4.1.2 Highway Congestion

The increase in total vehicle travel from 2017 through 2045 impacts congestion. Total person-hours of delay within the AM and PM peak periods provides a view of the total delay experienced by roadway users in Northern Virginia. Figure 18 presents the change in person hours of delay from 2017 to 2045, while Figure 19 presents the total 2045 person hours of delay. Table 13 presents the change in peak period person hours of delay for each of the eleven priority corridors.

Table 13 Daily Peak Period Person Hours of Delay by Priority Corridor (2017–2045)

Corridor	% Growth
Columbia Pike/Braddock Road	38%
VA 28	61%
VA 267/VA 7/VA 9	129%
I-95/I-395/U.S. 1	96%
I-66/U.S. 29/U.S. 50 Inner	32%
I-495 Beltway	115%
Prince William Pkwy.	73%
Fairfax County Pkwy.	79%
U.S. 50 Outer	72%
U.S. 15 Corridor	55%
Loudoun County Pkwy/VA 234	162%
Total	**83%**

- **Regional Level Observations**
  - » Total increases in person hours of delay from 2017 to 2045 are most significant (greater than 500 hours daily) on the high travel volume corridors, including I-95, I-495, and Rt. 267. There are several short segments of significant delay increases on principal and minor arterials where bottlenecks may be exacerbating congestion. Increased congestion levels also contribute to greenhouse gas emissions and other air pollutants.
  - » There are corridors with minimal increases (or even decreases) in person hours of delay, including I-66 from Haymarket to I-495, Fairfax County Parkway, VA 28, and I-495 north of Tysons. These outcomes are indicators of the benefits of programmed investments, particularly the expansion of managed lanes and transit in the I-66 corridor.
  - » I-95, I-495 from Tysons to Alexandria, and I-395 will continue to have the highest delay per mile in 2045.
- **Priority Corridor Observations**
  - » Person hours of delay in the peak period approximately double or more on four corridors—VA 267/VA 7/VA 9, I-95/I-395/U.S. 1, I-495, and Loudoun County Pkwy/VA 234. Additionally, these four corridors traverse or border Equity Emphasis Areas (EEAs).[3]
  - » Most other corridors increase by over 50 percent, except I-66 (32 percent) and Columbia Pike/Braddock Road (38 percent). Programmed capacity enhancement to these corridors and lower volume growth due to parallel multimodal investments limit the future increases in person hours of delay.

[3] For TransAction, EEAs are defined as any TAZ that is defined as either an MWCOG regional EEA or as a Northern Virginia Equity Area. The MWCOG EEAs were defined using average low-income and minority concentrations for the whole metropolitan region, while the Northern Virginia EEAs were identified using Northern Virginia specific averages.

Figure 18 Total Daily Person Hours of Delay Change (2017–2045)

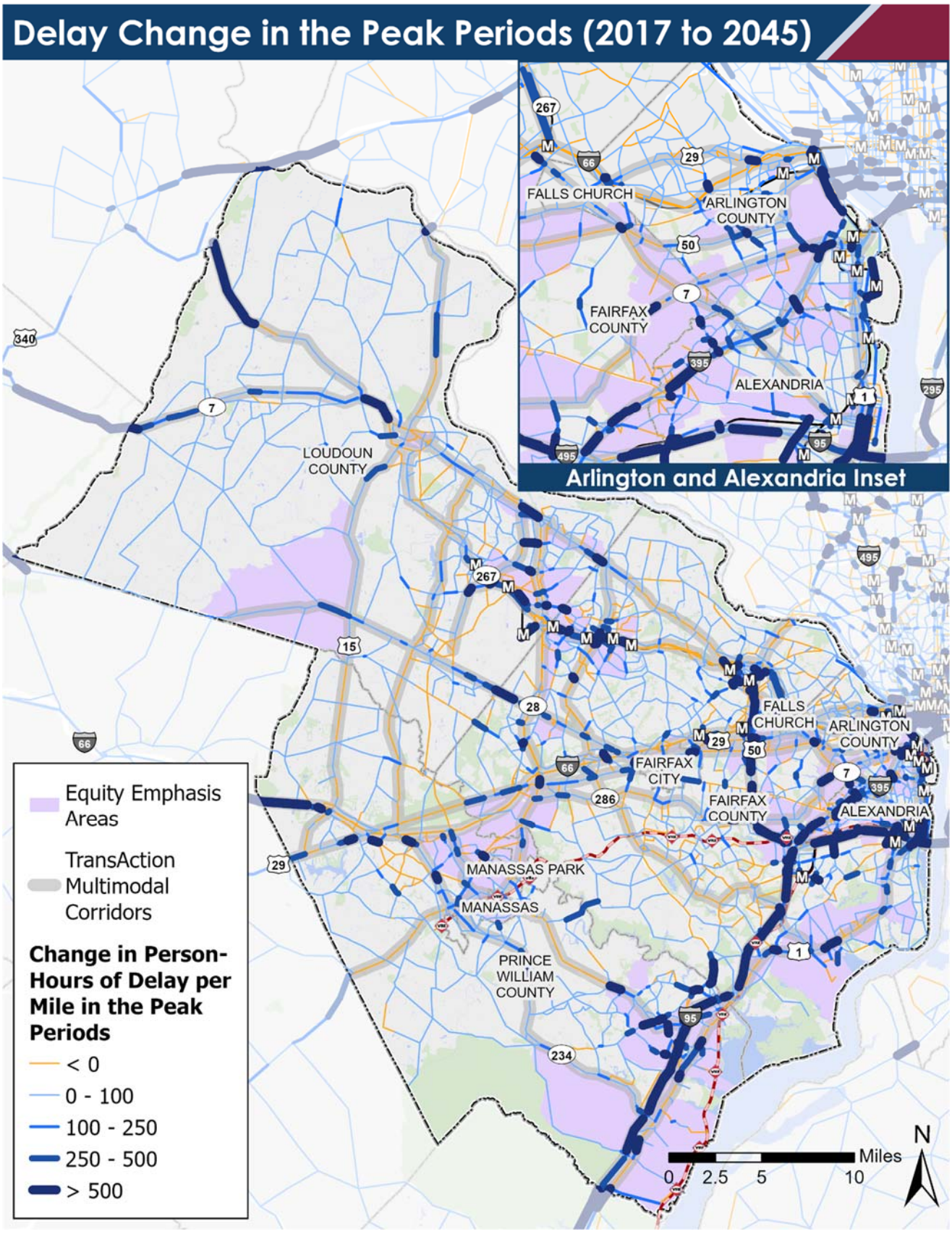
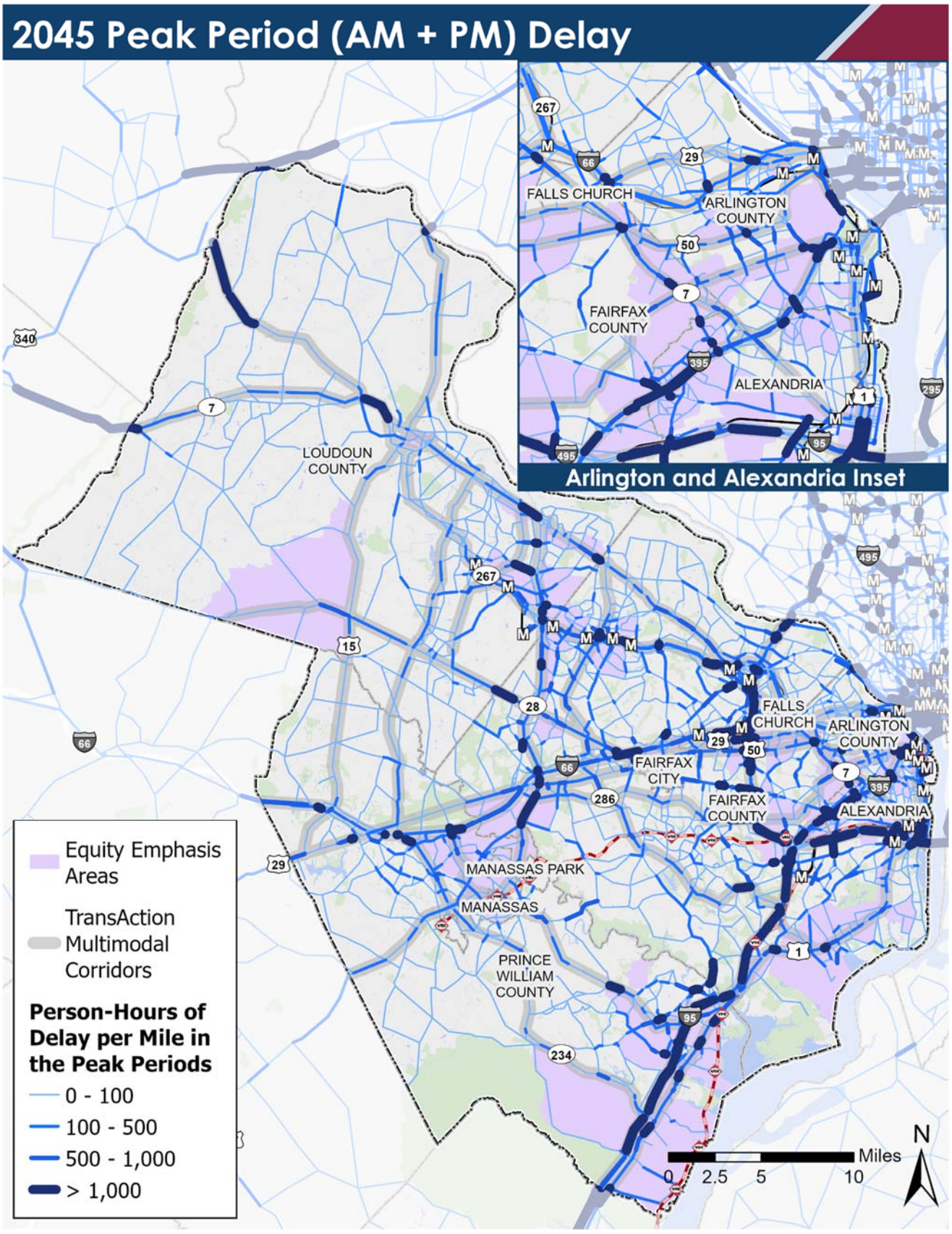


Figure 19 Total Daily Person Hours of Delay (2045)



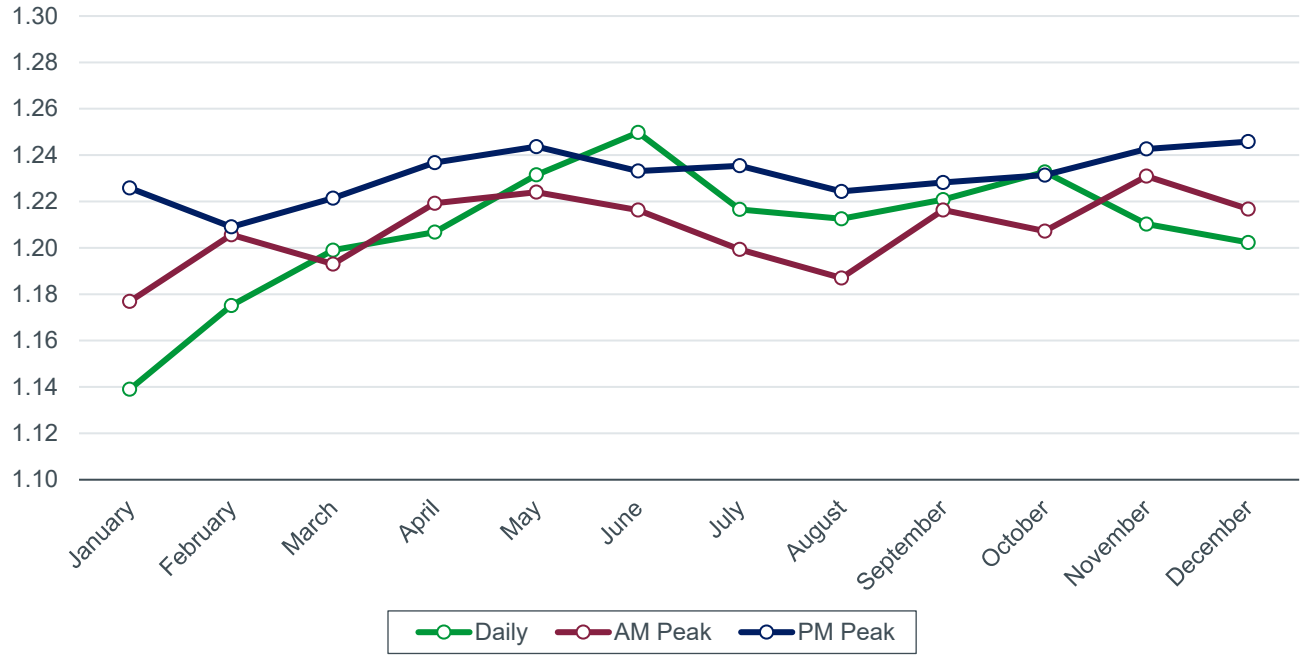
4.1.3 Highway Reliability Measures

Non-recurring events create travel time reliability challenges for Northern Virginia. These non-recurring events include crashes that close lanes or entire roadways for a period of time, weather events, closures of transit services due to an incident or other emergency, or any other unplanned event or infrequent event that impacts transportation system performance.

Roadway reliability is often calculated using the Level of Travel Time Reliability (LOTTR), which is defined as the ratio of the 80th percentile travel time compared to the 50th percentile travel time. Conditions are considered unreliable by users differently, however typically when the LOTTR is above 1.5 (in other words, 20 percent of the time, the trip takes 50 percent longer than the average trip), a corridor is considered to be unreliable.

Figure 20 presents a summary of average LOTTR on a daily basis, in the AM Peak (6 a.m. to 9 a.m.), and in the PM Peak (4 p.m. to 7 p.m.) on weekdays in 2019 based on real speed data collected by INRIX and summarized for analysis by the Regional Integrated Transporation Information System (RITIS). The overall travel time reliability of priority corridors is measured by its annual average LOTTR. The 2019 INRIX data were obtained for the analysis to reflect the system's latest performance before the impact of COVID-19.

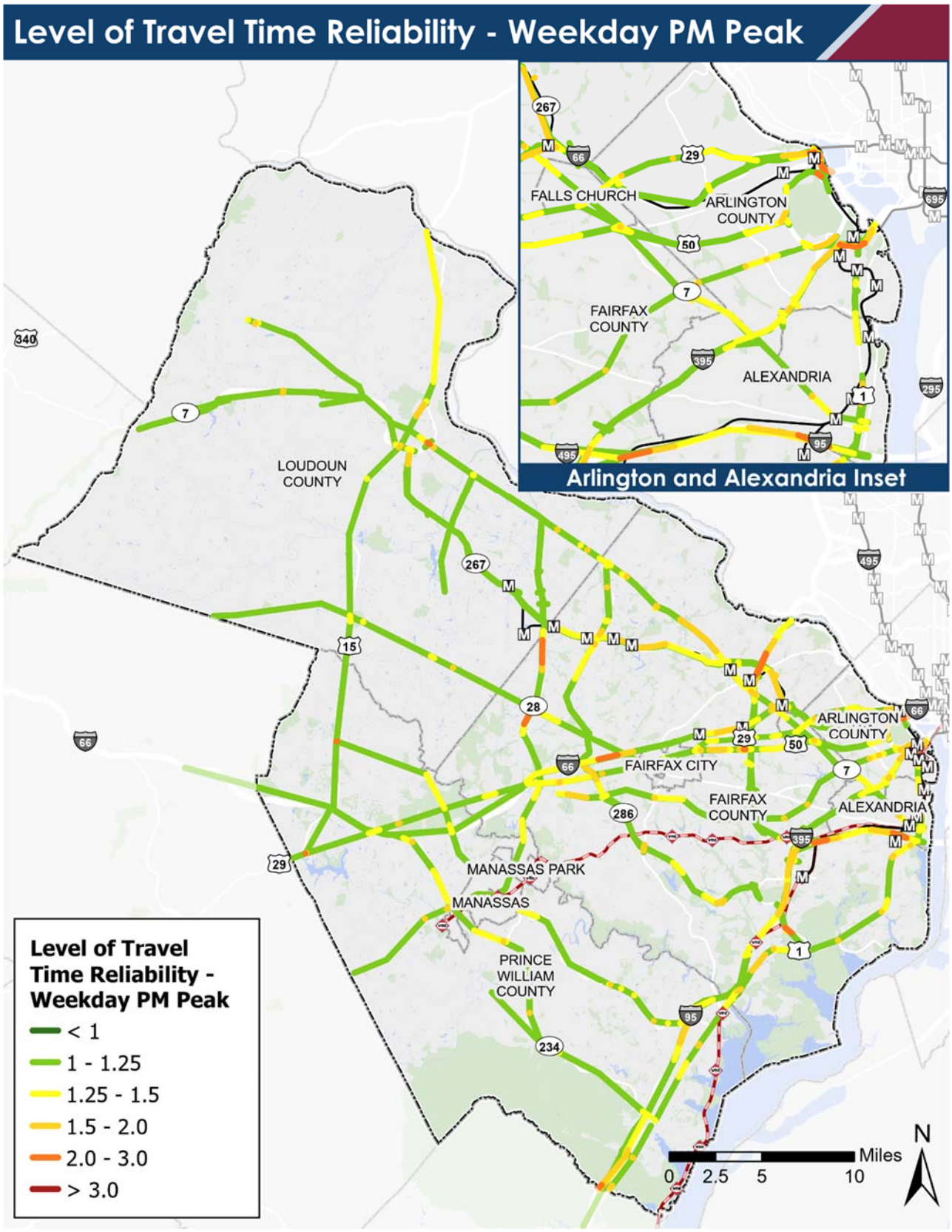
Figure 20 Priority Corridor Overall Travel Time Reliability by Month (2019)



Source: INRIX data obtained from Regional Integrated Transportation Information System (RITIS), 2021.

At the systemwide level, priority corridors operated at acceptable levels of travel time reliability in 2019 (averaging 1.20 to 1.24 by month). However, at the local level, several segments along the priority corridors had LOTTR higher than 1.50. Figure 21 shows the weekday PM peak LOTTR (typically the worst period) on priority corridors. Locations with LOTTR higher than 1.50 account for approximately five percent of total centerline miles of the priority corridors, including segments of I-495 north of Tysons, I-495 south of Alexandria, I-66 west of Falls Church, I-66 west of City of Fairfax, VA 28 between Chantilly and Dulles Airport, I-95 south of the Beltway, and I-95 near Dumfries in Prince William County.

Figure 21 Priority Corridor Overall Travel Time Reliability—PM Peak



Source: INRIX data obtained from Regional Integrated Transportation Information System (RITIS), 2021

Because reliability is very difficult to predict, a related measure, duration of severe congestion, is used to help identify locations on the highway system with likely reliability issues through 2045. Highway segments that routinely experience severe congestion, at travel time ratios of 2.5 or higher (meaning that it takes more than twice as long to complete a trip as it would in normal conditions), are more likely to experience highly unreliable travel conditions. In other words, these segments contribute to 95th percentile travel times, which is the basis for the planning time index (which is the ratio of the 95th percentile peak travel time to the free flow travel time). High travel and routinely congested corridors often have little to no ability to accommodate a reduction in capacity or spike in travel demand—leading to severe reliability issues. Figure 22 highlights corridors that experience different severity levels of congested conditions based on the highest ratio across the AM, midday, and PM peak periods. Many of the same corridors and segments with observed reliability problems in 2019 see travel time ratios at or above 2.5 in 2045 within the AM, midday, and/or PM peak periods.

4.1.4 Weekday Transit and Passenger Rail Performance

According to the TPB model, there were nearly 1.30 million daily transit boardings in the Washington metropolitan region in 2017, and this is forecast to increase to over 1.63 million by 2045. Within Northern Virginia, total weekday boardings in 2017 were 293,000 riders across Metrorail, Metrobus, VRE, and local transit providers. Total daily ridership is projected to increase by 57 percent through 2045, totaling nearly 460,000 daily transit boardings. Table 14 presents a summary of the 2017 observed data and 2045 model-predicted data.

Table 14 Average Weekday Transit Ridership (2017–2045)

	2017	2045	% Growth
Northern Virginia Total	293,000	460,000	57%
Metrorail/VRE	156,000	224,000	43%
Bus[1]	136,000	236,000	73%

Note:

[1] *Bus includes Metrobus, Fairfax Connector, OmniRide, Loudoun County Transit, DASH, ART, and CUE.*

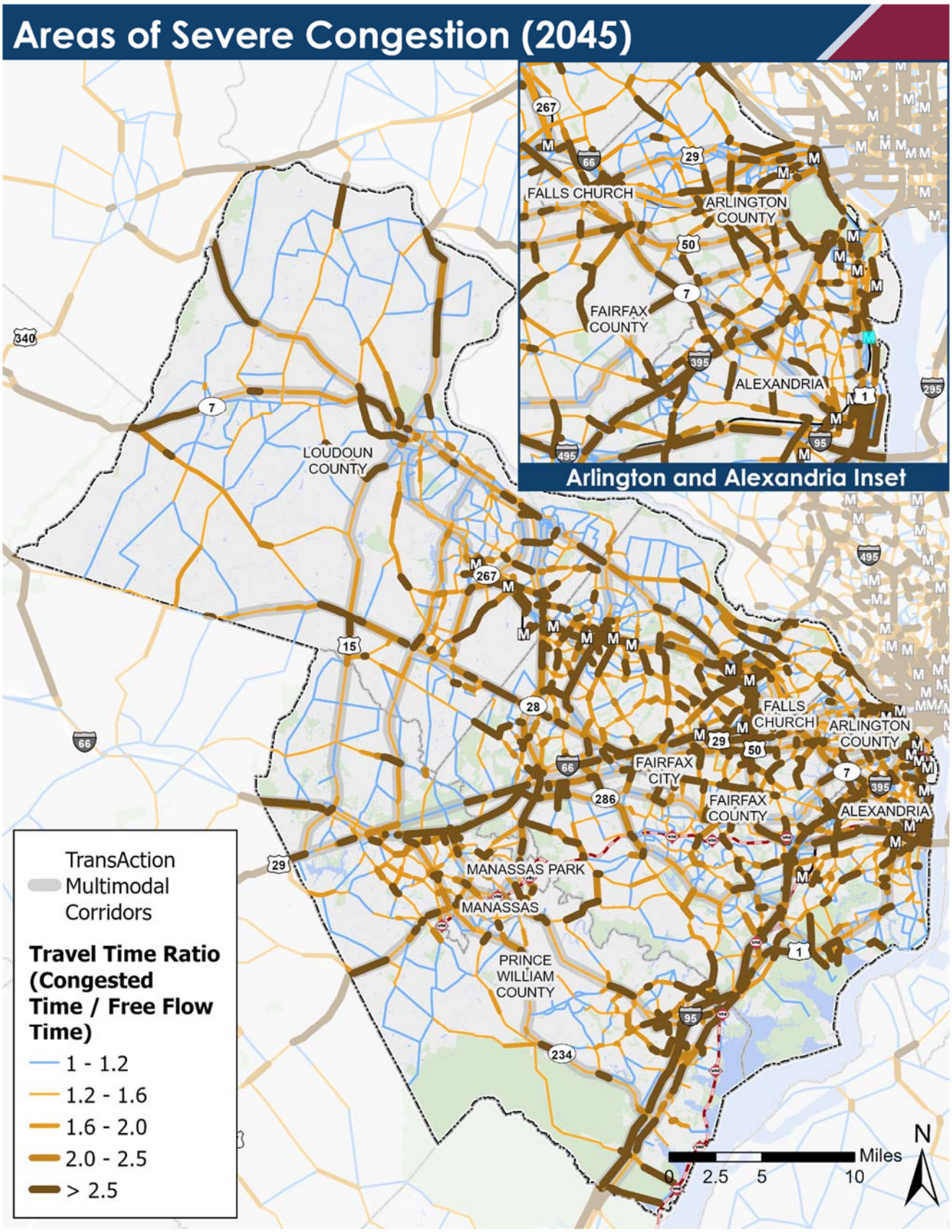
COVID-19 Impact

Annual Northern Virginia transit boardings totaled 81.50 ***million in FY2019 across Metrorail, VRE, and bus service. Annual transit boardings totaled 62.11 million in FY2020, indicating the impact from the COVID-19 pandemic from March through June 2020.***

FY2021 transit ridership statistics show more ***substantial decreases than FY2020. Based on FY2021 data developed by WMATA and DRPT, total Metrorail ridership in Virginia decreased to 13.68 million in FY2021, while total Metrobus ridership in Virginia decreased to 6.92 million. This equates to a 79 percent decrease in Metrorail ridership and a 45 percent decrease in Metrobus ridership.***

Source: NVTC FY2020 Annual Transit Ridership Report

Figure 22 Duration of Severe Congestion (2045)



Transit passenger miles traveled (PMT) also shows significant growth through 2045 (see Table 15). Growth in transit PMT of 46 percent is lower than the 57 percent growth forecasted for weekday ridership. Transit PMT is growing at a much higher percentage than Northern Virginia VMT growth through 2045 (27 percent).

Table 15 Transit Passenger Miles Traveled (2017–2045)

	PMT 2017	PMT 2045	Change
Metrorail/VRE	1,750,000	2,552,000	46%
Bus[1]	607,000	996,000	64%
Total	**2,357,000**	**3,548,000**	**51%**

Note:

[1] *Bus includes Metrobus, Fairfax Connector, OmniRide, Loudoun County Transit, DASH, ART, and CUE.*

On-time performance (OTP) is an important indicator of operational efficiency and customer satisfaction. WMATA has established performance targets of greater than or equal to 88 percent of rail customers arriving on-time, 75 percent of buses departing on-time, and 90 percent of MetroAccess vehicles arriving on-time. According to the Q2 FY2020 Performance Report, service met or exceeded these targets for bus and rail passengers with 90 percent of rail customers arriving on-time and, 76 percent of buses departing on-time; 88 percent of MetroAccess vehicles arrived on-time, falling short of the target of 90 percent.[4]

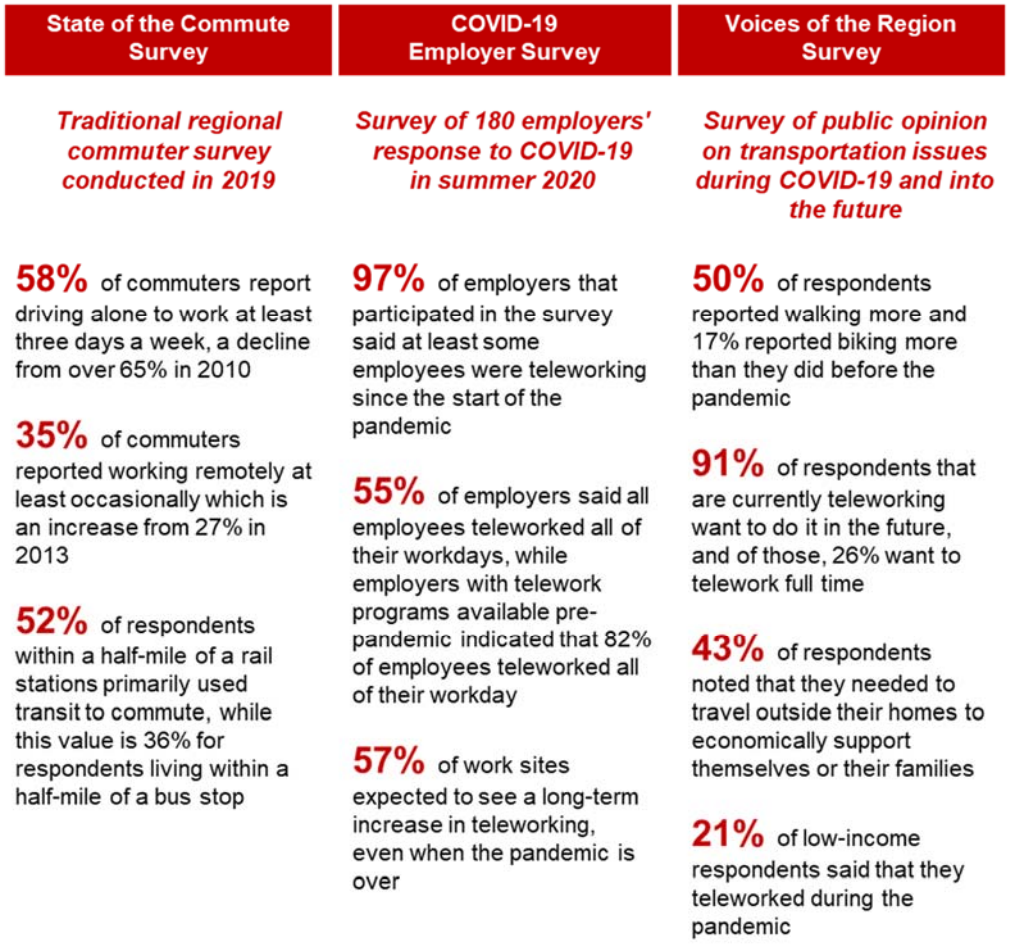
VRE's OTP standard is that trains arrive at their destination within five minutes of scheduled arrival, and no train departs an intermediate station before scheduled departure time. VRE has set a 90 percent OTP target for both the Manassas line and the Fredericksburg line. From 2014 to 2020, OTP was typically between 80 to 90 percent on the Fredericksburg Line and typically between 85 to 95 percent on the Manassas Line. On-time performance sometimes drops lower than these ranges for multiple months due to maintenance activities. For example, the Manassas line dropped to 39 percent OTP in April 2019, while the Fredericksburg line dropped to 53 percent OTP in July 2019. Since the beginning of the COVID-19 pandemic in March 2020, OTP has been above 90 percent on both lines due to VRE running limited-service schedules. Note, as of June 2021, VRE has returned to a full operating schedule (32 trains daily).

4.1.5 Shared Mobility, TDM, and Micromobility Participation

The 2019 State of the Commute (SOC) survey conducted for the Commuter Connections program administered through the National Capital Region Transportation Planning Board (TPB) at MWCOG provides insight into regional trends in commuting patterns and the prevalent attitudes about transportation services. The geographic scope of the 2019 SOC survey encompasses the 11 independent cities and counties that make up the Washington metropolitan nonattainment region. All employed residents who lived within this geographic area were eligible for selection in the study, and over 8,200 responded.

The SOC provides a comprehensive assessment of the use and preference regarding alternative modes within the region prior to the COVID-19 pandemic. During 2020, additional surveys of employers in the region and Voices of the Region survey associated with the ongoing update of TPBs long-range plan (Visualize 2045), provide insight into new perspectives on both commute and non-commute travel within the region.

[4] https://www.wmata.com/about/records/public-records.cfm.



The survey insights highlight that commuting over the prior decade has seen a continuing shift to alternative modes. This shift has occurred particularly for residents with jobs that are amenable to teleworking, with convenient access to transit, and with commute patterns that facilitate use of the regional managed lane network and existing TDM programs. **Low-income workers, workers in industries not amenable to telework, and residents living in areas where access to alternative modes is limited, predominantly drive alone to work often because they have no other reasonable option.** The SOC survey also provides insight into emerging mobility trends across the region, particularly the use of ride-hailing services and micromobility options like scooters and bikeshare.

- **1.1 percent of weekly commute trips were completed by taxi or ride-hailing services in 2019.** Nine in 10 of the taxi/ride-hail mode group trips were made in Uber, Lyft, Via, and other ride-hail services. If the ride-hail services were not available, about one-half of these commuters said they would have driven in a personal vehicle or ridden in a taxi, with the remainder saying that transit would have been the best option.
- **3.3 percent of weekly commute trips were completed by biking or walking, an increase of about 1 percentage point since 2013.** Most of these commuters use their own bike, while about 1 in 4 used a Capital Bikeshare or dockless bike, and about 1 in 10 used a personal scooter or rented scooter. There are currently 209 Capital Bikeshare stations in Northern Virginia with a capacity of over 2,900 docked bicycles.

The increases seen in telecommuting, ride-hailing and micromobility options will continue to shape regional travel into the future. These changes are explored further in TransAction using scenario analysis to test the sensitivity of standard travel forecasts to changes in telecommuting and technology that may change travel behavior.

4.2 Accessibility Needs Assessment

***Accessibility**: Strengthen the region's economy by increasing access to jobs, employees, markets, and destinations.*

Objective: Improve access to jobs

Objective: Reduce dependence on driving alone by improving conditions for people accessing transit and using other modes

4.2.1 Accessibility to Jobs and Opportunities

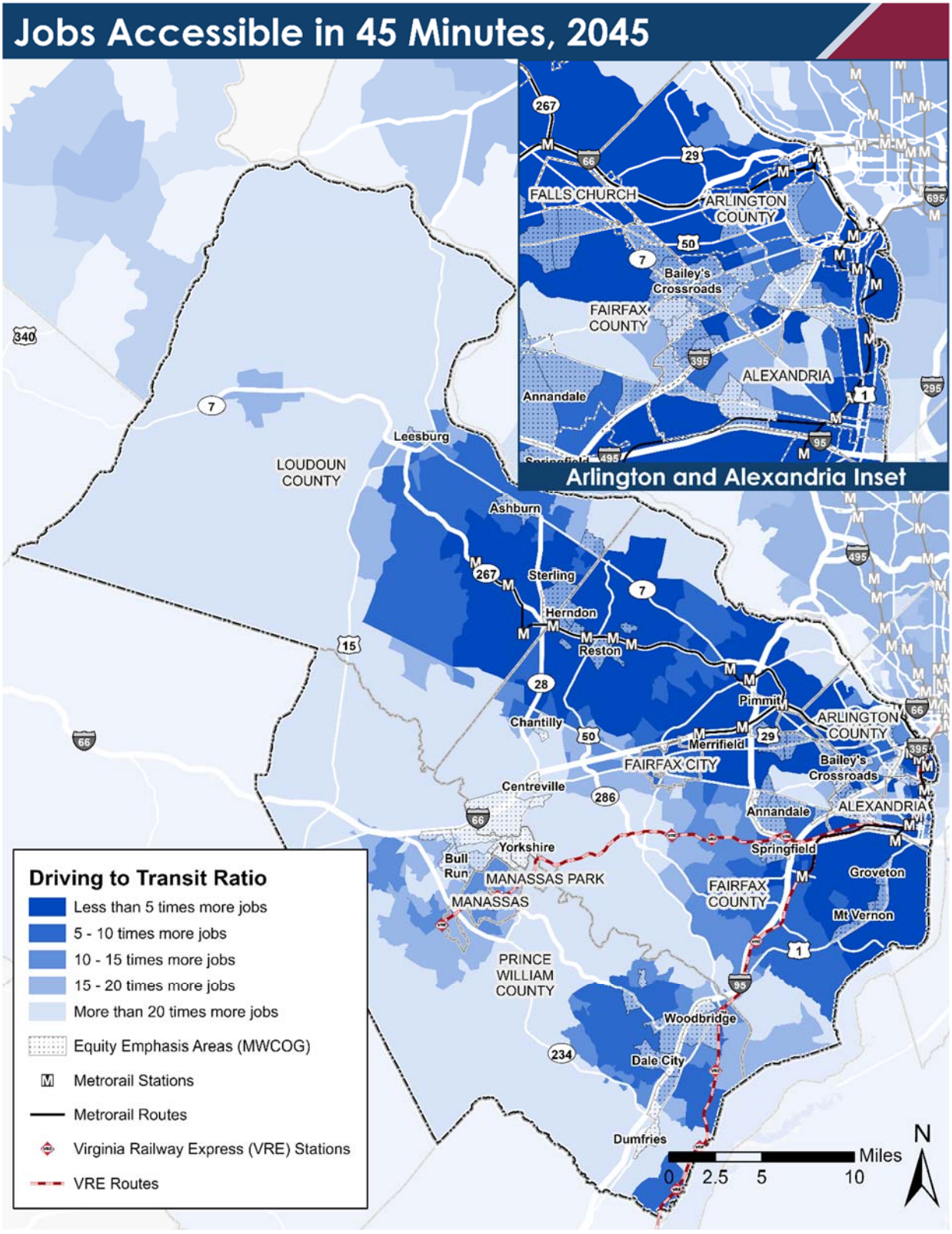
Data from TPB's travel demand model enables an estimate of the population and jobs accessible by driving or transit within 45 minutes of each traffic analysis zone (TAZ) in Northern Virginia. This analysis provides insight into overall accessibility and gaps where the transit network provides significantly less mobility than driving. Overall job access by transit is substantially less than job access by car. Areas in the region with the highest job access by transit still had more than 2 times more jobs accessible by driving within 45 minutes than by transit.

Transit accessibility to jobs varies from more than a million jobs reachable for residents in highly connected locations like Arlington to zero jobs accessible by transit for areas without any transit service. The modeling results show improvements in job accessibility between 2017 and 2045, especially by transit. The most substantial improvements in accessibility are expected in Alexandria (Potomac Yards, Beauregard Street corridor), the Dulles Toll Road Corridor through Fairfax and Loudoun counties, and Woodbridge/Dale City area of southern Prince William County. **There are several notable gaps in current transit access that will not be resolved through investments currently planned from now to 2045, which helps to inform potential TransAction investment** (see Figure 23):

- **I-66 Corridor Outside the Beltway:** Communities such as the City of Fairfax, Centreville, and Haymarket are forecasted to have little change in job accessibility by transit compared to driving between 2017 and 2045. For example, the average Centreville resident will have access by transit to just 5 percent of the jobs accessible by driving within 45 minutes.
- **U.S. 1 Corridor South of Dale City:** Outer suburban communities like Dumfries are expected to see little improvement in transit accessibility relative to driving, based on the CLRP analysis, over the next 25 years or more. In 2045, residents will be able to access more than 20 times more jobs by car than by transit within 45 minutes.
- **Columbia Pike between Annandale and Bailey's Crossroad:** The neighborhoods along Columbia Pike between Annandale and Bailey's Crossroads stand out as one of the largest gaps in transit access within the Beltway. This area is forecasted to see substantially worse transit access to jobs than adjacent parts of Annandale and Falls Church.

Other areas such as Fairfax Station, neighborhoods west of Rt. 123/Old Ox Road in Fairfax County, and much of Central Prince William County (along Rt. 234 and Rt. 294/Prince William Pkwy., show notable gaps in transit service compared to adjacent areas.

Figure 23 Comparative Access to Jobs by Transit and Driving by TAZ, 2045



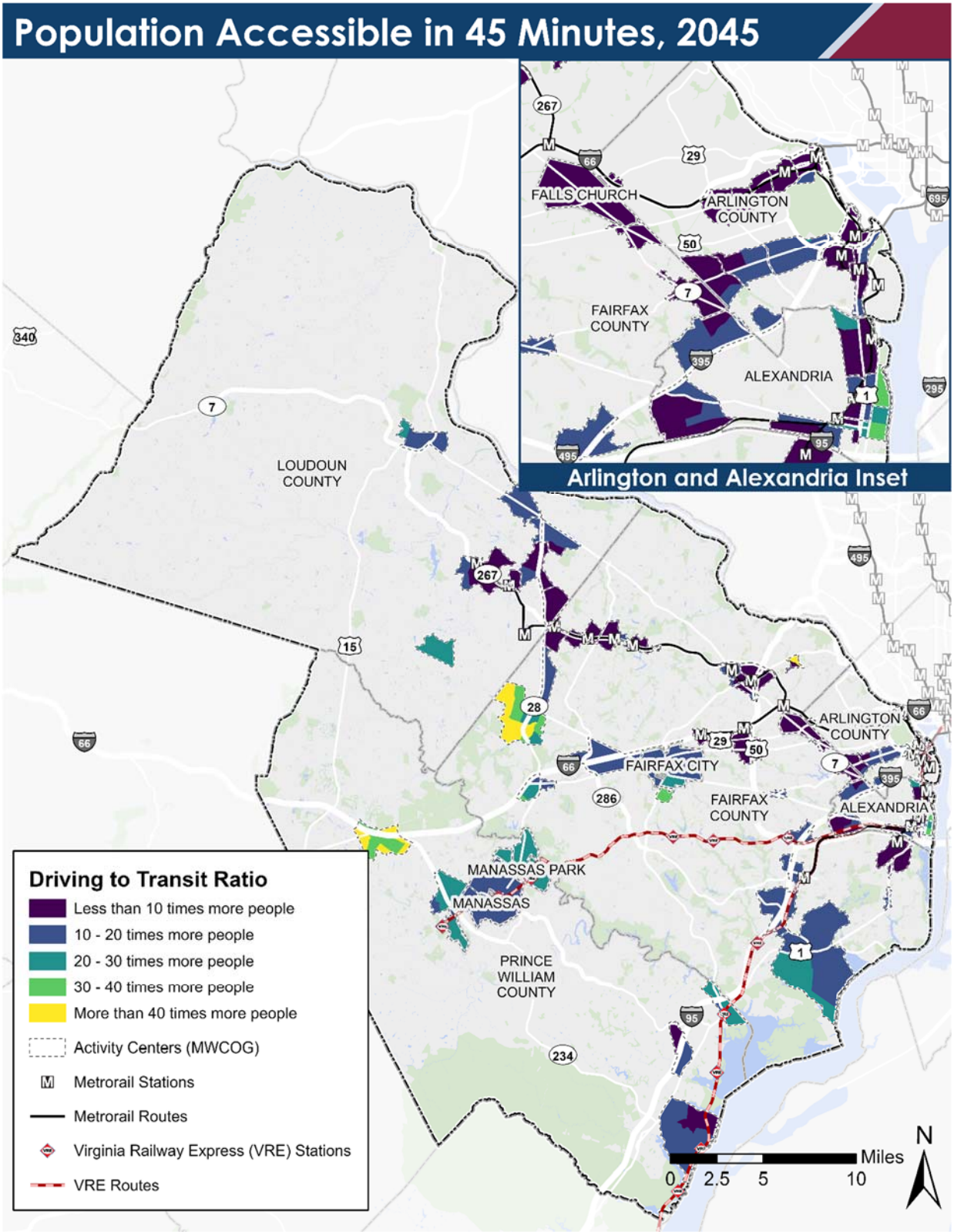
Another lens to evaluate accessibility is the population reachable from an activity center within 45 minutes of transit or driving (see Figure 24). This metric provides insights into how well the existing and planned transit network serves Northern Virginia's activity centers and identifies the employment-shed for jobs located in these activity centers. As expected, activity centers tend to have better transit accessibility than surrounding areas, although the level of accessibility differs widely by activity center and is dependent not only on transit service but the density of the surrounding communities.

Note, this is transit access from any transit service, regardless of the practicality of the trip. For example, Manassas shows a comparatively low transit-to-drive-access ratio relative to other suburban activity centers given the presence of VRE—although very few commuters are riding VRE to jobs in Manassas.

Activity centers with relatively poor transit access in 2045 include:

- **Activity Centers along I-395:** Compared to their Metro-accessible counterparts like Pentagon City and Rosslyn, activity centers such as Landmark, Beauregard, Shirlington, and Columbia Pike Village Center have less than one-half the number of people reachable within their 45-minute transit catchment area. Some of these areas are the focus of planned improvements such as the West End Transitway.
- **Alexandria Waterfront:** Old Town Alexandria stands out as one of the few dense urban areas of Northern Virginia with much worse transit access than driving access. This may reflect very high auto accessibility due to its proximity to the Beltway and the fact that the neighborhood requires a moderately long walk of over one mile to the King Street Metrorail station.
- **Gainesville and Upper Prince William County:** Portions of Gainesville have 40 times more people accessible by a 45-minute drive than 45-minute transit trip.
- **Dulles South:** The Dulles South corridor stands out as having the worst level of transit access to the region's population among activity centers in Fairfax County.
- **George Mason University:** This activity center has among the lowest transit accessibility as a percentage of auto accessibility of any activity center in Northern Virginia.

Figure 24 Comparative Access to Population by Transit and Driving by Activity Center, 2045



4.2.2 Comparative Access to Equity Emphasis Areas

Equity emphasis areas (EEAs) have been identified by MWCOG as part of Visualize 2045 to identify communities that have significant low income and/or minority populations.

Compared to job accessibility for all TAZs in Northern Virginia, EEAs in the region had slightly higher job accessibility by both transit and driving. While EEAs do not have less access to jobs than non-EEAs, there is still a significant difference in the number of jobs residents can access by transit compared to driving. This is important because many of the populations in these areas are more dependent on transit to access jobs and other opportunities. By 2045, as presented in Table 16, the regional travel demand model predicts EEA residents will only be able to reach one-quarter of the jobs by transit that are accessible by driving.

Table 16 Population Weighted Average Jobs Accessible by Transit and SOV Driving for EEAs, 2045

	Jobs within 45-Minute Drive	Jobs within 45-Minute Transit Trip	Accessible Auto Jobs to Accessible Transit Jobs Ratio
EEA	1,599,800	388,850	4.0 times more jobs by auto
Non-EEA	1,416,410	356,231	4.1 times more jobs by auto

4.2.3 Access to Critical Services

TransitCenter, a transit advocacy and research organization, has an Equity Dashboard that measures the effective accessibility of key public services by transit versus car. The analysis looks at average travel times by Census Block group in February 2020 by car and transit during the AM Peak period. **The results of the analysis demonstrate that, in much of the region, access to services like hospitals, higher education, and grocery stores is worse for transit riders than drivers.**

The disparity in auto and transit access is most striking for hospitals (see Figure 25). **Equity emphasis areas like Annandale, Bailey's Crossroads, Woodbridge, and Herndon have average transit travel times of 40 minutes or greater to the nearest hospital. Compared to driving, travel times to the nearest hospital for transit riders is upwards of 3 times longer.**

Travel time disparities exist for other critical services as well. While average travel times are lower than for hospitals, the typical transit travel time to the nearest college or university is more than double drive times in most of the region's equity emphasis areas as shown in Figure 26. Grocery stores, which generally have good accessibility across the region, are less accessible for transit riders than drivers, especially outside the Beltway were transit service is less extensive and less frequent.

Figure 25 Difference in Access Times to the Nearest Hospital by Transit and Car

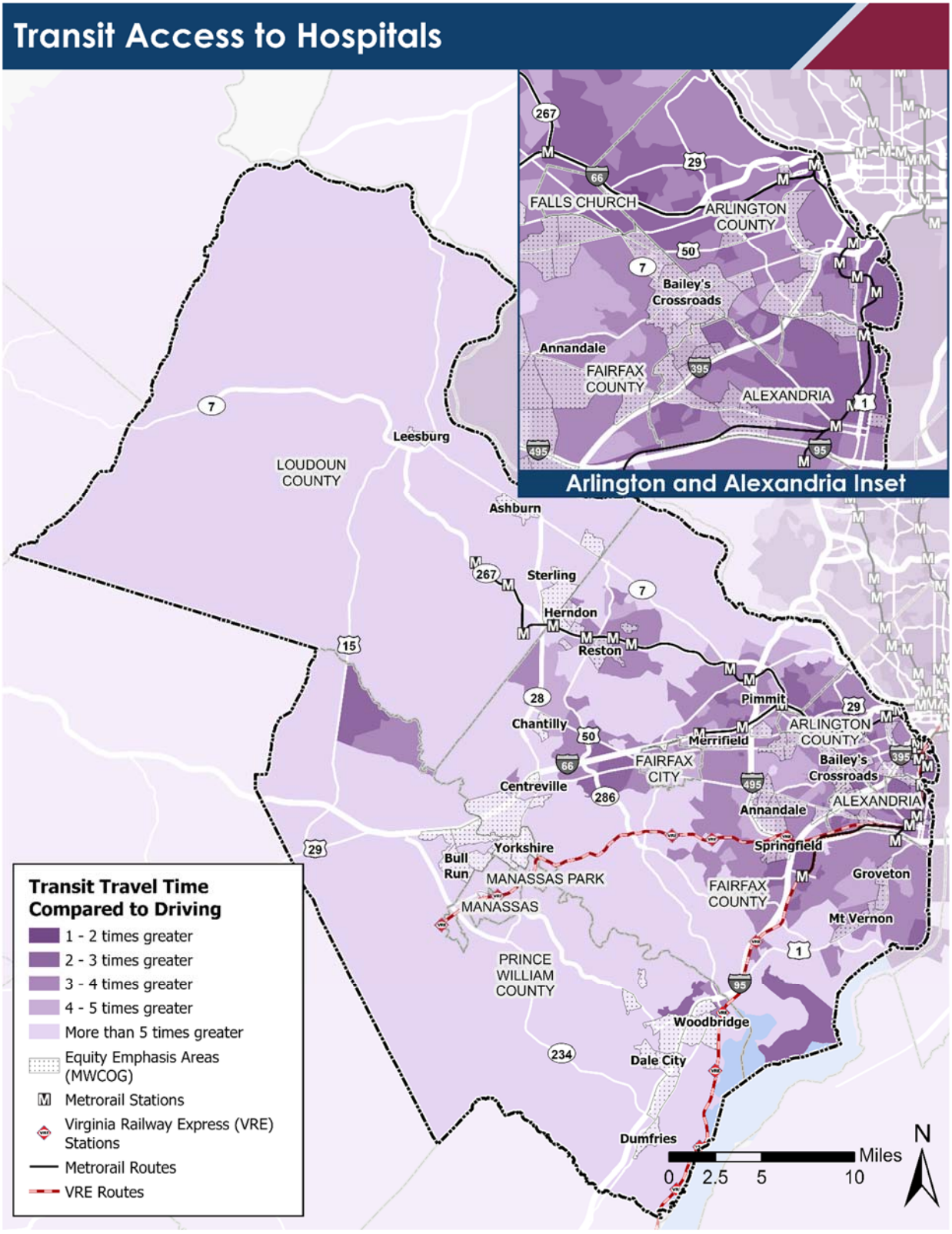
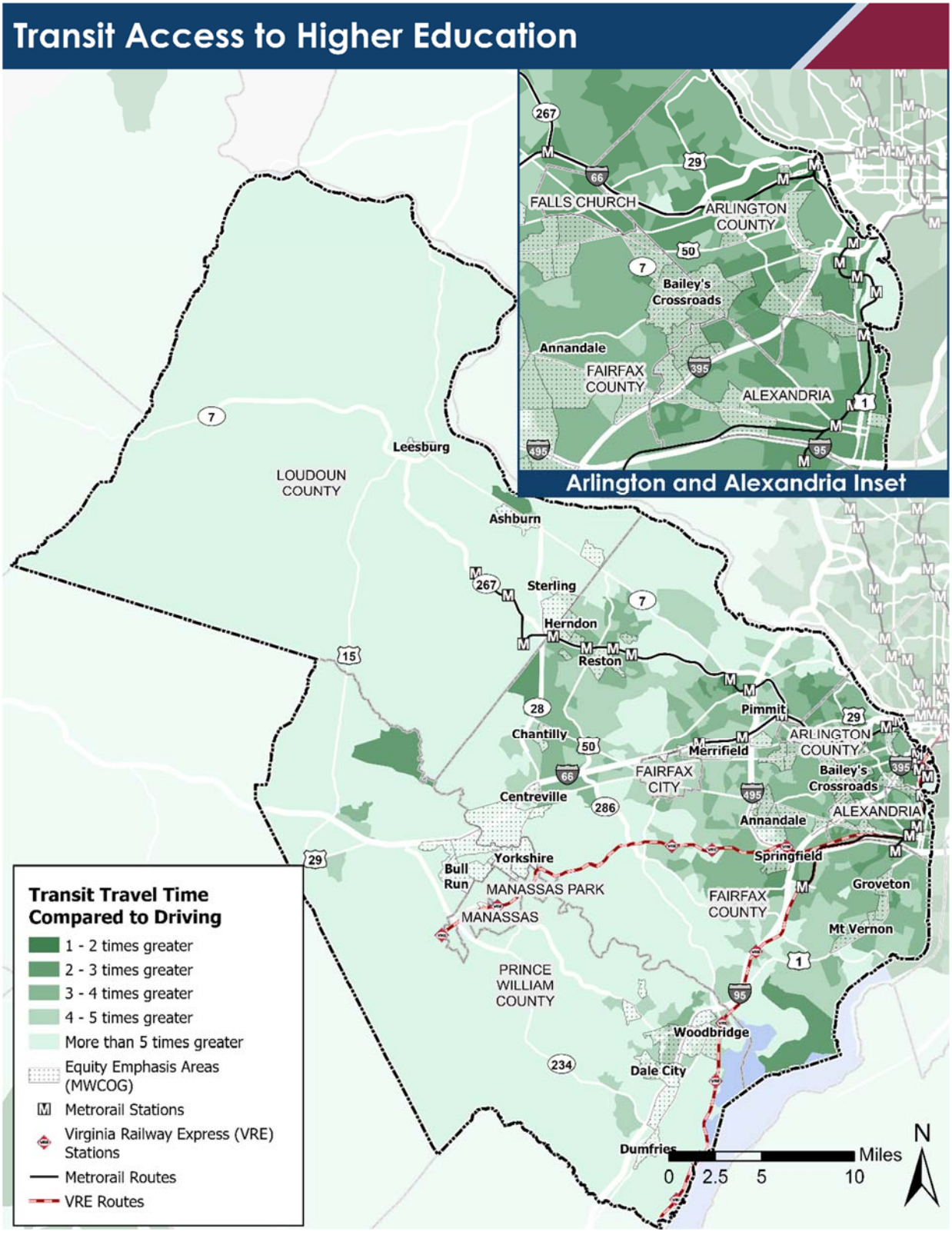


Figure 26 Difference in Access Times to Higher Education by Transit and Car



4.2.4 First Mile/Last Mile

Access to Transit

Access to high-quality transit is a critical factor in increasing the share of regional trips made on transit instead of by automobile. Improving access to transit can also reduce emissions through efficiency in moving people and through reduction of emissions produced by SOVs while idling in congestion. Transit access continues to be a priority for the region as evidenced by TPB's designation of 49 Transit Access Focus Areas (TAFAs) to prioritize those places with the greatest need for improvements to make it easier for people to walk and bike to transit.

Most people living in Northern Virginia have access to a fixed public transit route within a quarter mile of their home or job. While the network is most dense in the inner-ring suburbs of Alexandria and Arlington, the transit network extends into every jurisdiction in the region**. The most significant gaps in transit coverage exist in suburban and outer suburban communities in Prince William and Loudoun counties, which are expected to see the largest percentage growth in VMT by 2045.** In these areas, transit service only operates on a handful of major corridors, resulting in a lack of service in some more densely populated areas like portions of Manassas Park; Linton Hall, Haymarket, and Dale City in Prince William County; and the Dulles South area of Loudoun County. Within Fairfax, Arlington, and Alexandria, there are gaps in transit coverage, but those tend to be small and do not include neighborhoods with transit supportive densities.[5]

A more salient measure of transit accessibility is the prevalence of either all-day or frequent transit. All-day service includes transit operating at least 18 hours a day and frequent service includes transit operating at 10-minute or better headways during the AM Peak. While much of the region has access to some transit service, most routes operate infrequently or do not run beyond the peak periods. Only 45 percent and 44 percent of jobs are within a quarter mile of frequent and all-day transit service, respectively (see Table 17). **Twenty-seven percent of the population lives within a quarter mile of frequent and/or all-day transit.**

Table 17 Population Living within a Quarter Mile of Transit by Level of Service

	% of Population	% of Jobs
Any Fixed-Route Transit	57%	74%
10-minute or better headways	27%	45%
18+ hours of service	27%	44%

Communities inside the Beltway have the best access to all-day and frequent service, with only minor gaps in coverage (see Figure 27 and Figure 28). The rapidly developing Potomac Yards area of Alexandria is served by frequent Metroway bus service during the day but lacks transit service after approximately 10 p.m. (although this will be remedied before 2045 with the addition of the Potomac Yards Metrorail Station). In Arlington, the Claremont and Douglas Park neighborhoods along Four Mile Run Drive include Census Block Groups with densities exceeding 10,000 people per square mile but lack access to either frequent or all-day transit. Other commercial areas and suburban residential neighborhoods that have access to transit. However, due to their travel demand profile or overall development density, they may not warrant all-day and/or frequent service and therefore do not stand out as needs.

[5] Minimum transit supportive density of 3,500 people per square mile.

Figure 27 Access to All-Day Transit Service

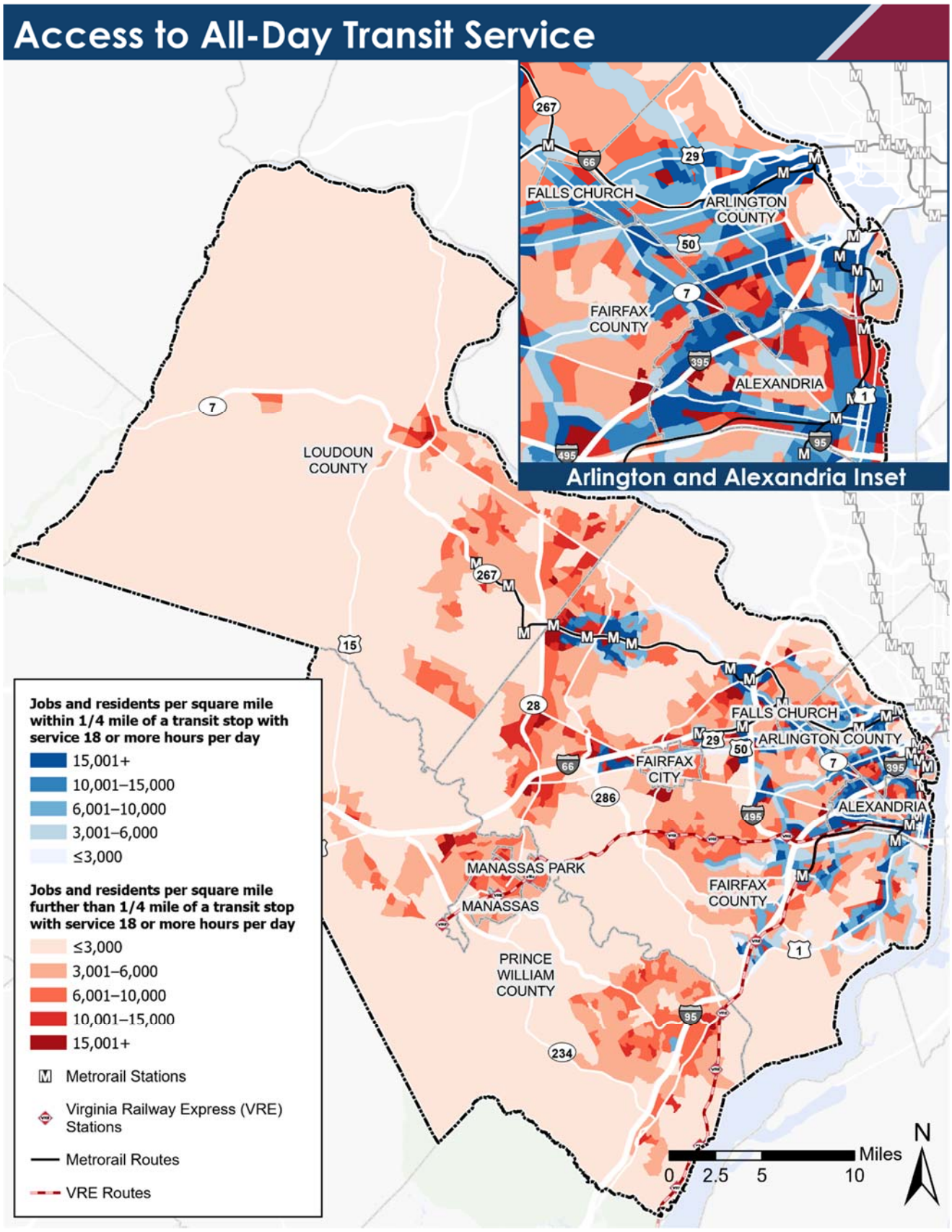
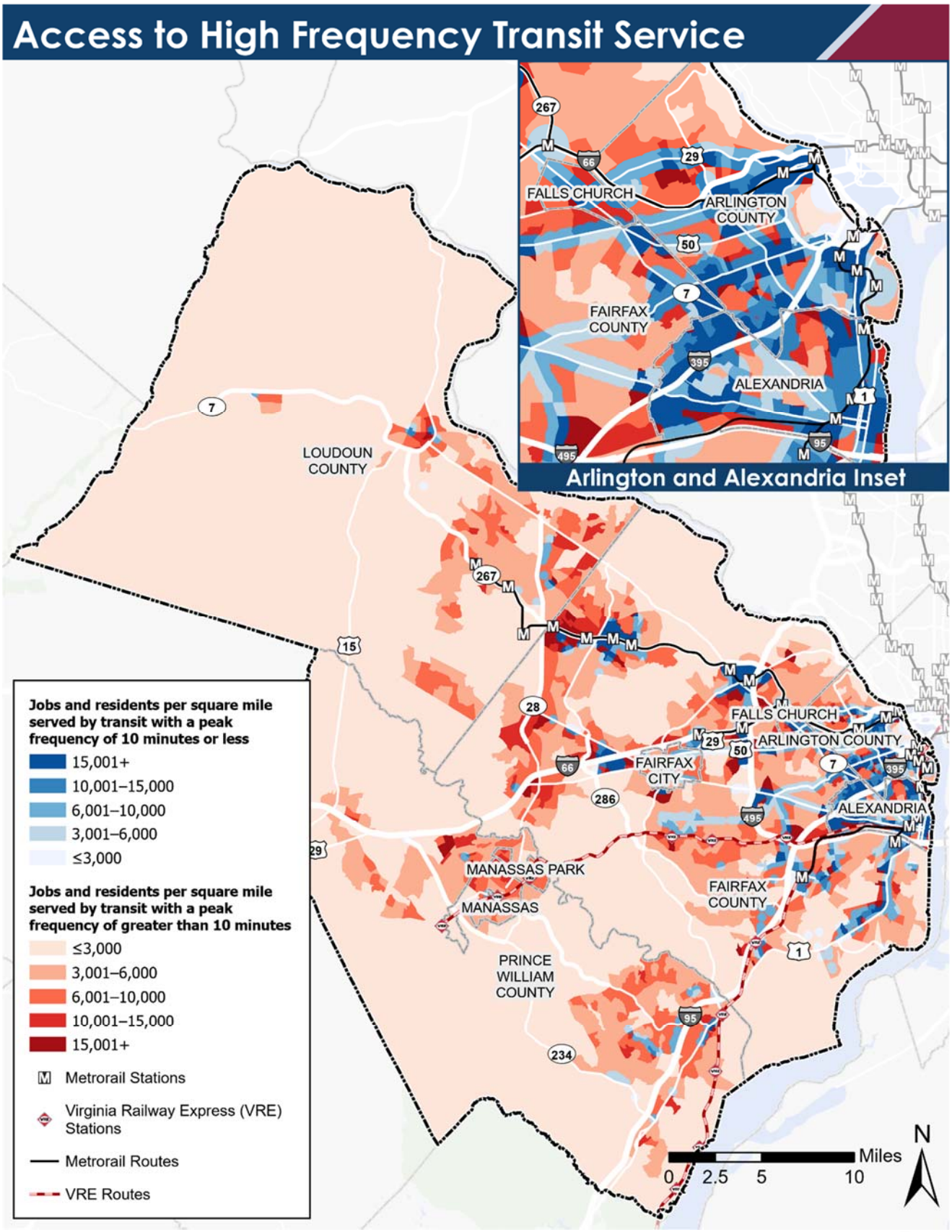


Figure 28 Access to High-Frequency Transit Service



Outside the Beltway, there are more substantial gaps in access to frequent and all-day service. The Dulles Corridor from Reston to Ashburn is home to some of the highest concentrations of people and jobs in the region but lacks frequent transit service and only a few routes serving this large area operate into the late-night period. Similarly, suburban centers like Manassas, Manassas Park, and Dale City lack any frequent or late-night transit. The U.S. 50 corridor from Fairfax to Chantilly lacks high levels of transit service even though this rapidly developing corridor is home to high concentrations of housing and moderate concentrations of jobs.

Bicycle Infrastructure

Northern Virginia currently has uneven access to bicycle infrastructure. While the region is served by a network of trails and dedicated on-road bicycle facilities, significant gaps exist in the bicycle network that make bicycling a challenging mode of transportation for many residents. To evaluate bicycle accessibility, the study team completed a network accessibility analysis that uses Bicycle Level of Traffic Stress (BLTS). Essentially, this analysis measures how far one can travel on the local roadway network on bicycle-friendly roads.

A BLTS assessment identifies the combined road network that is suitable for bicyclists of most skill and comfort levels using a combination of roadway geometry information from VDOT's linear referencing system and average annual daily traffic (AADT). The analysis scores roadway segments on a scale of 1 (lowest level of traffic stress) to 4 (highest level of traffic stress) based on posted speed limits, AADT, number of lanes, and availability of dedicated bike infrastructure. To evaluate BLTS at a regional scale, Northern Virginia was divided into five-mile-wide hexagon cells, which were scored based on the contiguous length of low-stress streets (Figure 29).

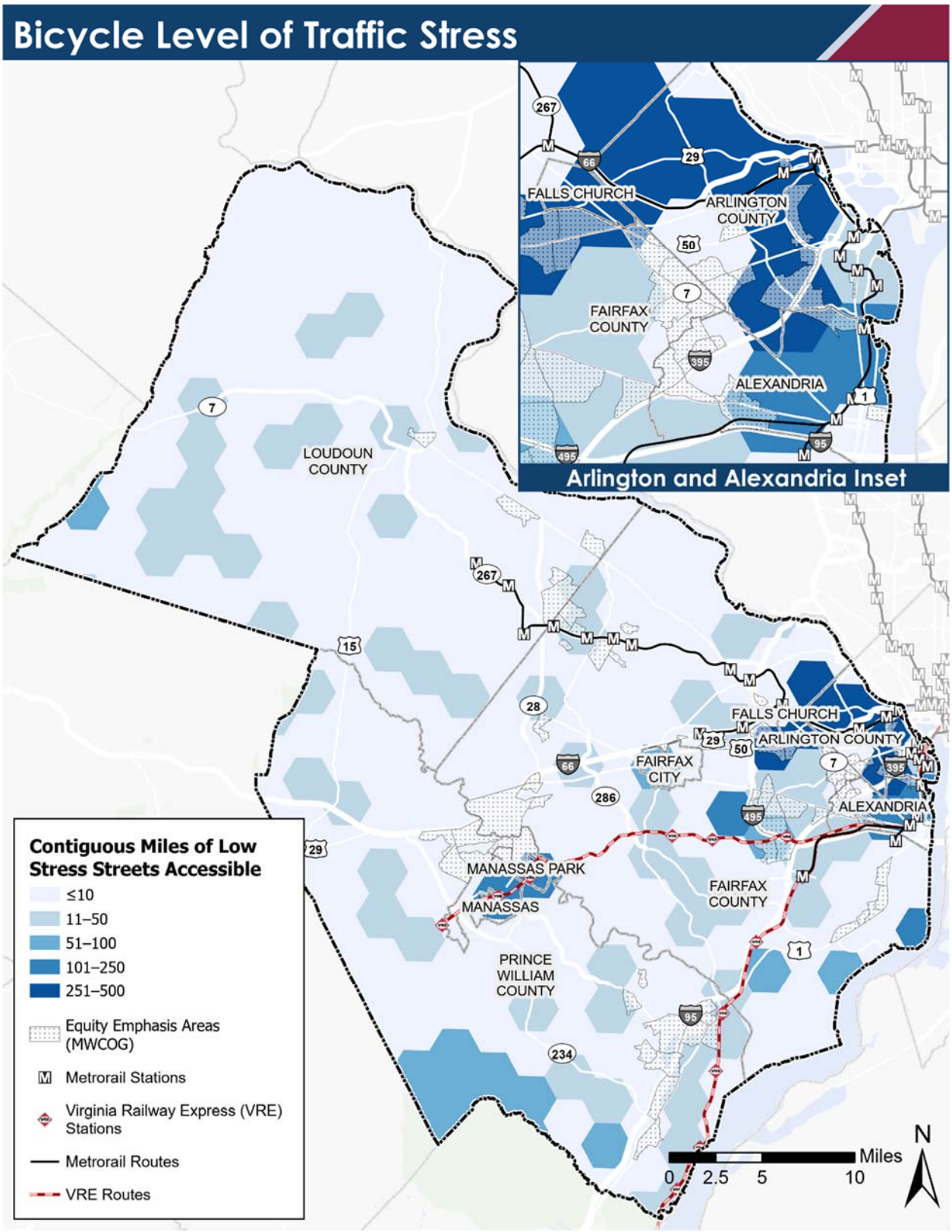
The analysis found that Arlington, Alexandria, Falls Church, and Manassas stand out as having the best low-stress network connectivity, meaning cyclists in these areas can travel farthest riding on roads that are conducive to biking. Outside these areas, a disconnected street grid, the need to travel on busy arterials, and gaps in bicycle infrastructure all pose challenges to cycling. **Densely populated areas like Alexandria West, Landmark, Bailey's Crossroads, Tysons, and Reston stand out for having a disconnected and inconsistent network of bicycle infrastructure.**

Longer distance bicycling trips are challenging due to gaps in the regional trail network. The W&OD and Mount Vernon trails provide key connections between regional activity centers. While shorter trails and on-street facilities provide additional connectivity, many of the region's major activity centers (e.g., Tysons, Seven Corners) lack access on dedicated or low-stress facilities.

The Capital Trails Coalition (CTC) is a collaboration of public and private organizations, agencies, and citizen volunteers working to advance completion of an interconnected network of multi-use trails for the metropolitan Washington D.C. region, including Arlington County, Alexandria, and Fairfax County. The Coalition coordinates among the public and private stakeholders who are critical to accomplishing the vision of an interconnected network. In the *Economic, Health, and Environmental Benefits of Completing the Capital Trails Network* report, a summary of benefits and existing and planned trail networks was documented.[6] The report references planned trails developed by CTC and its partners, including nearly 8 miles in Arlington County, over 6 miles in Alexandria, and over 60 miles in Fairfax County. These trails are viewed as critical connections particularly to address longer distance bicycling needs, while also provide direct access to important destinations.

[6] https://www.capitaltrailscoalition.org/report/.

Figure 29 Low-Traffic Stress Bicycle Network Connectivity Measure



BLTS connectivity analysis is not a perfect predictor of bicycle accessibility. Some subregions that would be considered relatively bike friendly still score poorly because of geographic constraints; for example, Old Town Alexandria scores poorly due to being hemmed in by low BLTS roadways around its periphery. Conversely, areas with restricted road access (e.g., Dulles Airport) show high levels of bicycle connectivity, but this is an artifact of the underlying road network that does not completely reflect conditions on the ground.

4.3 Safety and Resiliency Needs Assessment

Strengthen the region's economy by increasing access to jobs, employees, markets, and ***destinations.***

Objective: Improve safety and security of the multimodal transportation system

Objective: Reduce transportation related emissions

Objective: Maintain operations of the regional transportation system during extreme conditions

4.3.1 Regional Highway Safety Profile

Since 2017, Northern Virginia has represented roughly 20 percent of VMT in the Commonwealth of Virginia but less than 10 percent of fatalities (Figure 30). The proportion has ranged from 14.2 percent of serious injuries in 2017 falling to a low of 10.2 percent in 2020 (Figure 31).

Like the Commonwealth and the Nation, Northern Virginia saw a sharp increase in the fatality rate in 2020, due to lower pandemic VMT (23.1 percent decrease in Northern Virginia) but similar numbers of fatalities (only 6.9 percent decrease in Northern Virginia). The leading factors in these crashes include speeding and impaired driving,[7] which includes drunk, drugged, drowsy and distracted driving.

In addressing roadway safety, the Commonwealth applies a mix of infrastructure and behavior improvements. According to a 2020 Metropolitan Washington Council of Governments MWCOG report, in terms of road user behavior, 30 percent of fatal crashes in the region involve someone not wearing their seatbelt.[8] The second most common factor in fatal crashes was speeding and roadway departure.

Of the 80 fatalities in Northern Virginia in 2020, 70 occurred during normal driving conditions, and approximately 50 occurred during dusk or night.[9] There is some randomness to the location of fatal crashes, however, when looking at the locations during 2020 there are some key corridors of concern, including: 10 total fatal crashes on I-95 or on access roads adjacent to I-95; eight total fatal crashes on U.S. 1 (six in Fairfax County and two in Prince William County in Dumfries); and five total fatal crashes on I-66. Given the high volumes on these corridors, these results are generally expected. For the nearly 700 serious injury crashes in Northern Virginia in 2020, there are some more

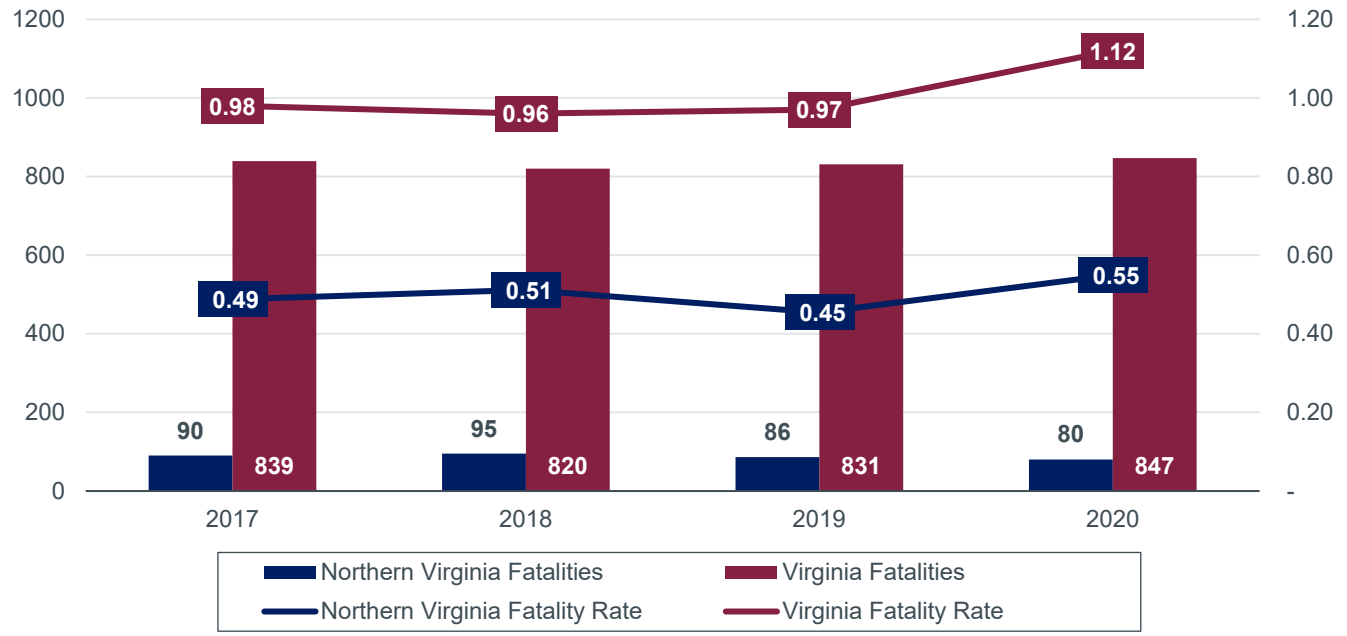
7 NHTSA (2021). "2020 Fatality Data Show Increased Traffic Fatalities During Pandemic." https://www.nhtsa.gov/press-releases/2020-fatality-data-show-increased-traffic-fatalities-during-pandemic.

8 Transportation Planning Board (TPB) (2020). TPB Safety Study Resources & Safety Policy. https://www.mwcog.org/documents/2020/07/22/tpb-safety-study-resources—safety-policy-Federal-performance-measures-highways—roads-traffic-safety/.

9 VDOT Crash Analysis Tool.

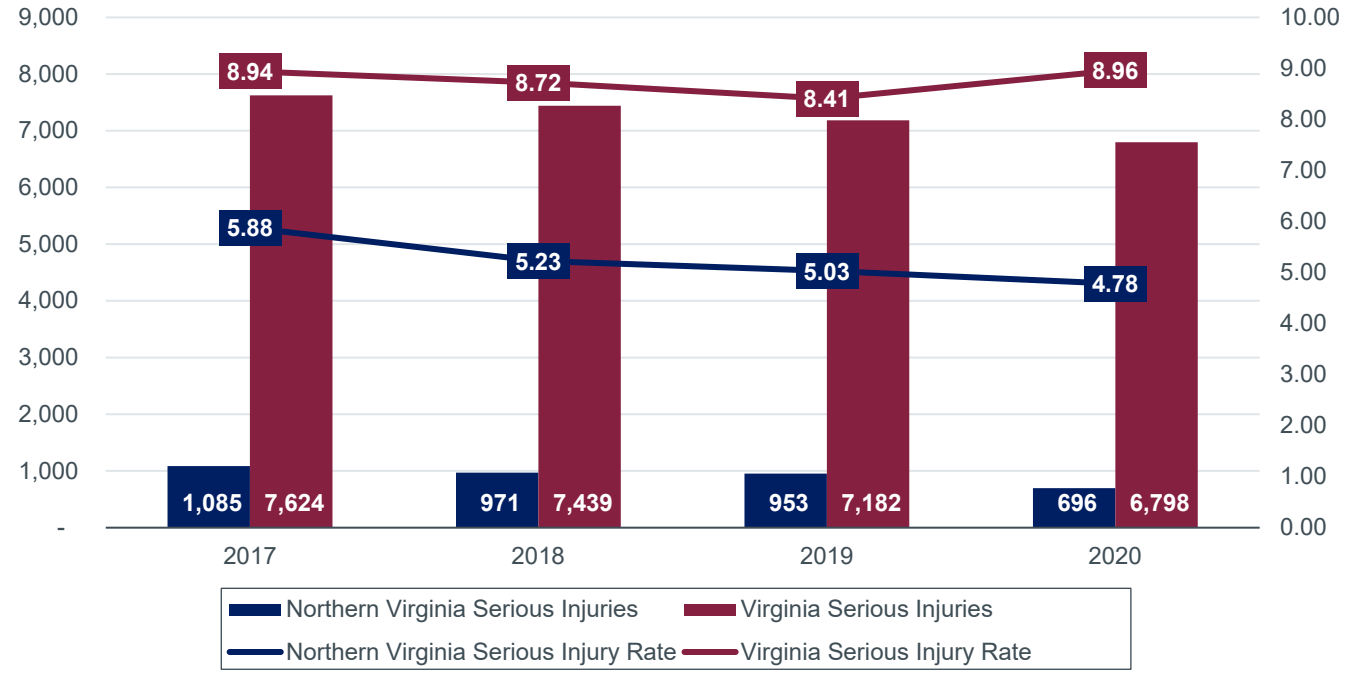
apparent crash clusters (not corridor specific, and less associated with traffic volumes) including: 24 in the Herndon area, 16 in Leesburg, and 15 in Falls Church (including Seven Corners).

Figure 30 Fatalities and Fatality Rate



Source: VDOT Traffic Safety Data

Figure 31 Serious Injuries and Serious Injury Rate



Source: VDOT Traffic Safety Data

Serious injuries have been trending downward for both the region and the state. However, the serious injury rate in Northern Virginia has been decreasing even as it rises in the Commonwealth as a whole. As the case with all crashes, leading factors in both fatalities and serious injuries include speeding and impaired driving.

4.3.2 Regional Bicycle and Pedestrian Safety Profile

Bicycle and pedestrian fatalities and serious injuries generally increased in the last few years, except for 2020, likely reflecting the anomaly of pandemic conditions. Northern Virginia fatalities and serious injuries for these system users represent between 23 and 28 percent of Virginia fatalities and serious injuries (Figure 32). During this time, pedestrian fatalities and serious injuries peaked in 2019 (160) and decreased to 120 in 2020 (Figure 33).

Figure 32 Total Non-Motorized Fatalities and Serious Injuries

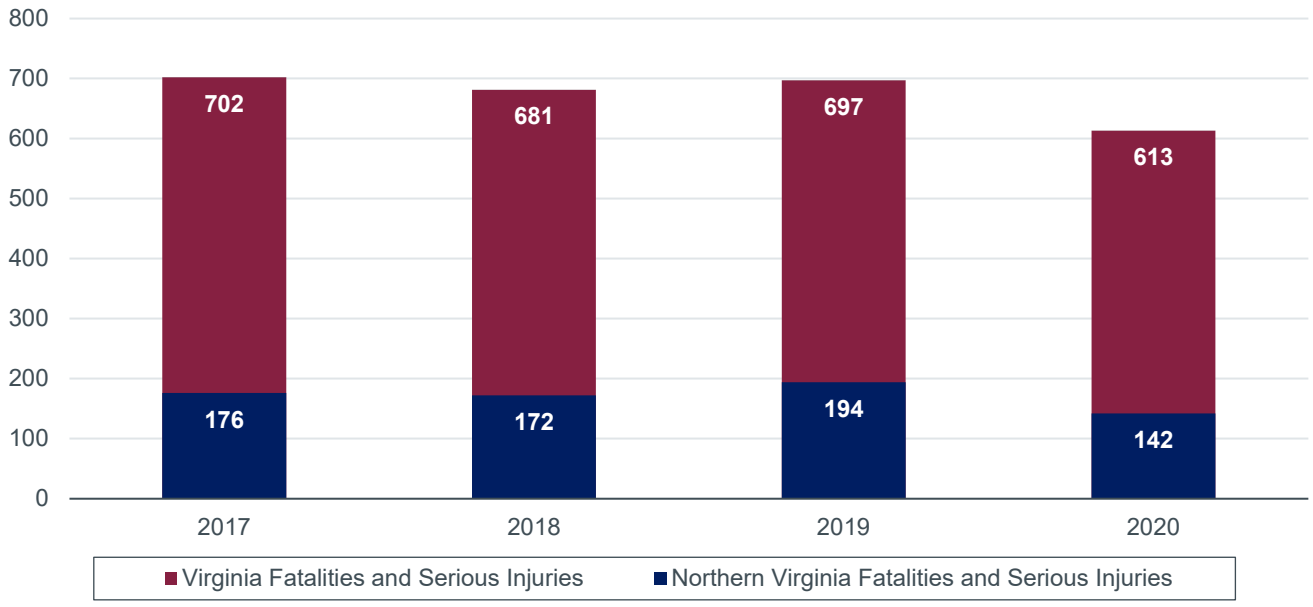
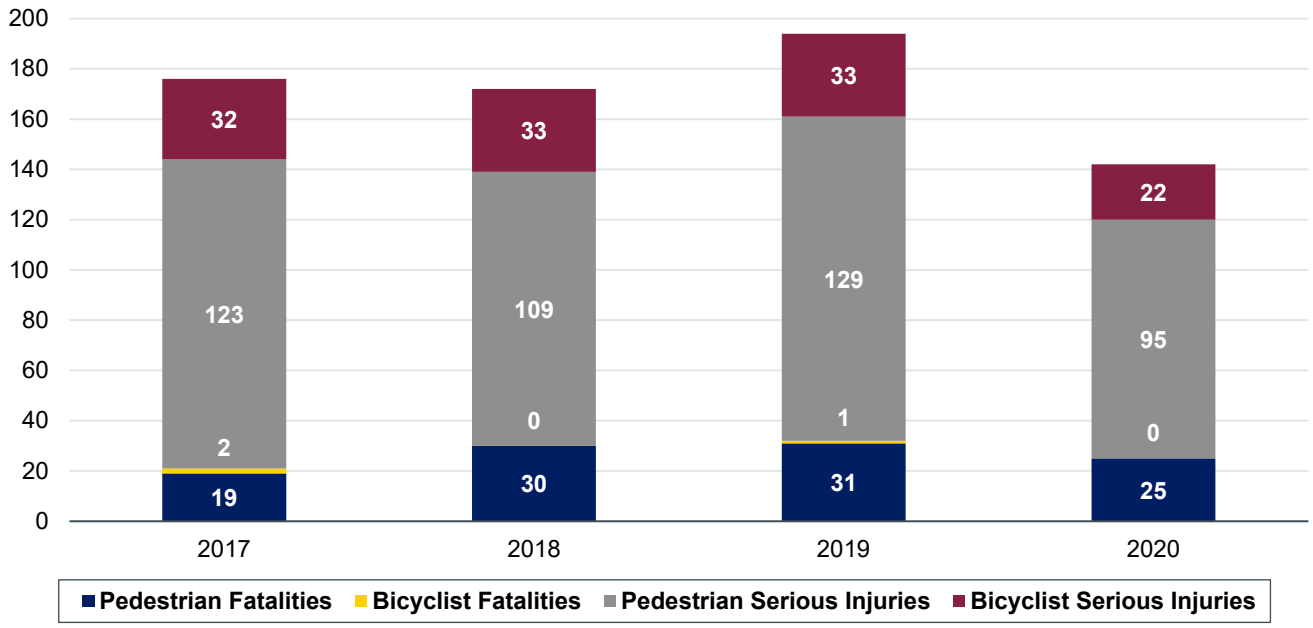


Figure 33 Northern Virginia Bicycle and Pedestrian Fatalities and Serious Injuries



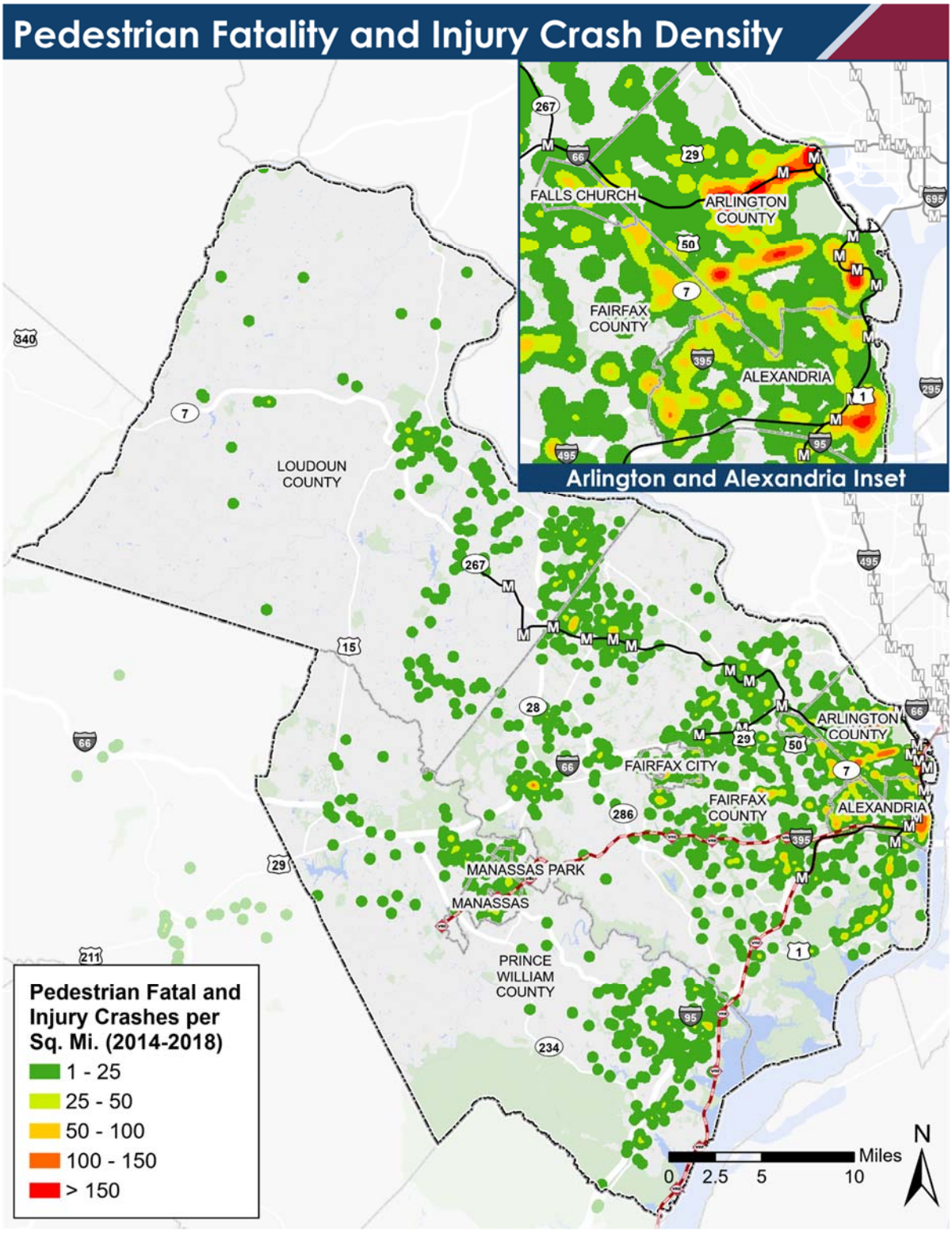
Source: VDOT Traffic Safety Data

Figure 34 shows pedestrian crash density from 2014 through 2018 in Northern Virginia. The highest concentrations occur in areas with high pedestrian activity, like Rosslyn, Crystal City, and Alexandria. Commercial corridors like Columbia Pike in Arlington and centers like Reston, Leesburg, Tysons, also feature higher crash densities.

Priority corridors represent those in the top 0.1 percent, top 1 percent, or top 5 percent across Virginia in terms of pedestrian crash frequency. According to the statewide 2018 Pedestrian Safety Action Plan (PSAP), 30 percent of priority corridors were in Northern Virginia, second only to Hampton Roads (34 percent). Of the 43 priority corridors in the region (Figure 35), 39 were in Arlington and Fairfax counties.

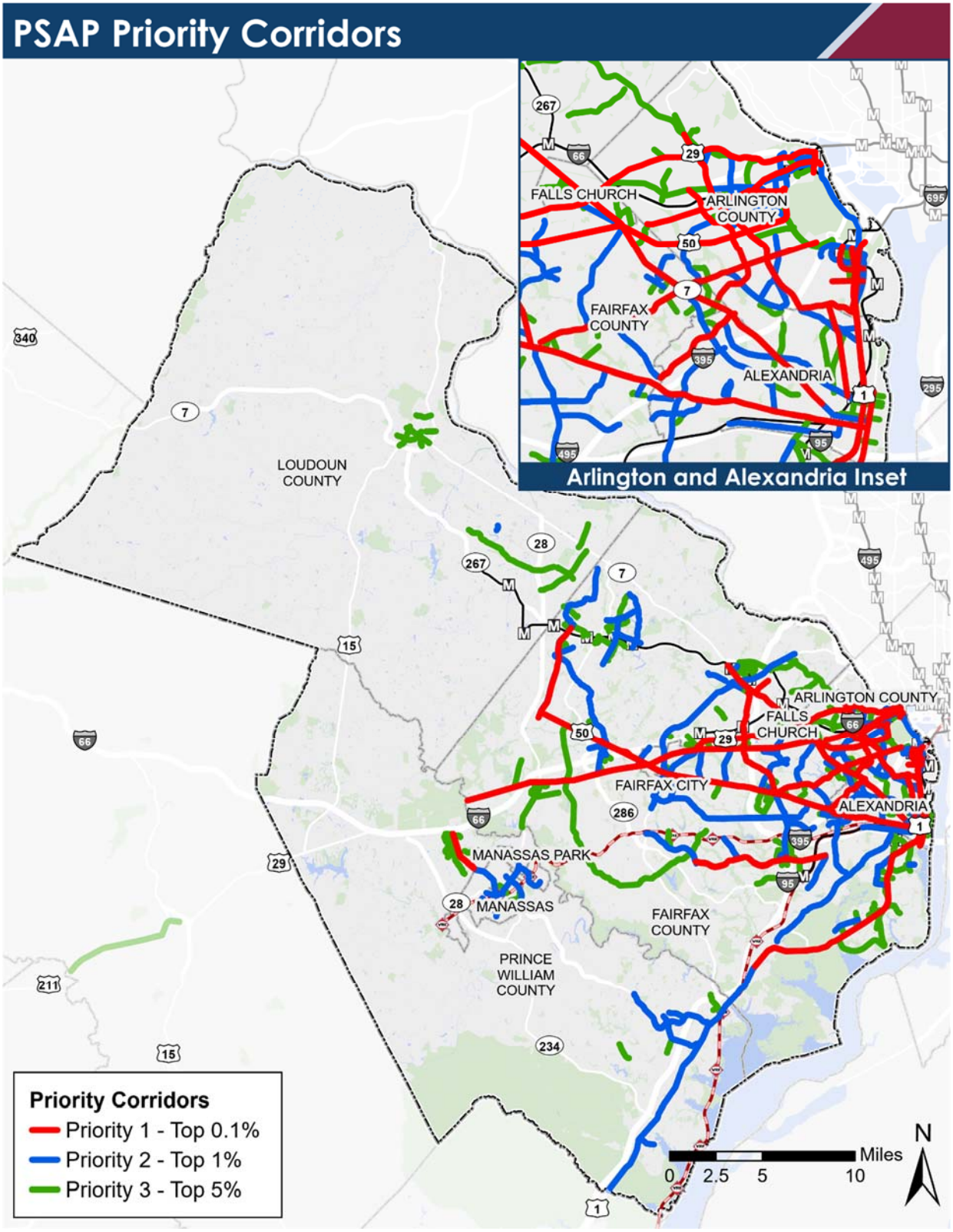
VDOT's PSAP report, crash assessment, and map viewer enable detailed review and analysis of crash locations and contributing factors for pedestrian crashes occurring from 2014 through 2018. More information is available through VDOTs Traffic Engineering Division, here: https://www.virginiadot.org/business/ted_app_pro.asp.

Figure 34 Pedestrian Crash Density (2014–2018)



Source: VDOT Pedestrian Safety Action Plan 2.0

Figure 35 Pedestrian Safety Action Plan Priority Corridors



Source: VDOT Pedestrian Safety Action Plan 2.0

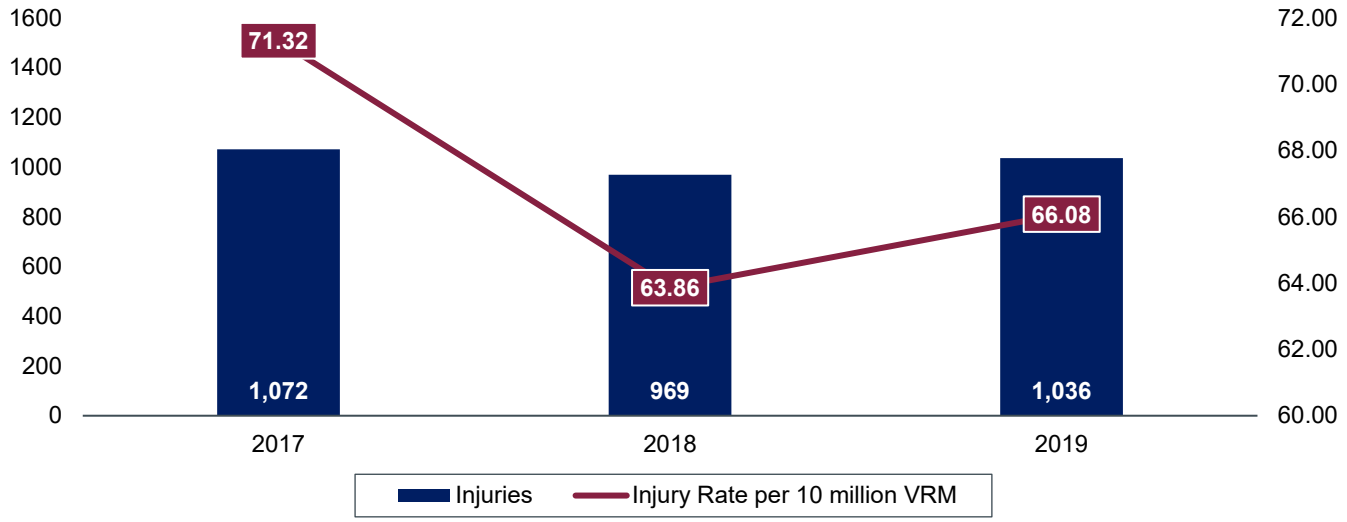
4.3.3 Regional Transit Safety Profile

Northern Virginia is a hub of transit activity. In evaluating the safety of transit systems, the Federal Transit Administration (FTA) utilizes the following performance measures, which are consistent with public transportation agency safety plans (PTASP) that transit operators report to the Federal Government:

- Fatalities and Fatality Rates (per 10 million vehicle revenue miles (VRM))
- Injuries and Injury Rates (per 10 million VRM)
- Safety Events and Safety Event Rates (per 10 million VRM)
- System reliability measured as the mean distance between major mechanical failures by mode
- Transit security events

Data for these measures for 2017 through 2019 was obtained from the National Transit Database.[10] **Transit fatalities are much lower than those resulting from motor vehicle crashes both in raw numbers and rate per VRM.**[11] There were four fatalities in 2017, five fatalities in 2018, and two fatalities in 2019. This equates to a three-year average of 0.24 fatalities per 10 million vehicle revenue miles. Serious injuries on transit are a much higher risk and occur mostly on or around buses. As shown in Figure 36, transit injuries decreased in 2018, but rose again in 2019.

Figure 36 Regional Transit Injuries and Injury Rate



Source: National Transit Database (NTD); Federal Railroad Administration (FRA)

Transit Safety Events: These events are those that may not result in an injury or death but are reported events. These include crashes, fires, or derailments. There has been a 12.2 percent increase in safety events from 2017 to 2019, as shown in Table 18. Most events occurred on WMATA Metrobus and Metrorail.

[10] VRE safety data was collected from Federal Rail Administration (FRA).

[11] The data excludes suicides and trespassing.

Transit Security Events: These events are categorized by system security (e.g., bomb threats, burglary, vandalism, cyber security events, and arson) and personal security events (assault, motor vehicle theft, suicide, and violent crimes). As shown in Table 18, these events are on the rise in the region, with a 60 percent increase from 2017 to 2019 with the increases mostly focused on WMATA Metrobus and Metrorail.

Transit Reliability: System reliability is another measure of transit safety. It is measured through the mean distance between major mechanical failures by mode. The higher the number the more resilient the transit system. Across the eight transit operators, Table 18 shows a sharp increase in rail system reliability (VRE and WMATA), but a drop in bus system reliability from 2017 to 2019 (8.4 percent).

Table 18 Transit Safety, Security, and Reliability

	Safety		Security		Reliability (Mean Distance Between Failure)	
	Total Events	Events Rate (per 10 Million VRM)	Total Events	Events Rate (per 10 Million VRM)	Bus System	Rail System
2017	835	55.55	86	5.72	6,390	78,977
2018	892	58.79	108	7.12	5,722	122,337
2019	937	59.77	138	8.80	5,850	218,360

Source: National Transit Database (NTD); Federal Railroad Administration (FRA)

4.3.4 Regional Emissions Assessment

The U.S. Environmental Protection Agency (EPA) establishes health standards for six criteria air pollutants, also referred to as the National Ambient Air Quality Standards (NAAQS) regulated under the Clean Air Act (CAA). The CAA also classifies areas that do not meet the Federal standards as nonattainment areas and establishes processes to reduce pollution in those areas. Currently, the Washington metropolitan region is considered a non-attainment area for ground-level ozone. This area includes all the jurisdictions in Northern Virginia, plus the District of Columbia and five counties in Maryland. Air quality is monitored daily across the region.

Criteria Air Pollutants

Ground-level ozone (O_3)

Particulate matter (PM)

Carbon Monoxide (CO)

Sulfur Dioxide (SO_2)

Nitrogen Dioxide (NO2)

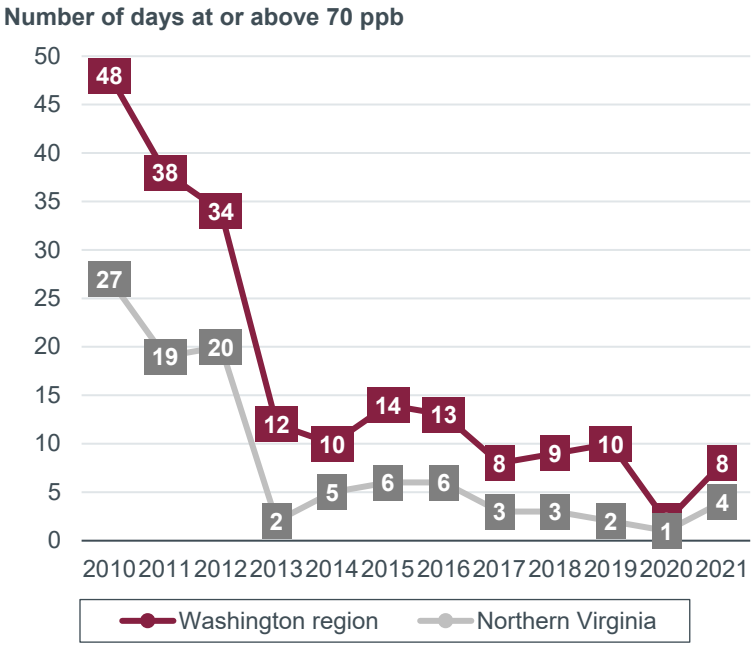
Lead (Pb)

Air pollutants from the transportation sector continue to decline even as VMT increases. For example, in 2020, as a result of reduced travel activity during the COVID-19 pandemic, the region experienced its lowest number of ozone exceedances since data collection officially started in the mid-1990s. Declines before the pandemic are due to a number of factors including Federal light-duty and medium-/heavy-duty fuel economy and greenhouse gas emission standards and state and local measures combined with actions taken by Commuter Connections; state, regional and local governments; individuals; and businesses. Even ozone levels, which are strongly impacted by hot, dry summers, continue to decrease in the region. Actions led by Clean Air Partners, Commuter Connections, and state, regional, and local governments help individuals take actions like using transit, carpooling, or working from home.

Ground-Level Ozone

EPA first established the NAAQS for ground-level ozone in the 1970s. EPA has continued to lower the standards to protect human health and the environment. An ozone exceedance occurs when an 8-hour average ozone concentration is above 70 parts per billion (ppb). As the eight-hour standard has declined, the region's status as a nonattainment area has evolved, particularly with the new, more stringent standard established in 2015. While the region has made dramatic improvements in regional ozone levels, weather conditions and other factors outside the region's control will continue to make meeting the new standards difficult.

Figure 37 Ozone Exceedance Trends



Source: *MWCOG 2020 Air Quality Trends Report.*

Note: *If any monitor exceeds the standard, it counts for the entire region, therefore the figure shows the total exceedances for the region, and only for monitors in Northern Virginia.*

Ozone season is a period in which ground-level ozone typically reaches its highest concentrations in the air we breathe. The ozone season stretches from April through September, as hot and humid weather conditions contribute to higher ozone levels. Figure 37 presents the count of ozone exceedances for the Washington region from 2010 through 2020. The trend continues in a positive direction for the Washington region as well as monitors in Northern Virginia.

Other Criteria Pollutants

The region meets the current NAAQS for the five other criteria pollutants. The region previously did not meet the original standard for particulate matter ($PM_{2.5}$) established in 1997, as well as more stringent standards set in 2006 and 2012. However, because of continuing declines in the number of days with exceedances (the region has averaged at or near zero since 2013), the region is in attainment for both PM_{10} and $PM_{2.5}$ standards. Actions taken by Federal, state, and local governments to lower emissions from power plants, passenger vehicles, and particularly heavy-duty diesel engines (such as commercial vehicles, school buses, and transit fleets), and other sources have helped the region meet all fine particle standards.

Greenhouse Gas Emissions

In 2018, according to analysis conducted by MWCOG, the transportation sector accounted for approximately 40 percent of total regional greenhouse gas emissions of 62.6 million metric tons (mmt) of carbon dioxide equivalent (CO_2e).[12] Many of the same actions helping to decrease criteria pollutant

[12] https://www.mwcog.org/documents/2020/11/18/metropolitan-washington-2030-climate-and-energy-action-plan/

emissions in the region also help reduce greenhouse gas (GHG) emissions including carbon dioxide, which represents nearly all greenhouse gas emissions from transportation.

Managed growth in vehicle miles traveled, more efficient travel (less GHG per mile due to managed congestion) and shifts to new vehicle technologies reducing fuel consumption (more efficient gasoline powered vehicles and shifts to hybrid or fully electric vehicles) all help to reduce GHG emissions. MWCOG assessed[13] the potential of these strategies, among others, to reduce regional GHG emissions and attain a goal of a 50 percent reduction in GHG emissions by 2030 compared to 2005 levels. The region also set a goal of an 80 percent reduction by 2050. The study found that achieving the 2030 goals is impossible even with the most aggressive combination of strategies while the 2050 goals can be achieved if all the aggressive strategies are implemented under a renewable electricity grid assumption.

The 2030 Climate and Energy Action Plan indicates that as of 2016, less than 1 percent of vehicles on the road in metropolitan Washington were battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). Based on more recent data from the Virginia Department of Motor Vehicles, the share of new statewide registrations that are BEVs or PHEVs has steadily increased, to 2.4 percent statewide in 2020. As of October 2021, per the Alternative Fueling Station Locator[14] managed by the U.S. Department of Energy, there are 425 electric vehicle charging stations with 1,127 outlets in Northern Virginia; 180 of these 425 charging stations have opened in 2021.

According to the analysis conducted by MWCOG, by 2030, BEVs and PHEVs would need to increase to more than 30 percent of light duty cars, 9 percent light duty trucks, 4 percent medium and heavy-duty trucks, and 30 percent transit buses to meet the 2030 GHG emission reduction goal. Several strategies will be necessary to achieve these goals. A widespread EV charging network, especially in Northern Virginia, reduces one of the primary barriers to EV purchases—range anxiety. Improving battery technology and lowering EV costs are also helping the market grow. For example, WMATA has committed to transitioning to a 100 percent zero-emission bus fleet by 2045.[15] In DRPTs FY2022 grant cycle, funding was approved for Fairfax County to purchase four all-electric zero emissions buses for the Fairfax Connector fleet. In its FY2022–2027 SYP, NVTA has allocated $10 million to Fairfax County for purchasing eight zero emission battery electric vehicles for Fairfax Connector. In 2018, NVTA has allocated nearly $12 million for purchase of eight electric buses and improvements to charging and maintenance facility in the City of Alexandria for DASH.

4.3.5 Regional Resiliency Assessment

Northern Virginia is susceptible to extreme weather events that threaten the region's transportation infrastructure. Natural hazards such as flooding, tornadoes, hurricanes, and winter storms disrupt normal transportation system performance and operations, damage or destroy transportation infrastructure, and increase safety risks for residents and travelers.

Transportation resilience for this assessment is measured on the 11 TransAction multimodal corridors previously shown in Figure 16. These corridors **constitute approximately 5 percent of the region's roadway mileage while carrying 56 percent of regional VMT**. Note, the D.C. Homeland Security and Emergency Management Agency

[13] https://www.mwcog.org/tpb-climate-change-mitigation-study-of-2021/.

[14] https://afdc.energy.gov/.

[15] https://www.wmata.com/initiatives/plans/zero-emission-buses.cfm.

has established 19 routes out of D.C. in the event of a regional evacuation. In Northern Virginia, these include ten corridors and the Beltway.[16] Eight of these ten corridors are also TransAction corridors.

Operational Reliability

Regional resiliency is focused on operational reliability which measures and compares the regional system's overall travel time reliability to its reliability during extreme events. The former assesses the system's day-to-day performance with common disruptions such as recurring congestion, incidents, work zones, and minor weather events. The latter measures the reduction of the system's reliability when it is impacted by a significant natural hazard. System impacts due to human-caused hazards (such as terrorist threats, hazardous material spills or human related crashes) are outside the scope of this assessment.

A winter storm from December 18–20, 2009, was chosen as an example of an extreme natural hazard given its scale of impact and data availability. The event caused significant disruption and travel delays throughout the region. Reagan National Airport recorded 15 inches of snow on December 19, and a two-day storm total of 19.3 inches.[17]

Typical conditions were represented by performance on the same days of the week within two weeks before and after the event days, which in this case are Fridays, Saturdays, and Sundays between December 2, 2009, and January 5, 2010. As shown in Table 19, the average speed of the priority corridors decreased by 12 percent during the storm events as compared to Fridays, Saturdays, and Sundays within two weeks before and after the event. The average LOTTR changed from 1.16 to 1.30, reflecting an average 12 percent decrease in travel time reliability during this event.

Table 19 Priority Corridor Operation Performance in 2009 Winter Storm

		Average Speed (mph)	Average LOTTR	Unreliable Roadway Centerline Mileage (LOTTR > 1.50)
Event Days	**December 18–20, 2009**	52	1.30	11%
Typical Condition	**Same weekdays within two weeks before and after event**	59	1.16	2%

Average LOTTR during the event days were significantly higher than typical days of the week before or after the event, indicating a general decrease in travel time reliability along the priority corridors. To reach a conclusion on how well the system operates during extreme events, a diversity of events should be considered, as there are several factors that impact the extent of the effect on system performance. Generally, a 12 percent regional average increase in travel time during a severe storm event seems reasonable—although without further event comparisons, it might be difficult to assess the relative severity of the impact.

[16] https://esa.dc.gov/service/dc-evacuation-route-planning.

[17] Northern Virginia Hazard Mitigation Plan, 2017.

Asset Durability

Asset durability is a method to measure the resiliency of pavement and bridge infrastructure to respond to extreme events (natural or man-made hazards) through design, construction materials and/or asset condition. Reports by VDOT on priority corridor pavement and bridge conditions are included at the end of this assessment to highlight the importance of maintaining infrastructure to levels which prepare for and adapt to changing conditions.

The current and projected condition of pavement and bridge assets along the priority corridors are indicators of infrastructure vulnerability subject to extreme natural hazards, environmental stressors, and faster rates of deterioration due to heavy freight demand. Extensive damage or destruction to these assets under extreme events can disrupt overall system performance, inhibit access to major activity centers, isolate communities, impede the flow of emergency supplies into the region and/or the evacuation of residents out of the region.

Substandard sections of assets are at greater risk for stressors such as pavement buckling due to prolonged heat exposure and greater bridge scour in **flood hazard zones which impact about 5 percent (43 miles) of the priority corridors and 4 percent (21,000 parcels) of parcels within one mile of priority corridors.**[18]

Figure 38 indicates the potential risk, damage, and disruption to critical priority corridor links under a 500-year flood event which is a typical measure of infrastructure vulnerability. Areas where TransAction corridors and flood zones intersect are highlighted in red. This includes sections of key corridors, such as the I-95 corridor at Occoquan and the VRE Fredericksburg and Manassas lines. There is a strong platform of recent regional assessments, plans, and data upon which NVTA, and its partners can build a coordinated framework, including:

- **2017 Northern Virginia Hazard Mitigation Plan**[19]**—**outlines mitigation strategies to reduce the severity of future events based on the region's adaptive capacity.
- **2018 Resilient Critical Infrastructure Roadmap**[20]**—**a high-level planning framework from which to guide more in-depth planning, assessment, and implementation studies for Northern Virginia.
- **2019 Utilizing Regional Collaboration to Build Community Resilience in Northern Virginia**[21]**—** development of a risk matrix, monitoring plans, and a resilience index lead by a regional, multi-stakeholder Climate Resilience Team.
- **2021 Climate Resilience Dashboard**[22]**—**launched by the Northern Virginia Regional Commission (NVRC) containing information on environmental stressors and modeled scenarios to enable "policy-makers, planners, and the public to examine climate-related variables and take action to protect vulnerable people, infrastructure, and assets."

Corridor sections of poor condition pavement and bridges with roadway sections experiencing weekday peak hour LOTTR greater than 1.5 are compared to identify corridors with both an asset condition and reliability deficiency.

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18 https://consapps.dcr.virginia.gov/VFRIS/ and https://msc.fema.gov/portal/advanceSearch.

19 https://www.fairfaxcounty.gov/emergencymanagement/emergency-plans.

20 https://va-nvrc.civicplus.com/DocumentCenter/View/11835/Resilient-Roadmap-Report-February-2018-PDF?bidId=.

21 https://www.deq.virginia.gov/home/showpublisheddocument/9785/637599636768570000.

22 https://www.novaregion.org/1481/ClimateResiliency-Dashboards.

Assessing system performance in this manner informs how to comprehensively scope the full cost of future resiliency needs and projects to address a range of capacity, operational, and asset-based deficiencies. Table 20 lists specific sections and their corresponding miles along each priority corridor and Figure 39 presents the same information within a map depicting the priority corridors and the overlap areas.

Table 20 Priority Corridors with Overlapping Operational and Asset Needs

Priority Corridor	Location(s)	Miles
I-66/U.S. 29/U.S. 50 Inner Corridor	I-66 between the Potomac and VA-267 U.S.-50 west of interchange with I-495 I-66 between VA-234 and VA-234 Bus.	12.53
I-95/I-395/U.S. 1 Corridor	I-95 between Cardinal Dr and Caton Hill Rd Intersection between N Kings Hwy and U.S.-1 I-395 between the Potomac River and VA-7	7.82
Dulles/VA 7/VA 9 Corridor	VA-7 near Leesburg Bypass VA-267 west of Fairfax County Pkwy VA-267 north of interchange with I-66	5.35
VA 28 Corridor	Between U.S.-50 and VA-267 Between Yorkshire Ln and Manassas Dr Near interchange with VA-234	3.97
I-495 Beltway Corridor	North of VA-267 Near Exit 173 (VA-401 Near interchange with VA-611 (Exits 176A-176B)	3.37
Columbia Pike/Braddock Rd Corridor	Braddock Rd between Clifton Rd and Colchester Rd	1.08
U.S. 15 Corridor	N King St, south of Leesburg Bypass	0.65
U.S. 50 Outer Corridor	North of I-66	0.35
Fairfax County Pkwy Corridor	West of Ox Rd and Interchange with I-95	0.22
Total Miles across Priority Corridors		**35.34**

Figure 38 Flood Zones Affecting TransAction Corridors

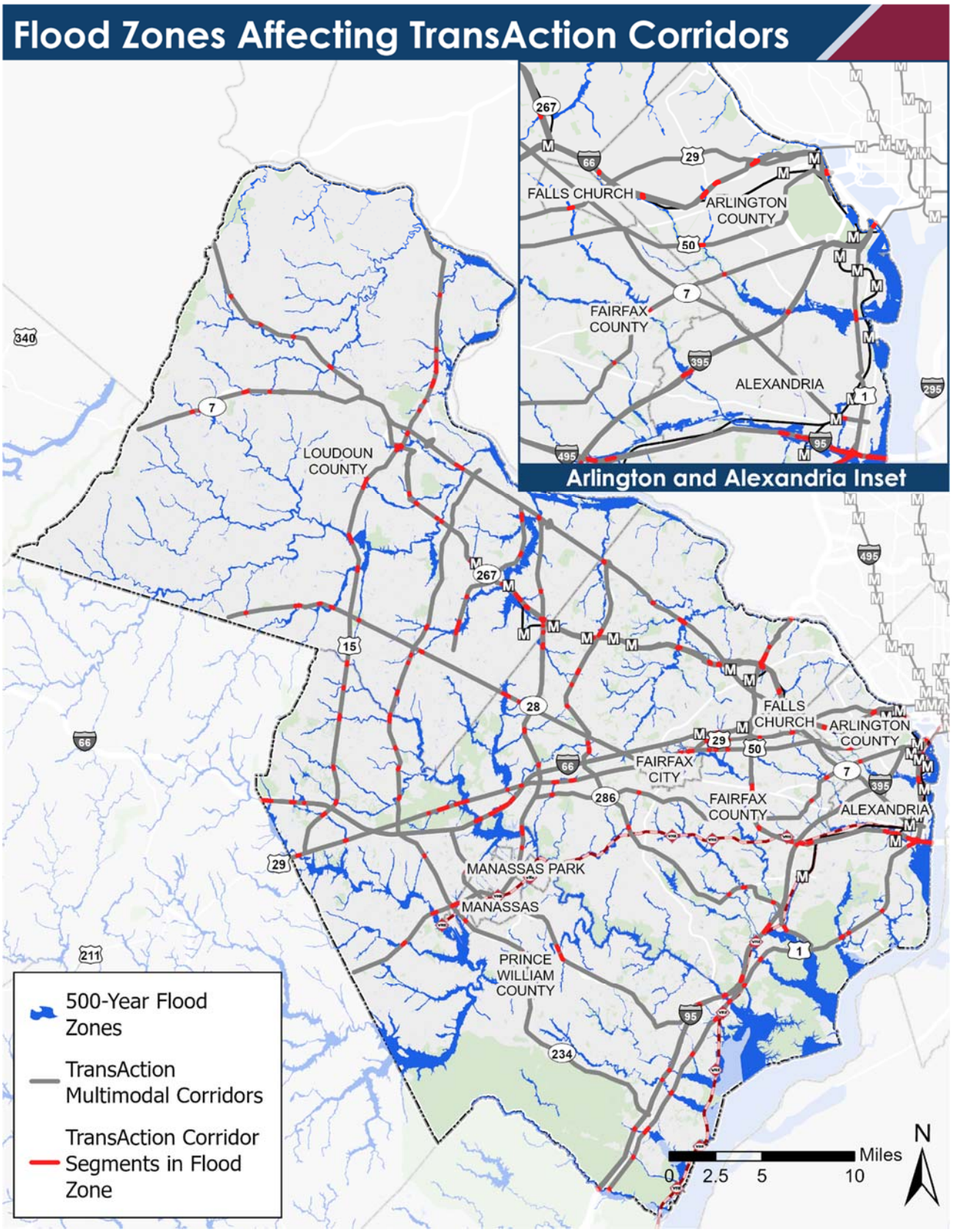
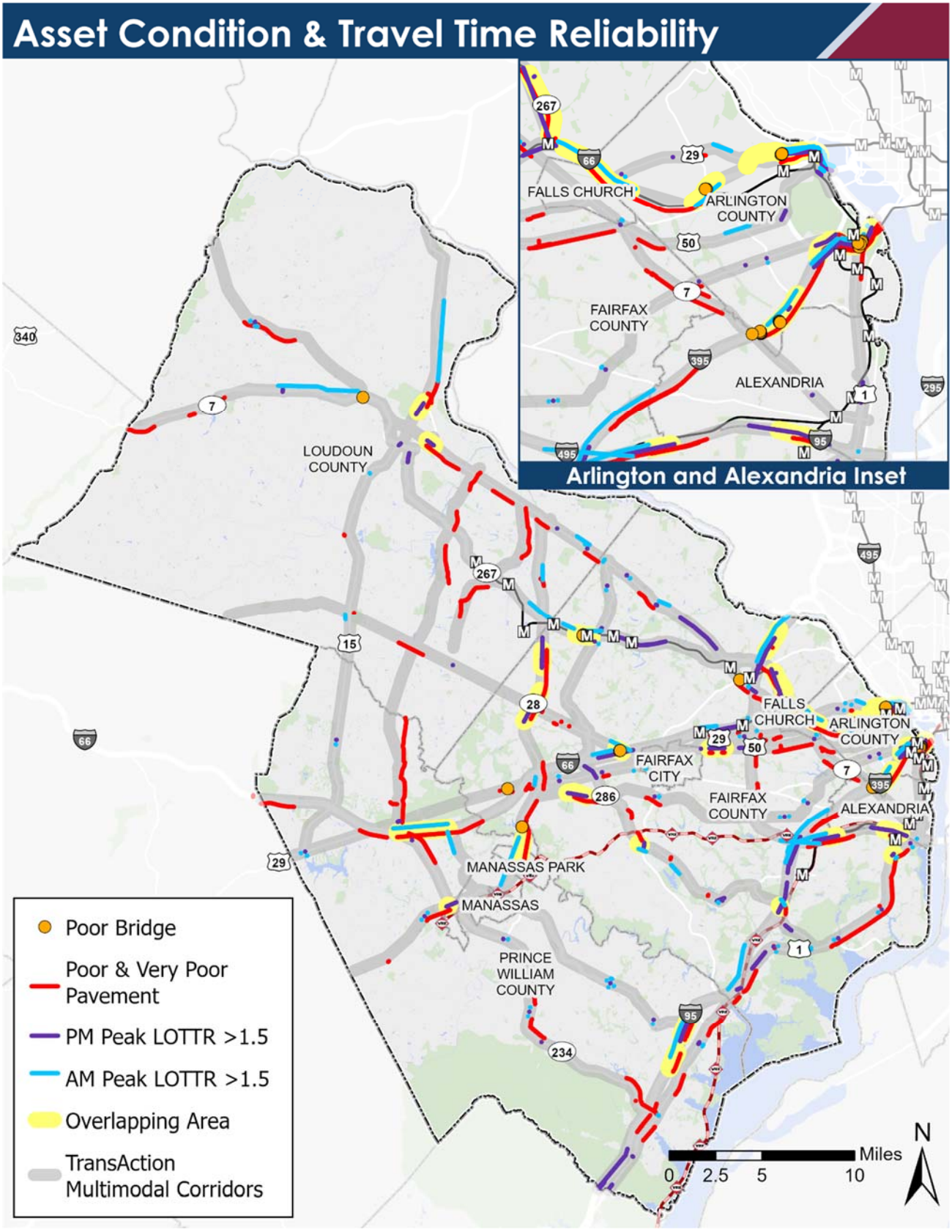


Figure 39 Asset Condition and Travel Time Reliability



4.4 Summary of Transportation Needs

Table 21 presents highlights from the needs assessment applicable to the relationship between the TransAction goals and the core values.

Table 21 Needs Assessment Highlights

	Enhance Mobility	Increase Accessibility	Improve Resiliency
Equitably	• Increasing congestion will negatively impact mobility • Alternative travel options, including high-quality transit, are particularly needed for low-income residents to avoid excessive trip times	• Activity centers are harder to reach by transit than driving with notable disparities in several equity emphasis areas (EEAs) • EEA population may rely on transit more to reach critical services	• At-risk portions of the transportation system (both from an asset condition and extreme event impact) are spread throughout the region; however, disruptions/closures could impact disadvantaged populations more.
Sustainably	• Growth in VMT will continue to lead to more recurring and non-recurring congestion throughout the region, leading to wasted time and fuel and increased emissions. • Gaps in transit and bike/ped infrastructure in some parts of the region limit non-vehicular travel options.	• Less than one-half of jobs and a third of people are within walking distance of high frequency or all-day transit service. As population and VMT grow, this is unsustainable. Gaps in transit and bike/ped infrastructure in some parts of the region limit non-vehicular travel options.	• Recent pandemic-related increases in telework, along with technology improvements and access to alternative vehicles and fuels, will continue to have a positive impact on reducing emissions, however coordinated and concerted efforts will be necessary to achieve GHG emissions reductions goals.
Safely	• Crashes are a major source of recurring and non-recurring congestion. Growth in VMT will likely lead to more fatalities and injuries without concerted effort to reduce crashes. The existence of 43 high priority crash zones in Northern Virginia and the increase of bike and ped serious injuries and fatalities and transit safety events over the last few years may deter use of non-vehicular modes.	• Lack of multi-use roadways or trails makes bicycling challenging across much of the region (outside Arlington, Falls Church and Alexandria).	• Deferred investments in priority corridors may worsen operational reliability and threaten the ability of vulnerable assets to withstand and respond to extreme conditions.

4.4.1 Mobility

Enhance quality of life by improving the mobility of Northern Virginians on the region's multimodal transportation system.

Growth in all travel and VMT: A continuing strong regional economy is anticipated to bring more residents to Northern Virginia from all over the world; new, expanded, and more diverse businesses; and more workers commuting to Northern Virginia from the rest of the Washington D.C. region, as well as other locations through Virginia, Maryland, and West Virginia. Future land use patterns will have a strong impact on how people and goods travel, as will the availability of reliable, safe, and accessible multimodal transportation options. Future projections indicate that the region could see a decrease in daily VMT per household, as a result of development patterns

adjacent to more alternative modes. This is a positive sign, even as regional daily VMT is still forecast to increase by 27 percent from 2017 to 2045.

Need: Management and strategic expansion of high-volume travel corridors, particularly those facilitating interregional and cross-regional trips.

Growth in VMT per capita in suburban/outer suburban parts of the region: Growth in VMT will continue, especially in the suburban/outer suburban parts of the region such as Loudoun and Prince William counties. These two counties are forecasted to see VMT growth approaching 40 percent through 2045 which also leads to an increase in VMT per capita. High residential development and less access to transit, particularly in outer suburban areas of these counties, will lead to growing congestion issues on lower capacity roadways.

Need: Operational enhancements, technology deployments and capacity expansion on minor arterials and collector roads throughout Loudoun and Prince William counties to accommodate safe and efficient travel, plus expanded trip choices, including transit service and regional trails.

Truck travel growth: Total annual tonnage carried by trucks into and out of the region is projected to increase by 83 percent from 2017 to 2045 according to data from IHS Insight. The regional travel demand model shows total daily commercial vehicle trips are projected to increase nearly 40 percent during that same period. Trucks lead to more wear and tear of highway infrastructure and generate more emissions on a per mile basis creating both asset preservation and environmental impacts.

Need: More direct and safer connections between regional freight routes and key freight industries, distribution centers, and intermodal facilities, like Dulles Airport.

Growing congestion challenges on priority corridors: Programmed investments in both NVTA's and VDOT's current six-year programs as well as long-term planned investments in MWCOG's current CLRP help to alleviate congestion in some corridors, particularly I-66 outside the Beltway. In most of the 11 priority corridors, the increase in total person hours of delay from 2017 to 2045 is substantial, averaging an 83 percent increase. Table 22 presents the change in corridor VMT and peak period person hours of delay. Some key results include:

- VMT growth on the Loudoun County Pkwy and VA 234 is in part associated with planned new projects and new capacity. The over 150 percent growth in peak period person hours of delay indicates that this new capacity will be overwhelmed through 2045.
- VMT growth in the VA 267/VA 7/VA 9 corridor is below the regional average, but the increase in delay is over 120 percent, particularly in Loudoun County and in the Herndon-Reston area.

Table 22 Priority Corridor VMT and Delay

Corridor	Average Daily VMT % Growth	Peak Period Person Hours of Delay % Growth
Columbia Pike/Braddock Road	9%	38%
VA 28	30%	61%
VA 267/VA 7/VA 9	28%	129%
I-95/I-395/U.S. 1	22%	96%
I-66/U.S. 29/U.S. 50 Inner	39%	32%
I-495 Beltway	47%	115%
Prince William Pkwy.	29%	73%
Fairfax County Pkwy.	50%	79%
U.S. 50 Outer	12%	72%
U.S. 15 Corridor	10%	55%
Loudoun County Pkwy/ VA 234	83%	162%
Total	**33%**	**83%**

- Delay will continue to be a significant challenge on the I-95/I-395/I-495 corridors. Even with lower growth in VMT (compared to other regional priority corridors), peak period person hours of delay are projected to more than double through 2045.

Need: Traffic management systems and new technologies to optimize existing capacity of these corridors, and where solutions are cost effective, strategic capacity expansion to address bottlenecks.

Higher risk of significant delays due to nonrecurring congestion: Higher travel volumes during all times of the day, particularly peak travel periods, mean that the highway system is more susceptible to significant delays resulting from unpredictable events. These events range from minor crashes and breakdowns to crashes resulting in extended lane closures or the impact of severe weather events. While measures of reliability on weekdays pre-pandemic reflect limited unreliable segments within the system, this is likely to increase in parallel with increasing recurring delay.

Need: More comprehensive traffic management and communication systems to manage events and event recovery, including those planned for inclusion within the Regional Multimodal Mobility Program (RM3P).

Growing demand for transit: Through 2045, regional transit person miles traveled are expected to increase 51 percent (compared to regional VMT increasing 27 percent over the same period). This increase in transit use relative to driving reflects the benefits of programmed and planned investments, as well as more preference for transit use among Northern Virginia residents. Transit services will need to maintain a high level of reliability and customer service to make sure these riders' mobility needs are met. The highest growth in demand is in existing high-capacity transit corridors, particularly along Metrorail corridors. Microtransit services offer the potential to provide more reliable, direct service in lower-density parts of the region, such as OmniRide's Connect Microtransit service in Manassas Park that replaced an existing fixed-route service.

Need: More frequent and extended service in existing high-demand areas as well as current areas lacking service, particularly communities in equity emphasis areas.

Growing demand for alternative modes throughout the region: Even before the pandemic, travel preferences were changing throughout the region thanks to the proliferation of new mobility options. With a strong preference for a more flexible telework environment, it is anticipated that working from home will remain an important benefit for many employees, which opens opportunities for decreased car ownership and more use of alternative modes.

Need: Address existing gaps on the regional trails system and first/last mile connections for transit riders, bicyclists, and pedestrians to activity centers and transit stations.

4.4.2 Accessibility

Strengthen the region's economy by increasing access to jobs, employees, markets, and destinations for all communities.

Access to jobs and workers: Access to jobs and workers is significantly more limited in Northern Virginia by transit than by driving. While major investments, like the extension of the Silver Line, will help address these gaps, significant disparities remain even in 2045.

Need: Address areas with most disparate transit versus auto access to jobs through transit service expansion or focused TDM strategies to provide more travel options for these communities.

Access to public transit: Areas with notably poor access to public transit include much of the I-66 corridor outside the Beltway, the U.S. 1 corridor in Southern Prince William County, Columbia Pike corridor between Annandale and Bailey's Crossroad, the I-395 corridor, North Woodbridge and Fort Belvoir, Manassas, and the Dulles South corridor.

Many of these areas also include concentrations of historically disadvantaged populations and low-income workers.
Need: Explore opportunities for new or more frequent or flexible transit services within these communities.

Access to critical services: Critical services like medical care, higher education, and grocery stores/fresh food are harder to reach by transit than driving. This disparity is notable in several equity emphasis areas where a larger share of the population may rely on transit to reach such services such as: Annandale, Bailey's Crossroads, Woodbridge, and Herndon.
Need: Explore opportunities for new or more frequent or flexible daily and off-peak transit services connecting nearby communities to these key destinations.

Walking access to frequent and/or all-day transit: Fewer than one-half of jobs and less than a third of people are within walking distance (1/4 mile) of high frequency transit (10-minute headways or better) or all-day transit service (18 hours of service or better). Several densely developed areas have large gaps in frequent or all-day transit access, including: the Dulles corridor from Reston to Ashburn, the U.S. 50 corridor from Fairfax to Chantilly, and outer suburban centers of Manassas, Manassas Park, and Dale City.
Need: Explore opportunities for new or more frequent or flexible daily transit services in these areas with safe and accessible pedestrian network and accommodations to access transit service.

Bicycle network connectivity: The lack of multimodal facilities or trails makes bicycling challenging across much of the region, notably outside Arlington, Falls Church, and Alexandria. In much of the region, major arterials divide bicycle-friendly road networks from one-another. Activity centers like Tysons and Seven Corners are nearly inaccessible to all but the most confident cyclists.
Need: Equitably prioritize planned trail corridors and other bicycle facilities that would address areas with high bicycle level of traffic stress and contribute to a safe and continuous network.

4.4.3 Resiliency

Improve the transportation system's ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.

Pedestrian Safety: Thirty-nine of the 43 high-priority crash corridors within Northern Virginia identified in the 2018 Virginia PSAP were in Fairfax and Arlington counties. Some potential countermeasures for these corridors include several traffic calming infrastructure measures such as high-visibility crosswalks, road diets, sidewalk connections, and transit stop access improvements.
Need: Work with VDOT and jurisdictions to develop and deploy countermeasures in these areas to minimize auto and pedestrian interactions where possible and ensure safe interactions elsewhere.

Roadway and Transit Safety: Many transit operators have only recently resumed full service since March 2020 when the COVID-19 pandemic began. As commuters return to their offices, it remains to be seen how commute patterns and roadway and transit safety will change. From a fatality and serious injury rate perspective, roadway travel in Northern Virginia is comparatively safer than the rest of Virginia.
Need: Work with VDOT and jurisdictions to assess common factors impacting fatal and serious injury crashes, particularly along priority corridors and in high cluster areas like Leesburg, Herndon, and Falls Church.

Vehicle emissions: VMT and congestion will continue to increase in the region as vehicle technologies continue to help reduce criteria pollutant and GHG emissions. While these technology factors will help mitigate or reduce emissions, the true emission reduction potential of new technologies are somewhat limited by the VMT and congestion increases. Of particular concern is the continued faster growth of commercial vehicle VMT within the region, and the more pronounced emission impacts of these vehicles (along with a slower path toward a zero-emissions vehicle fleet).

Need: Collaborate with Virginia DEQ, EVGo (DEQs partner on deploying stations within Virginia funded by the Volkswagen Mitigation Trust[23]), and local jurisdictions to assess strategies to more evenly and equitably distribute EV charging stations throughout the region. Collaborate to respond to grant opportunities for agency fleet replacements, including electric, or other low or zero emission, transit and school buses.

Resilience to major events: Priority corridors with substandard assets, sections in proximity to 500-year flood risk zones and sections experiencing recurring delays during daily peak periods represent targeted, strategic investment opportunities to strengthen regionwide reliance against intensifying and more frequent natural hazards and localized weather events. Improvements along sections of I-66, I-95/395, U.S. 1, VA 7, VA 9, and VA 28 and other priority corridors help NVTA prepare for, adapt to, withstand future events and enhance system performance across the region.

Need: Ensure that the region is better prepared and has the proper tools at its disposal to manage the system and keep people moving, including ongoing efforts through RM3P.

Asset Durability: Approximately 5 percent (43 miles) of priority corridors intersect with 500-year flood zones and 4 percent (21,000 parcels) of parcels are within one mile of priority corridors. Anticipated increases in freight demand and regional commerce will accelerate pavement and bridge deterioration worsening their current condition and making these assets more vulnerable to future extreme events.

Need: Actively collaborate with VDOT as part of decision-making regarding ongoing and planned capital and routine maintenance activities, particularly on higher risk regional assets that also facilitate high travel volumes or emergency evacuations.

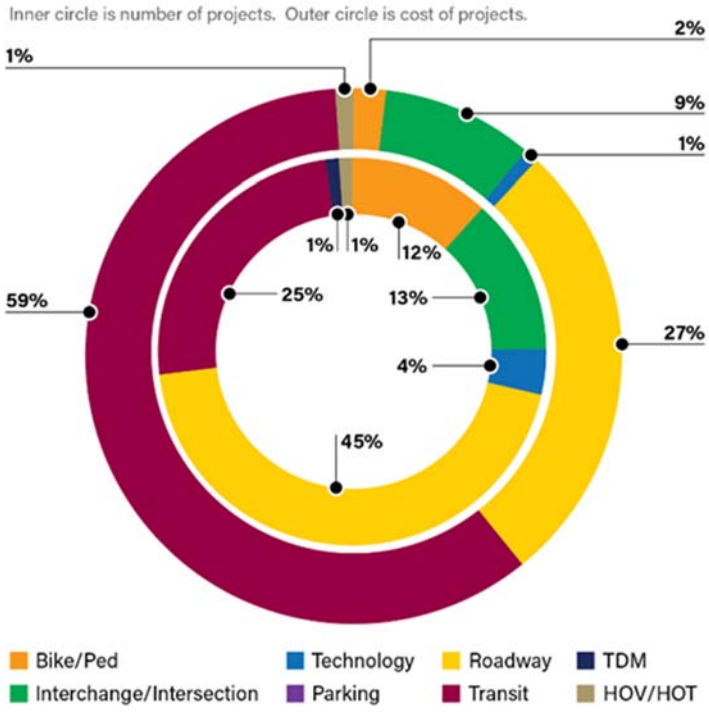
[23] https://www.deq.virginia.gov/get-involved/topics-of-interest/volkswagen-settlement-agreement

5.0 PLAN ELEMENTS

5.1 Overview of Project List

A variety of projects and programs are required to meet the complex transportation needs of Northern Virginia. With **111 new projects and a net increase of 72 projects** since the 2017 TransAction Plan, this TransAction Plan update includes 424 regionally significant projects and programs. These projects do not include regional projects that are already fully funded, which are included in the No-Build assumptions for 2045, including the Silver Line Metrorail extension to Loudoun County, the opening of the Potomac Yard Metrorail Station, and extensions to the I-495 Express Lanes from Route 267 into Maryland. These **424 projects and programs** would cost an **estimated $74.9 billion** (in 2021 dollars). Approximately $29 billion of this cost estimate is attributed to 25 projects that extend beyond Northern Virginia, requiring funding and implementation in partnership with external jurisdictions and agencies.

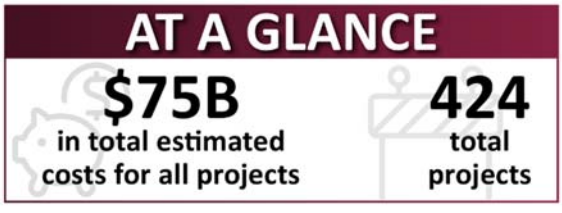
Figure 40 TransAction Project Mode Types



Note acronyms: High-occupancy vehicle (HOV), high-occupancy toll (HOT), and Transportation Demand Management (TDM).

The chart shows the percentage of TransAction projects based on the primary mode type, by both the number and cost of projects. The 189 roadway projects are 45 percent of the number of projects, but 27 percent ($20.3B) of the total cost. The 104 transit projects are 25 percent of the number of projects but 59 percent ($44.5B) of the total cost. Many projects encompass elements from more than one mode type. For example, 39 percent of the 424 projects include a roadway element and 22 percent of projects include a transit element. The 424 projects included in this Plan range from the construction of new multi-use trails, new interchanges, transit expansions and enhancements, and programs to encourage alternative modes of transportation, representing the diversity of transportation priorities across the region. Projects range from smaller facility improvements to large infrastructure investments and systemwide programs. This variety is also reflected in the range of estimated project costs, with 19 projects costing under $1 million and ten projects costing more than $1 billion, and the average project cost between $25 to $50 million. **As intended for an unconstrained needs-based Plan, the $75-billion cost of all the projects in the Plan is well beyond NVTA's available funding. Inclusion in TransAction doesn't guarantee NVTA regional revenue funding for these projects. NVTA regional revenues are determined on a competitive basis through the Six Year Program (SYP).**

The following pages of this section provide an overview of the different project types included in the Plan. Two new Plan elements have also been highlighted in greater detail—building a regional bus rapid transit (BRT) system and leveraging technology to address regional transportation needs.



5.2 Plan Elements

Non-Motorized

Includes bicycle and pedestrian improvements that provide connectivity in the region. Some projects also include technology elements.

$1.5B

50 non-motorized projects

Example Projects:

- Connect multi-use trail along Route 29 from Merrifield to Haymarket via Centreville
- Connect Landmark and Manassas with trail segments along the VRE Manassas Line
- Construct trail along Route 7 from Leesburg to Alexandria
- Improve bicycle and pedestrian infrastructure in and around the Columbia Pike corridor
- Multimodal access improvements for the East Falls Church and West Falls Church Metrorail Stations

Intersections & Interchanges

Includes grade-separated interchanges as well as at-grade intersection improvements that are intended to reduce traffic delay; many of these projects include pedestrian improvements and/or technology enhancements.

$6.9B

54 intersection/ interchange projects

Example Projects:

- Construct grade-separated interchange at Loudoun County Parkway and Arcola Boulevard
- New and modified interchanges on Fairfax County Parkway
- Improve Interchange at Route 28 and Old Ox Road (Route 606)
- Construct Interchange on Route 234 at Sudley Manor Drive and Wellington Road

Technology

Includes a range of technologies, such as Intelligent Transportation Systems (ITS), transit signal priority, real-time traveler information, electric vehicle (EV) charging infrastructure, and Connected and Automated Vehicle (CAV) enabling technologies. Technology projects can serve travelers using all modes.

$721.1M

17 technology projects

Example Projects:

- Provide charging/fueling infrastructure for low or zero emission cars and trucks
- ITS, adaptive traffic control, and hard shoulder lanes on I-95
- Implement ITS and integrated corridor management strategies on key regional corridors and parallel facilities

Parking

Includes parking improvement projects that can add capacity or technology-based enhancements to parking facilities, including park-and-ride lots.

$10M

1 parking projects

Example Project:

- City of Falls Church "Park Once and Walk" garage network

Roadways

Includes the construction of new roads, capacity improvements on existing roads, and/or reconfiguration of existing roads; often includes multimodal elements such as pedestrian and bicycle improvements, intersection improvements, and technology.

$20.3B | **189** roadway projects | **1040** new lane miles

Example Projects:

- Construct Route 28 bypass to improve regional connectivity
- Route 50 widening and interchanges
- Widen southbound I-95 to four lanes between the Occoquan River Bridge and Dumfries Road
- Loudoun County Parkway widening from Route 50 to Braddock Road

Transit

Includes a range of projects necessary to improve transit service in Northern Virginia, including Metrorail extensions, capacity and service enhancements for VRE, new High-Capacity Transit services that could be BRT lines, and improvements to bus services. Transit facilities, new transit vehicles, and station access improvements are also included.

$44.5B | **104** transit projects | **370** miles of prioritized transit right-of-way

Example Projects:

- Implement regional BRT system on multiple corridors including Route 7, Richmond Highway, and Duke Street and West End Transitway in Alexandria
- Metrorail core capacity and Blue/Orange/Silver core realignment
- VRE rail capacity and service enhancements
- Station access improvements (multiple stations)
- Enhanced bus service and facilities

Transportation Demand Management (TDM)

A set of services designed to provide commuters with alternative options to driving alone by providing information, programs, and incentives to encourage a change in traveler mode.

$63.9M | **3** TDM projects

Example Projects:

- Implement and expand TDM initiatives and programs in major employment centers within Northern Virginia
- Improve and expand the commuter assistance and other programs provided by Arlington County Commuter Services
- Implement and expand TDM initiatives and programs in the City of Falls Church

High-Occupancy Vehicle/Toll (HOV/HOT)

Travel lanes designated for a minimum number of passengers (HOV) or lanes that allow a toll to be paid in lieu of meeting the minimum number or passengers (HOT).

$920M | **6** HOV/HOT projects

Example Project:

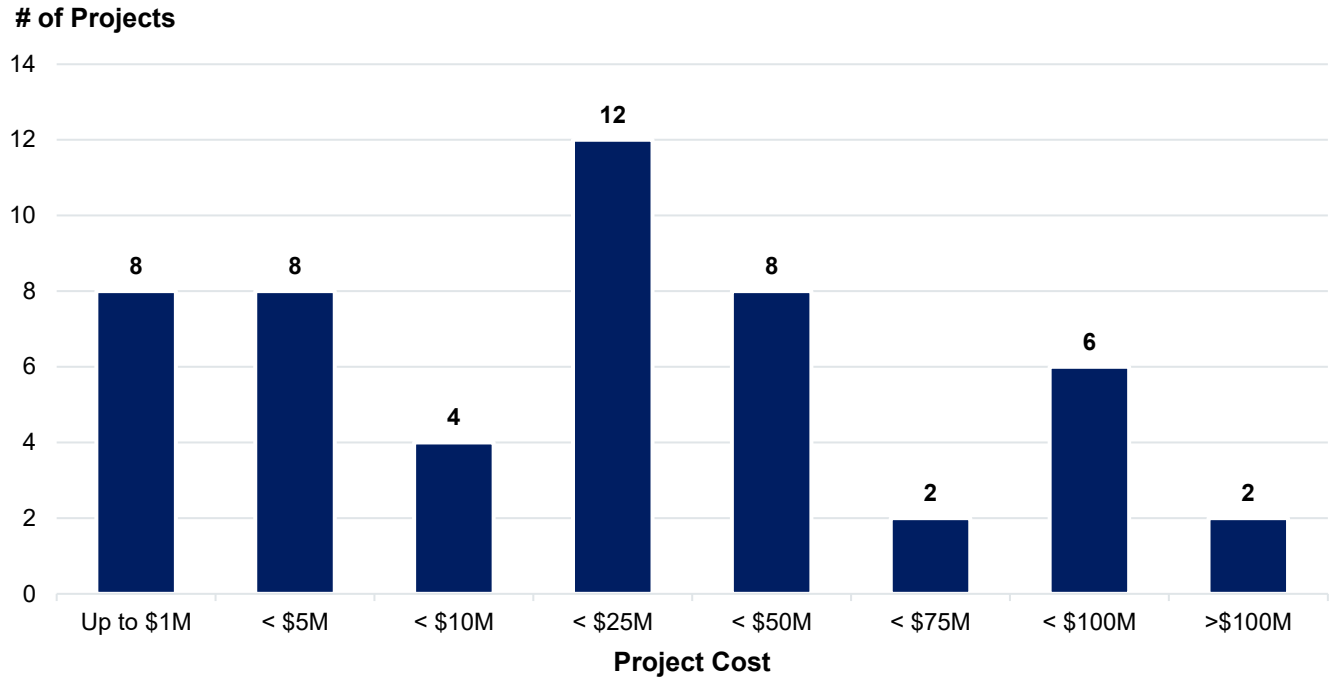
- Implement reversible HOV lanes on Route 28 between I-66 and the Dulles Toll Road during AM and PM peak periods
- Widen, upgrade, or convert Fairfax County Parkway (Route 286) to include HOV lanes from Dulles Toll Road (Route 267) to I-66
- Add HOV lanes to Franconia-Springfield Parkway (Route 289)

For the full Project List, with details of projects, refer to Appendix E: TransAction Project List, Sortable TransAction Project List, or the Interactive Map of TransAction Projects.

5.2.1 Bike & Pedestrian Projects

The TransAction Plan includes 50 projects that are primarily bike and pedestrian, and 82 projects total that include bike and pedestrian elements. Overall, approximately 248 miles of trails, paths and bike lanes are included in these 82 projects. As seen in Figure 41, these projects cost from less than $1 million to several $100 million. The most common cost for one of the included bike and pedestrian project is between $10 and $25 million.

Figure 41 Bicycle and Pedestrian Project Cost Graph

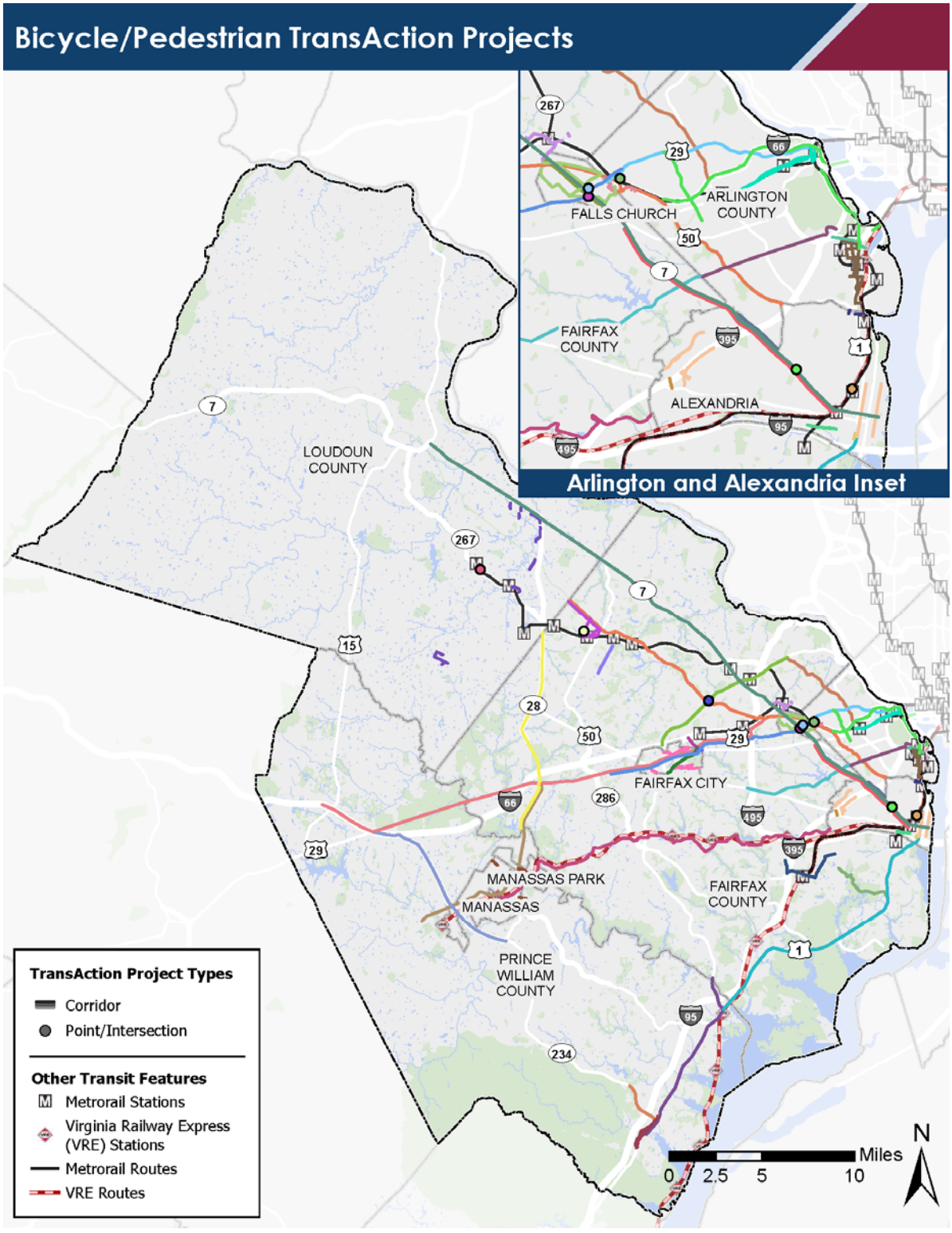


The types of pedestrian and bike improvements included in TransAction include the following:

- Multi-Use Trails
- Bike Lanes
- Sidewalks and paths
- Bikeshare infrastructure
- Multimodal improvements
- Access to Transit stations and stops
- Mobility Hubs
- Intersection improvements (e.g., crossings, signalization, ADA ramps)

Figure 42 illustrates the bike and pedestrian projects included in TransAction, which includes clusters in the denser areas of Arlington, Alexandria, and Fairfax City, as well as along the I-95 corridor through Fairfax and Prince William Counties. More continuous infrastructure, signified by lines in Figure 42, extend west into Loudoun County and in the western side of Fairfax County.

Figure 42 Bicycle and Pedestrian TransAction Project Map



5.2.2 Roadway & Parking Projects

Roadway Projects

The largest portion of projects (45 percent) included in TransAction are roadway projects. As seen in Figure 43, these projects range in cost from less than $1 million to over $1 billion, with the majority of projects between $10 million and $75 million. In total, there are 211 projects included that have roadway improvement elements, while 189 are primarily roadway related. These roadway improvements include the following:

- Widenings
- Extensions/new roadways
- New Bridges
- Street Grid Additions
- Multimodal improvements
- HOV/HOT Lanes
- Ramp/interchange improvements
- Intersection improvements
- Spot safety improvements
- Transit access and priority

However, additional roadway miles are not the focus of most of these projects. This is displayed in Figure 44, which shows that the majority of projects if implemented, may add between zero and five lane miles. Additionally, Figure 45 and Figure 46 show that 96 percent of projects are on non-interstate roads and more than one-half of the projects are on roads that are below the FHWA classification of a principal arterial.

Figure 43 Roadway Project Cost Graph

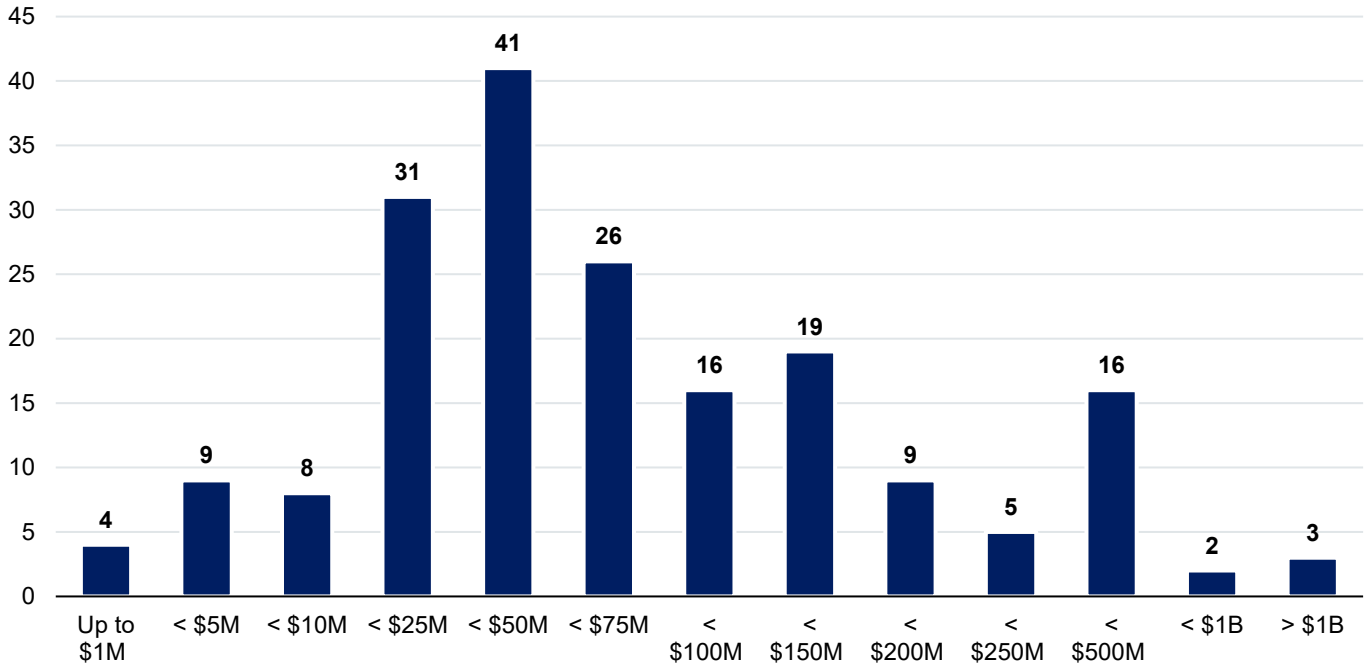


Figure 44 Roadway Projects Miles

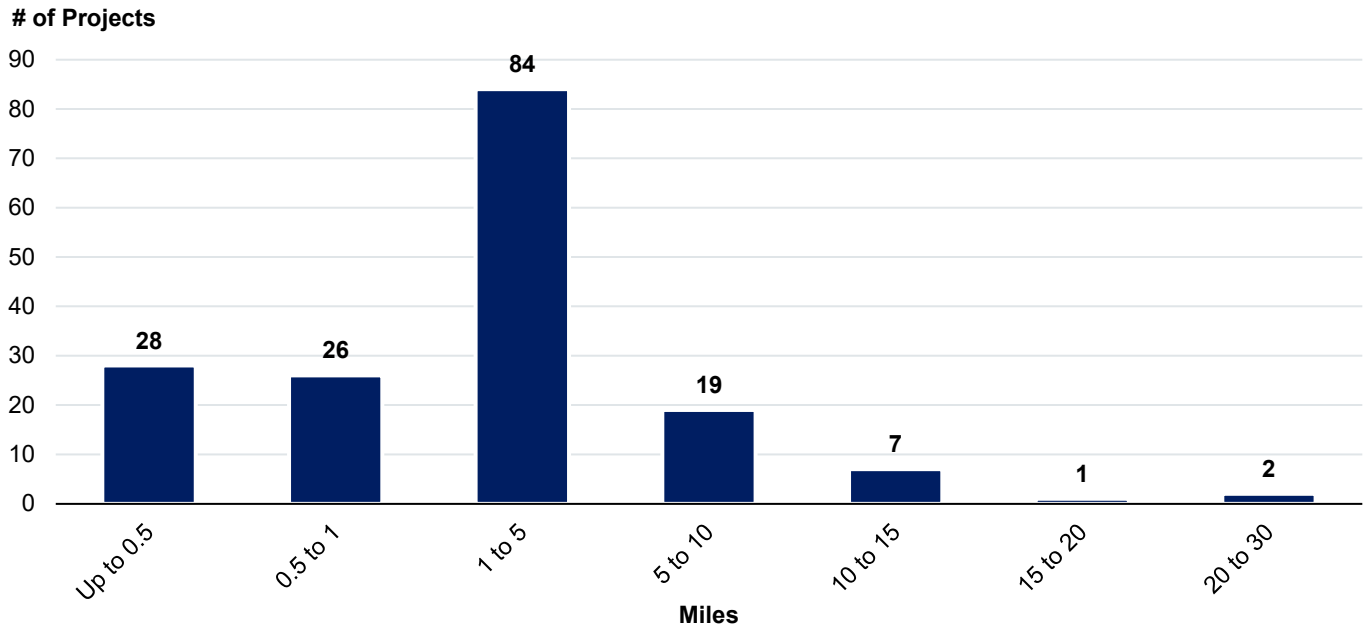


Figure 45 Interstate versus Non-Interstate Roadway Projects

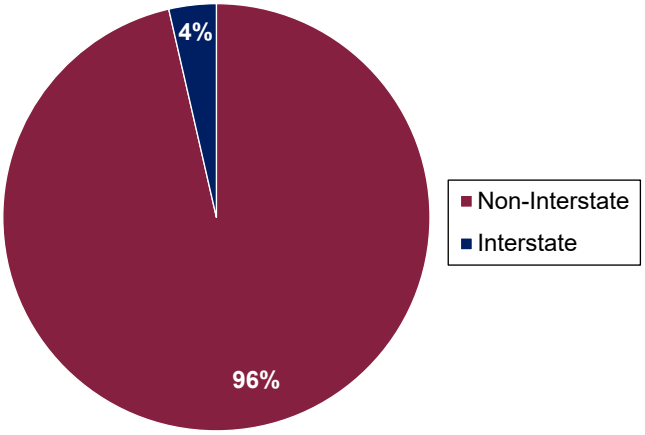


Figure 46 Roadway Project FHWA Functional Classification

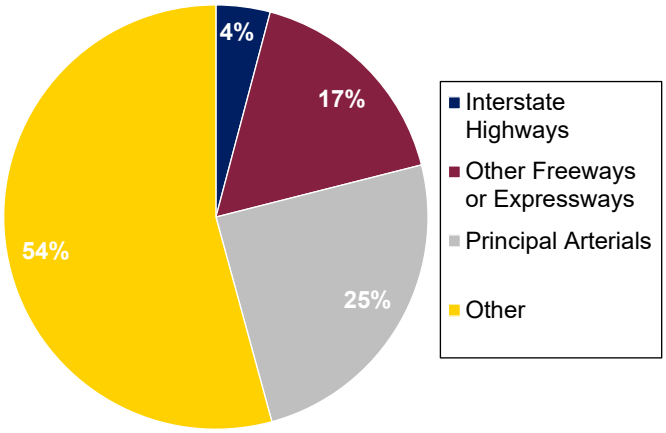


Table 23 breaks down the 1,040 project lane miles by jurisdiction, which Figure 47 displays in map form. The project lane miles are almost evenly spread among the three counties, with most project lane miles in Fairfax County (319), closely followed by Prince William County (298) and Loudoun County (280). 94 project lane miles are multi-jurisdictional.

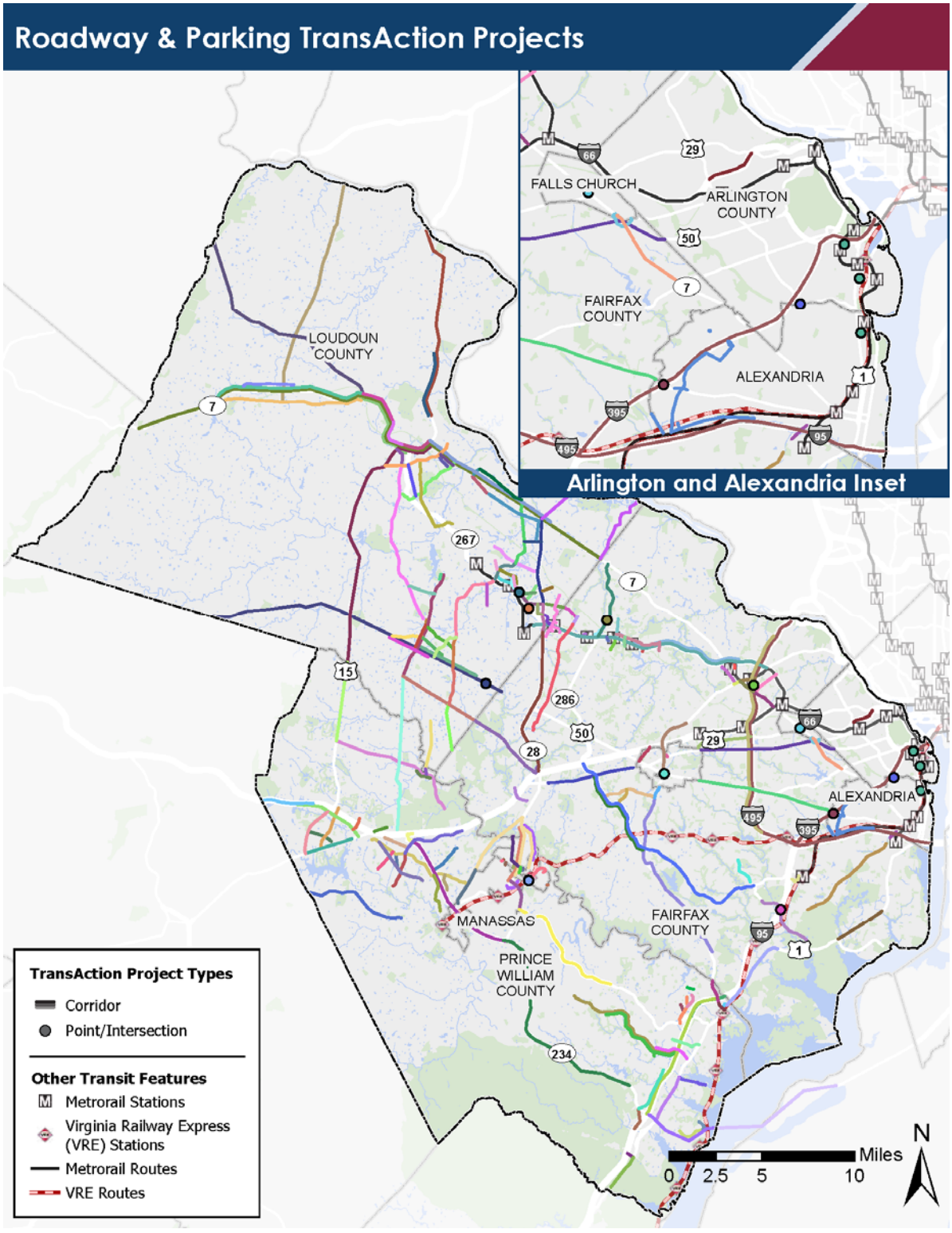
Table 23 Roadway Projects Lane Miles by Jurisdiction

Lane Miles by Jurisdiction	Total
Fairfax County	319
Loudoun County	280
Multi-jurisdictional	94
Town of Herndon	6
Prince William County	298
City of Manassas	4
Town of Leesburg	15
Manassas Park	4
Total	**1,040**

Parking

TransAction includes one primarily parking project, a $10 million “Park Once and Walk” Garage Network in the City of Falls Church. However, four more projects involve parking elements, three in Prince William County and one in Loudoun County. These projects are included in Figure 47.

Figure 47 Roadway and Parking TransAction Project Map



5.2.3 Transit Projects

TransAction includes 104 projects that are primarily transit-focused, the second highest number of project types (Figure 40) at 25 percent. Total, TransAction includes 116 projects that feature at least some transit elements. The 104 primarily transit-focused projects amount to $44.5 billion. The cost breakdown of these projects is shown in Figure 48, which shows transit projects cost varies. While the majority of projects cost less than $50 million, nine projects cost more than $1 billion.

These projects include transit elements such as:

- New/extended services across all modes
- More frequent transit service
- Transit priority
- Facilities
- Station access, circulation, capacity, & amenities
- Metrorail station second entrances & internal circulation
- Multimodal roadway improvements
- Real-Time Information
- Off-Board Fare Payment
- Mobility Hubs
- Park-and Rides
- Ferry service capacity improvements
- Microtransit
- Metrorail Core Capacity program (including 8-car trains and BOS realignment)
- VRE service & infrastructure program including (but not limited to) Transforming Rail in Virginia improvements

These projects also include 370 miles of prioritized transit right-of-way. The projects are largely in the eastern portion of the region, as seen in Figure 49, which is more densely populated. One type of project included in the Plan, BRT, is detailed later in the chapter.

Figure 48 Transit Project Cost Graph

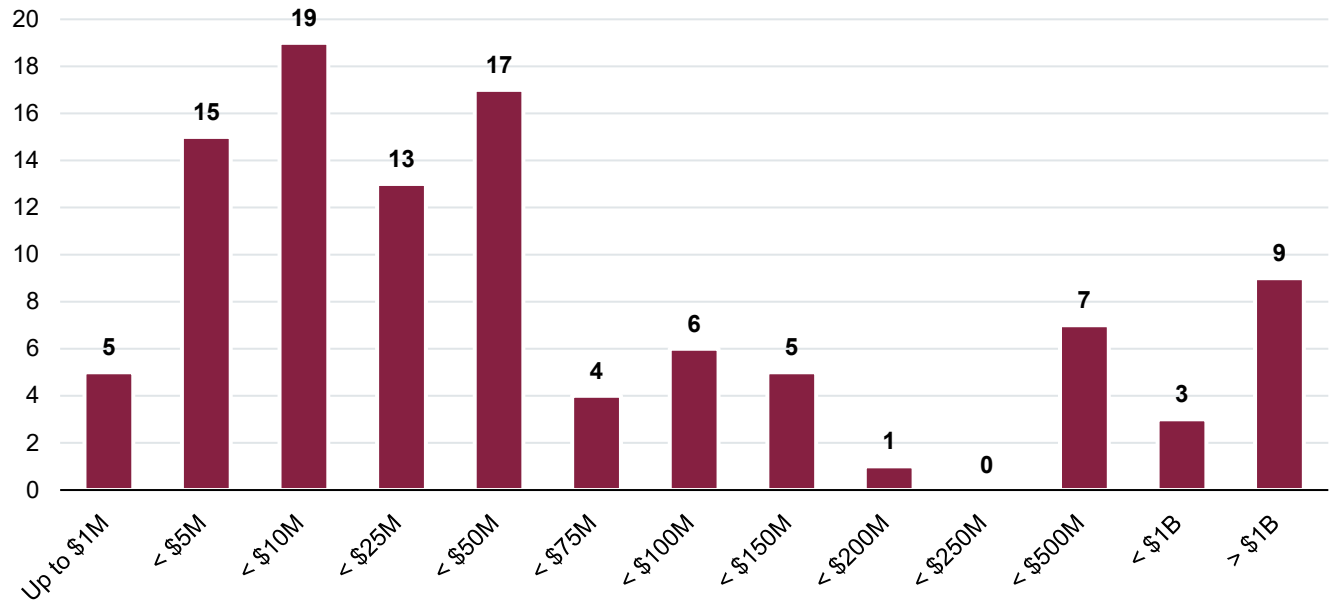
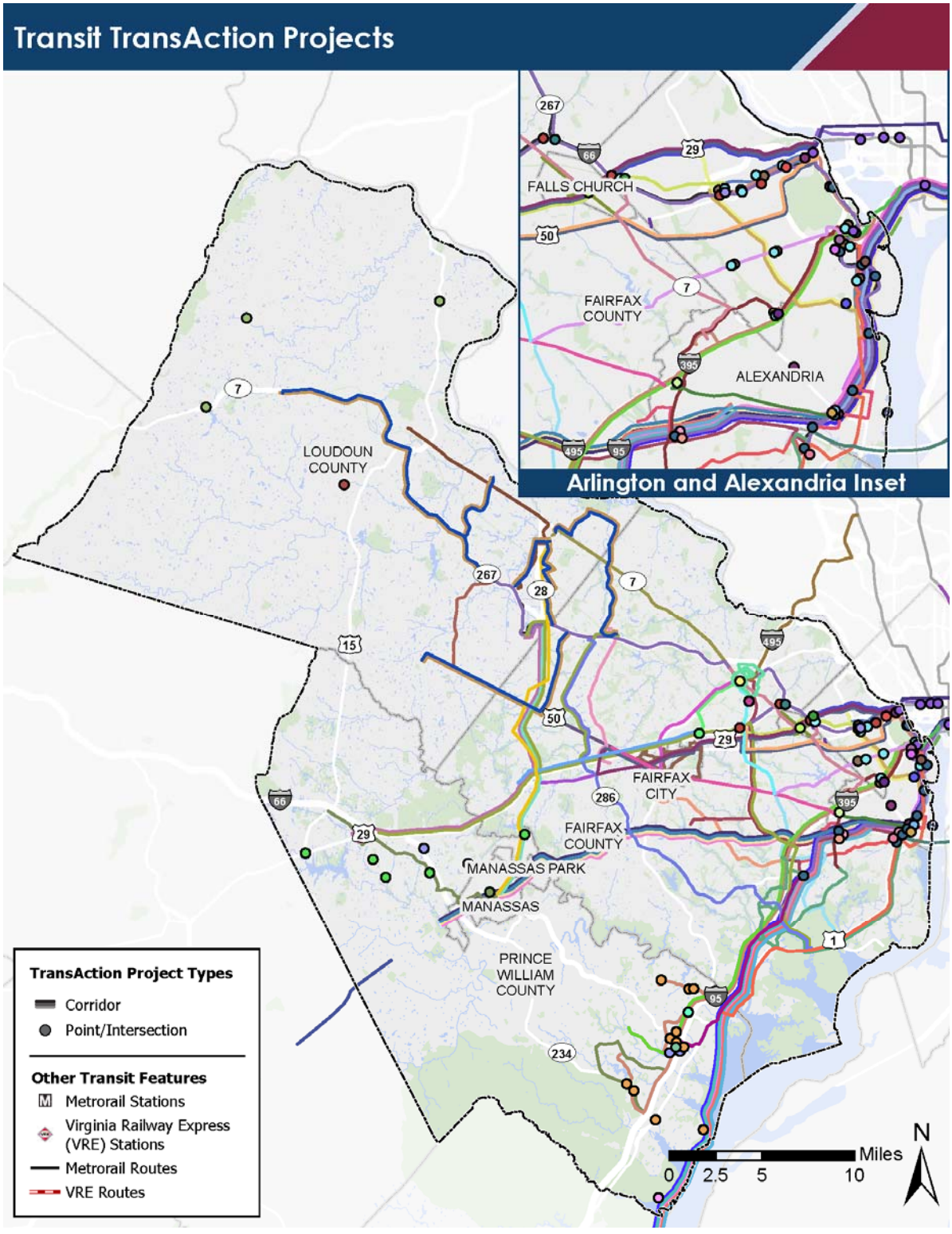


Figure 49 Transit TransAction Project Map



5.2.4 Interchange/Intersection Projects

TransAction includes 54 projects that are primarily intersection/interchange projects, but 87 projects included in TransAction include interchange/intersection elements, such as:

- Grade Separated interchanges
- Partial grade separation
- Innovative intersection designs
- Intersection improvements (signalization, added turn lanes, medians, etc.)

Total, these projects cost $6.9 billion, with a majority of projects costing between $75 and $100 million. Three projects cost less than $5 million and one project costs over $500 million.

Figure 51 shows the locations of the interchange/intersection projects across the Northern Virginia region.

Figure 50 Interchange/Intersection Project Costs

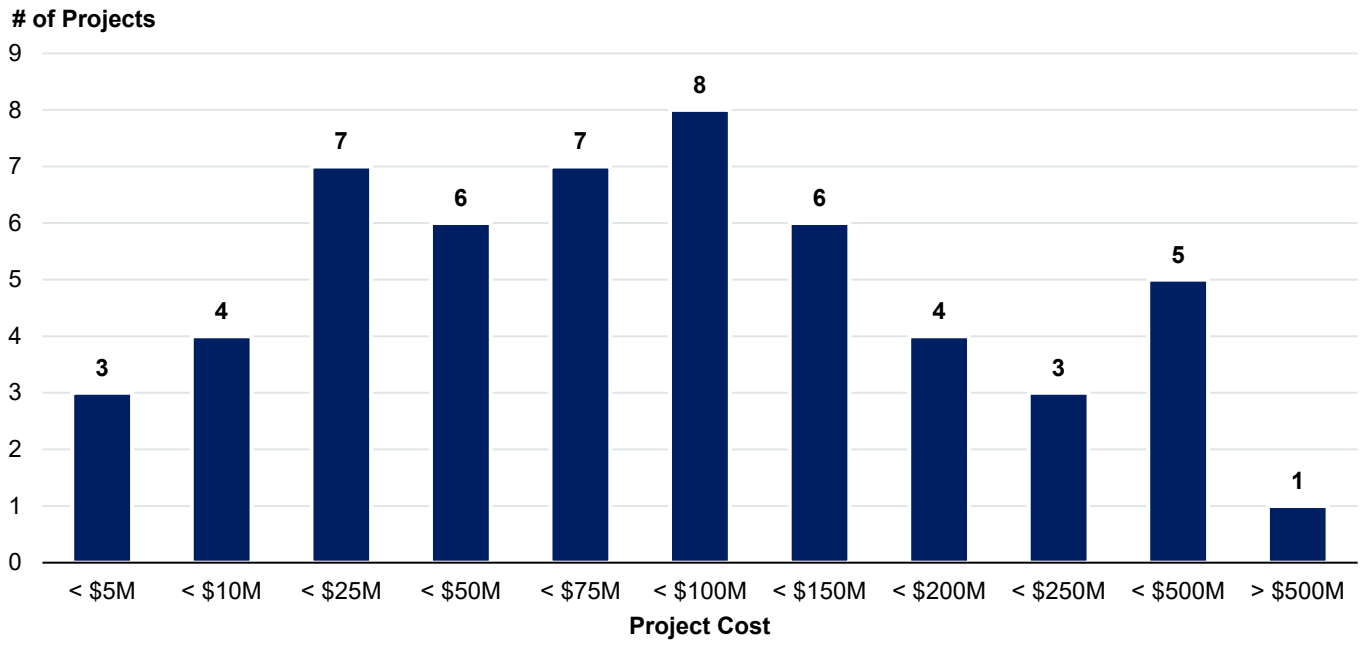
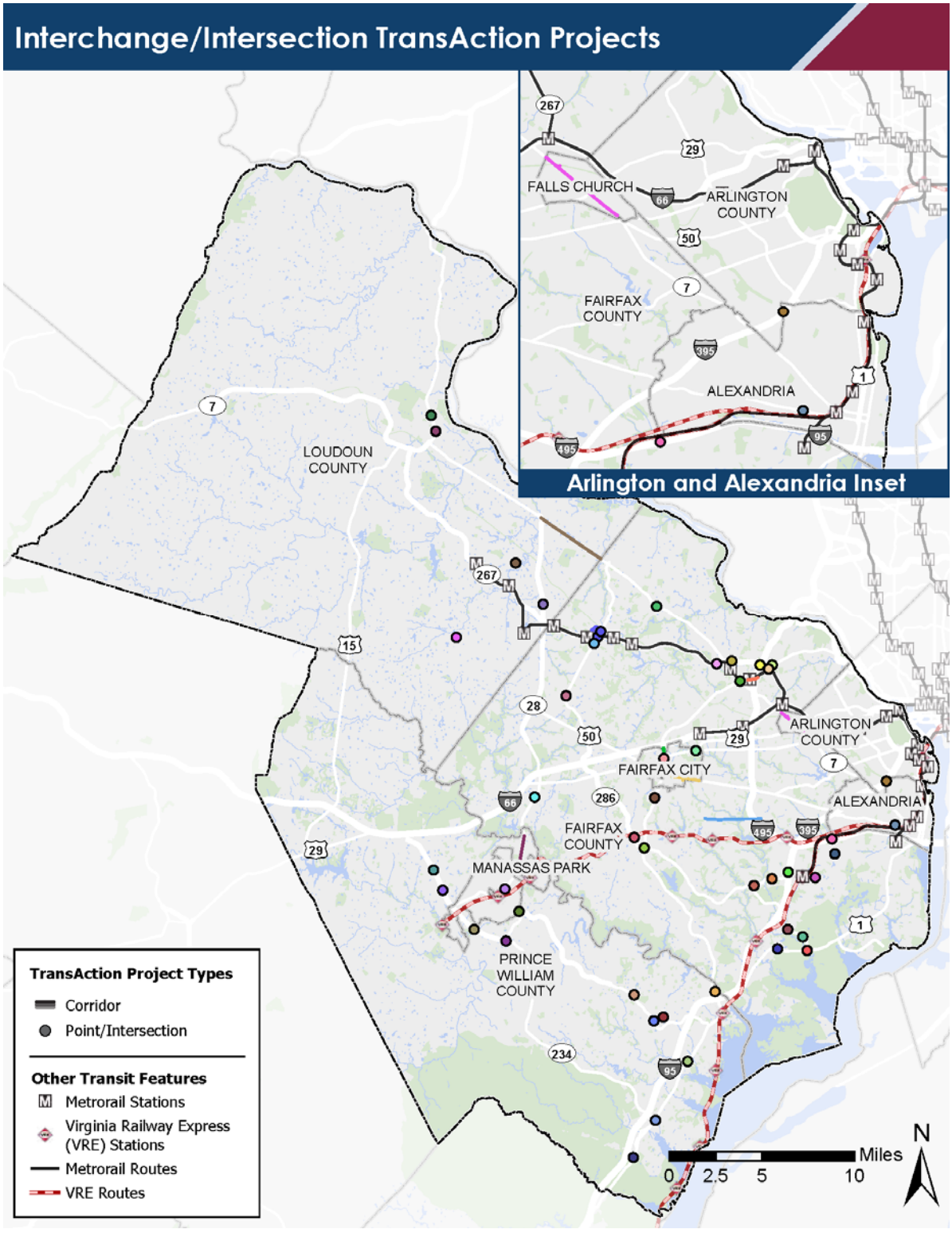


Figure 51 Interchange/Intersection TransAction Project Map



5.2.5 Technology Projects

TransAction includes 17 projects that are primarily technology projects, while 26 projects include technology elements, such as:

- Intelligent transportation systems (ITS) and integrated corridor management (ICM)
- Transit signal priority
- Real-time information (parking, transit)
- Low/zero-emission vehicle (ZEV) charging/fueling infrastructure
- Connected and autonomous vehicle (CAV) enabling technologies
- Regional multimodal mobility program (RM3P)

These projects cost $721.1 million in total, but the majority of the 17 projects cost between $10 and $25 million (Figure 52). The farthest reaching and most expensive technology project is ITS/ICM improvements across the Northern Virginia region, which costs $444.5 million. Figure 53 shows a map of the technology projects across Northern Virginia included in the Plan. An explanation and benefits of technology projects are detailed at the end of this chapter.

Figure 52 Technology Project Costs

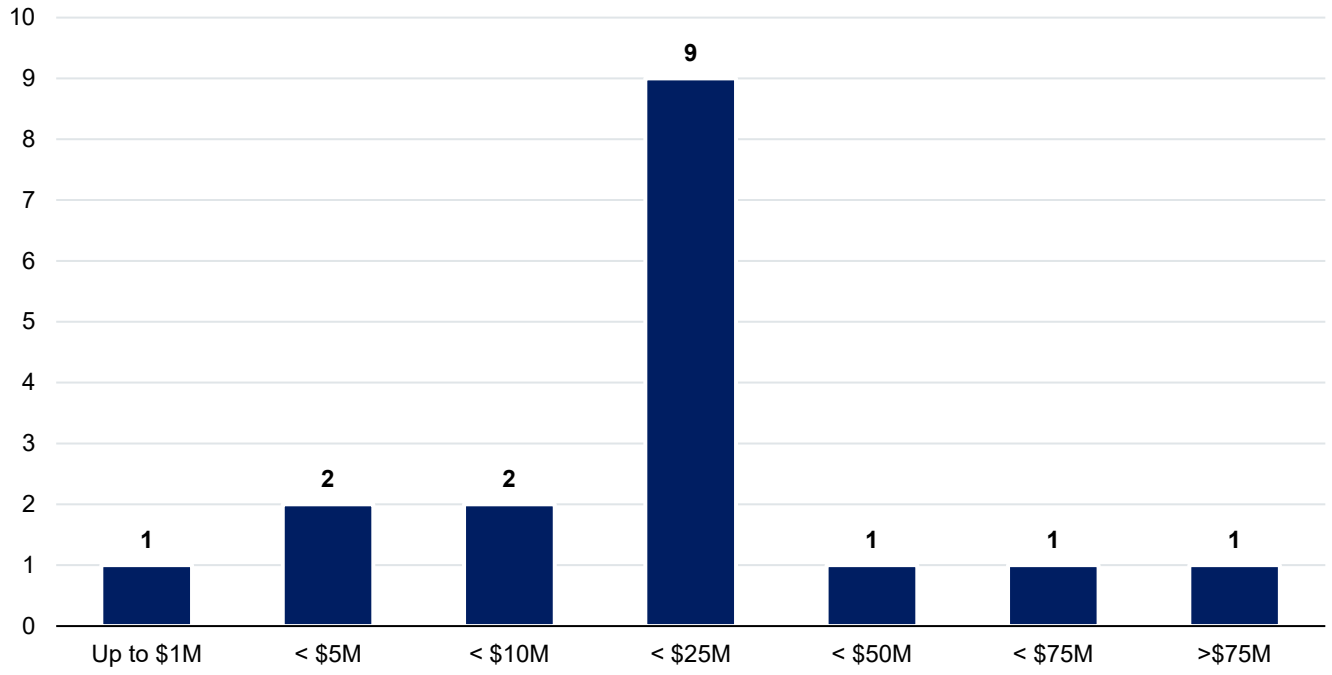
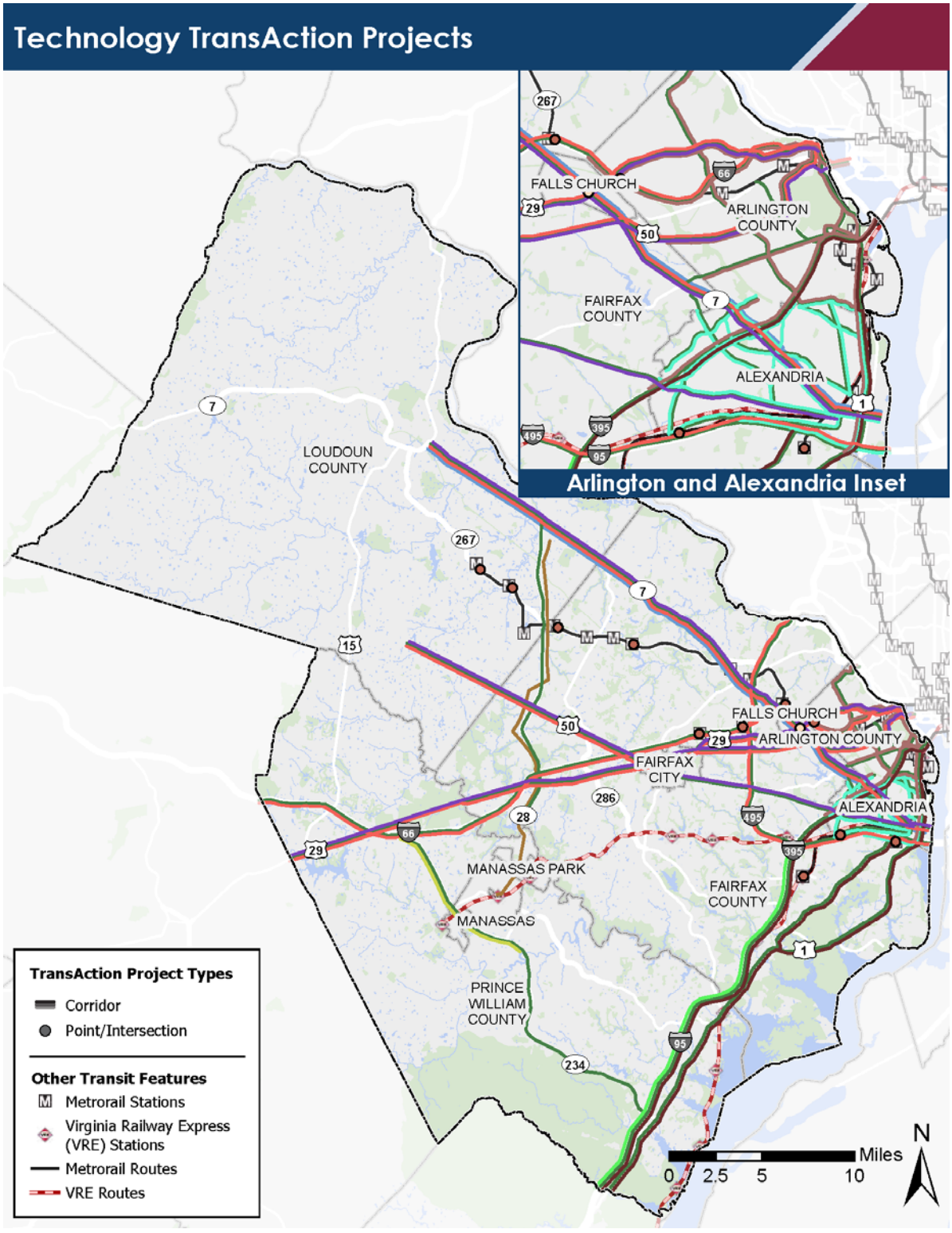


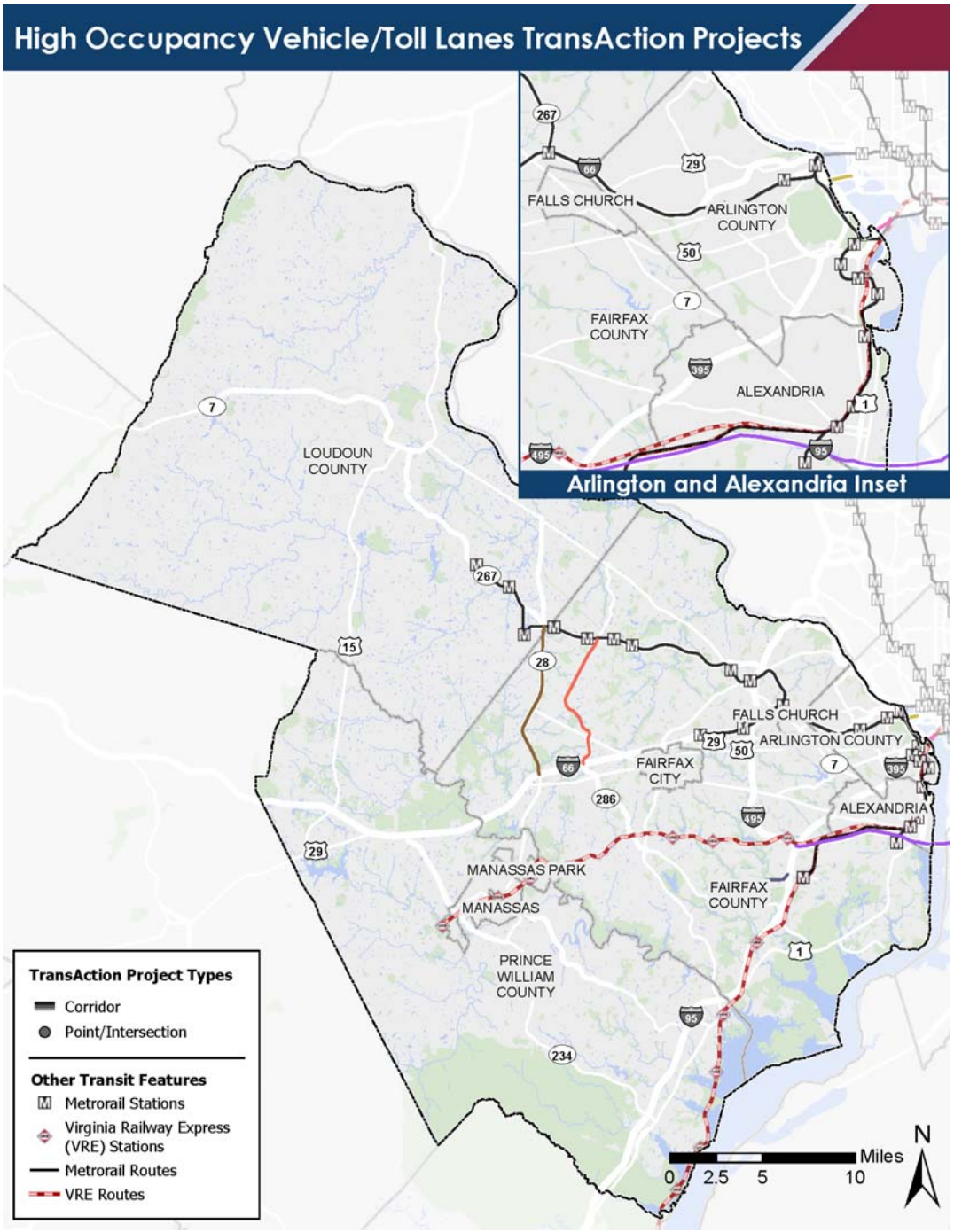
Figure 53 Technology TransAction Project Map



5.2.6 HOT/HOV Projects

Six projects in TransAction are primarily focused on HOT/HOV improvements, such as new or expanded HOV/HOT facilities and HOV/HOT interchanges. Figure 54 shows the locations of these projects, which are in Fairfax County and bridges connecting D.C. to Northern Virginia. These projects total $920 million.

Figure 54 HOV/Toll Lanes TransAction Project Map

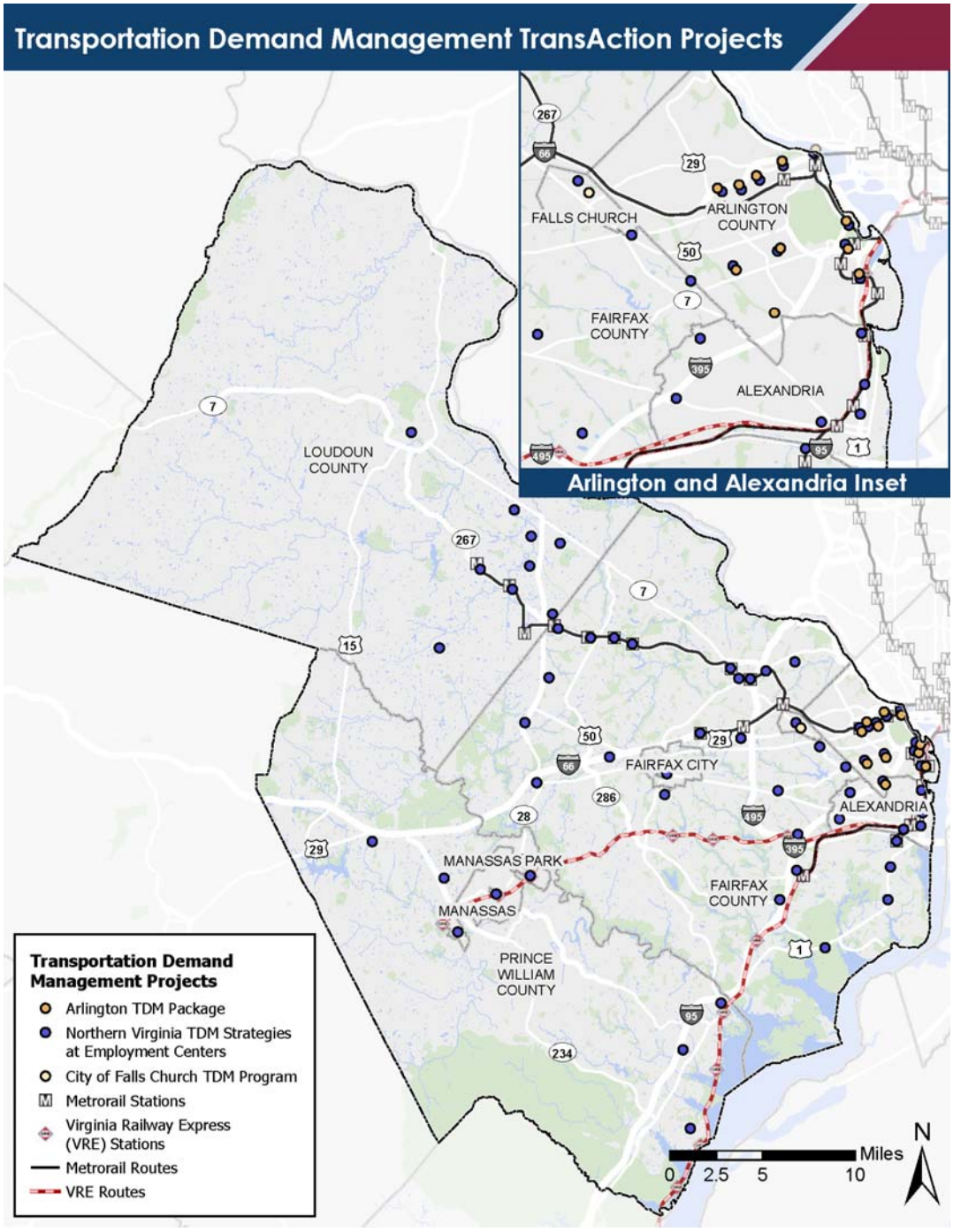


5.2.7 TDM Projects

The three projects that are focused on TDM total $63.9 million. The three TDM projects in TransAction are:

- Arlington TDM package ($1.5 million);
- Northern Virginia TDM Strategies program ($53.3 million); and
- City of Falls Church TDM Program ($100,000).

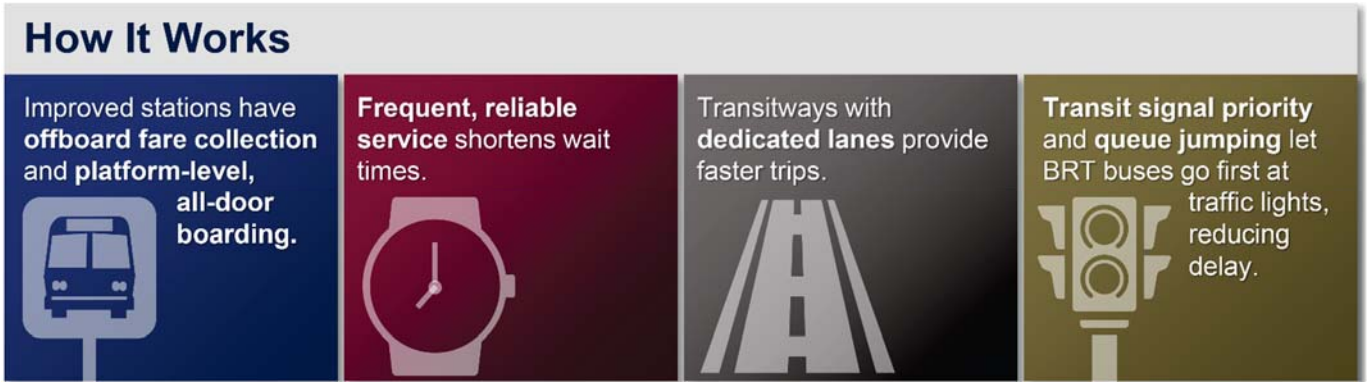
Figure 55 TDM TransAction Project Map



5.3 Building a Regional Bus Rapid Transit System

TransAction includes two types of transit projects that will bridge the gap between the region's backbone rail network (Metrorail and VRE) and the many local and commuter bus services provided throughout Northern Virginia, BRT and High-Capacity Transit (HCT). BRT is a high-quality and high-capacity bus-based transit system that delivers fast, comfortable, reliable, and cost-effective transit service. HCT could be similar to BRT but is used in TransAction to signify that a preferred modal technology (BRT, light-rail transit, heavy rail transit) has not yet been selected. This potential network of BRT and HCT will provide new transportation options that offer vital alternatives to personal and single occupancy vehicles. While BRT and HCT projects have been included in prior versions of TransAction, this update has highlighted the importance of a regional BRT system to provide high-quality transit connections across the region.

BRT provides an experience similar to a rail system through fast and frequent operations in dedicated transit lanes, branded stations and buses, off-board fare collection, and real time information. BRT is designed to provide bus service that is fast, frequent and reliable by minimizing typical causes of delay such as traffic congestion, intersection delay and boarding delay. BRT is often more flexible and less costly than a fixed-guideway heavy/light rail system.



5.3.1 *Why a Regional Bus Rapid Transit Network Is Important for Northern Virginia:*

- Improves resiliency, can provide equitable travel options and is economically, environmentally and socially sustainable.
- Reduces travel times and leverages the network effect of integrating multiple corridors to make transfers easier, improving access to jobs and destinations.
- Leverages existing infrastructure and investments (roads, rail, transit centers, toll facilities).
- Has a proven positive impact on economic development.

Source: NVTC

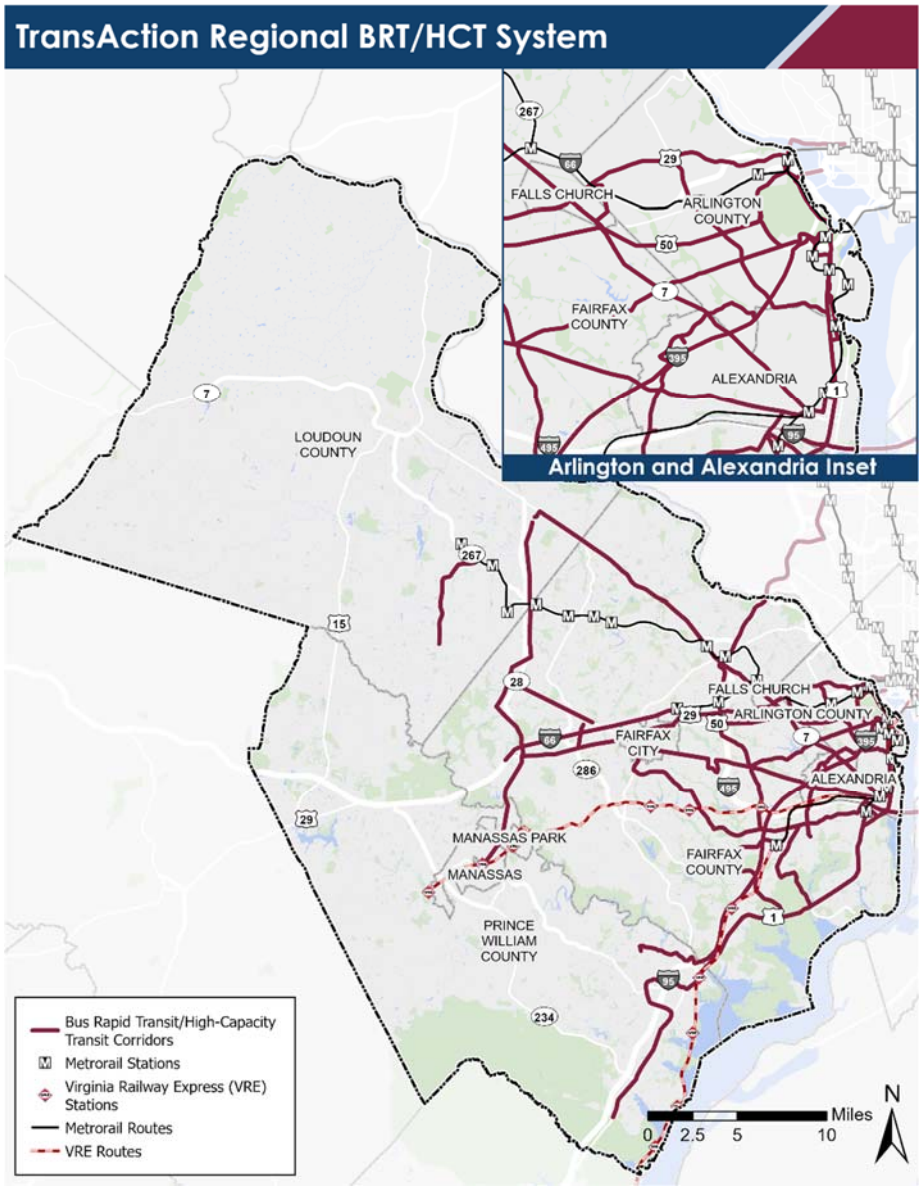
NVTA has convened a BRT Planning Working Group consisting of planners and project sponsors from Northern Virginia, as well as Montgomery and Prince George's Counties in Maryland, and the District of Columbia, to review the current plans and implementation status of BRT projects in the region. Five BRT projects, each of which are partly funded by NVTA, are in the project development process or under construction: Metroway/Crystal City Transitway (in operation), Richmond Highway BRT, Envision Route 7, West End Transitway, and Duke Street Transitway. TransAction has identified additional corridors that will address gaps and provide regional connections.

5.3.2 Planned BRT or HCT Corridors Included in TransAction:

TransAction includes over 90 miles of BRT, as part of a BRT/HCT system totaling approximately 280 miles including:

- Columbia Pike (Annandale to Crystal City)
- Route 7 (Tysons to Mark Center and Sterling to Tysons)
- Richmond Highway/Route 1 (Huntington to Ft. Belvoir; Extension to Potomac Mills/ Triangle)
- Duke Street Transitway and West End Transitway (City of Alexandria)
- U.S. 50 (D.C. to Chantilly)
- U.S. 29 (D.C. to Centreville)
- I-66 Corridor (Vienna to Centreville)
- Glebe Road (U.S. 29 to Potomac Yards)
- Annandale to Merrifield-Tysons
- City of Fairfax to Springfield/Huntington
- Route 28 Corridor (Manassas to Dulles Town Center)
- Ashburn Station to U.S. 50 via Brambleton
- Wilson Bridge (Franconia-Springfield to Branch Avenue)
- American Legion Bridge (Tysons to North Bethesda)

Figure 56 Regional BRT/HCT System



5.4 Leveraging Technology to Address Regional Transportation Needs

TransAction recognizes that technology and innovation offer a wide range of ways to address transportation needs by improving the efficiency of our existing infrastructure and providing new and better travel choices to the region's residents. It is informed by NVTA's own Transportation Technology Strategic Plan (TTSP), which is a living document that was developed as a tool for establishing a proactive approach to innovation, while keeping congestion reduction top of mind.

TransAction includes 17 projects that are primarily focused on implementing various types of technologies across Northern Virginia, and dozens more that include a technology element. Some types of technology projects include:

- Intelligent Transportation Systems (ITS), which can help improve operations in a number of ways:
  - » Directly improve the operations of roadways and transit through coordination of traffic signals, or metering freeway ramps.
  - » Dynamic and real-real time monitoring and response technologies, allowing for better and faster responses to crashes and other emergencies.
  - » Improving the information available to travelers regarding all transportation modes, such as real-time parking availability for park-and-ride lots, next bus arrivals, implementing ramp metering, and improving emergency responses.
- Low/ZEV charging/fueling infrastructure, which will support the transition of the region's vehicle fleet to electric or other low/ZEV emissions vehicle technologies.
- Improvements that enable use of CAV technologies, which can reduce crashes, increase the carrying capacity of roads, and provide first mile/last mile connections to transit and activity centers.
- Transit Signal Priority (TSP) which helps transit vehicles move faster and spend less time delayed at traffic signals.

Source: Getty Images

Many of these technologies are most effective when they are applied on a wide scale—along entire corridors or even across the whole region. To make the most of these technologies, it will be necessary to coordinate their implementation and ensure interoperability. When applied in an intentional way, these technologies can have major impacts on all aspects of the transportation system, including congestion, equity, sustainability, and safety. NVTA's TTSP identifies strategies and related actions to maximize the potential benefits and minimize any negatives of innovation in a manner that is highly consistent with NVTA's Core Values.

6.0 ANALYSIS OF THE PLAN IMPACTS

6.1 Evaluation Approach

6.1.1 Performance Measures

Potential transportation improvement projects are evaluated based on their ability to improve the region's transportation system across the three TransAction goals, which are further defined by a more specific set of seven objectives and ten performance measures. These performance measures, each with a corresponding weight, are listed in Table 1. Three additional metrics are also summarized as an indication of the impact of the TransAction projects on regional travel:

- Number of person trips by mode (auto, transit, nonmotorized)
- Person miles traveled
- Vehicle miles traveled

Ultimately, NVTA is pursuing a set of projects that have broad benefits and are modally balanced, in addition to helping achieve the regional transportation vision.

6.1.2 Travel Modeling

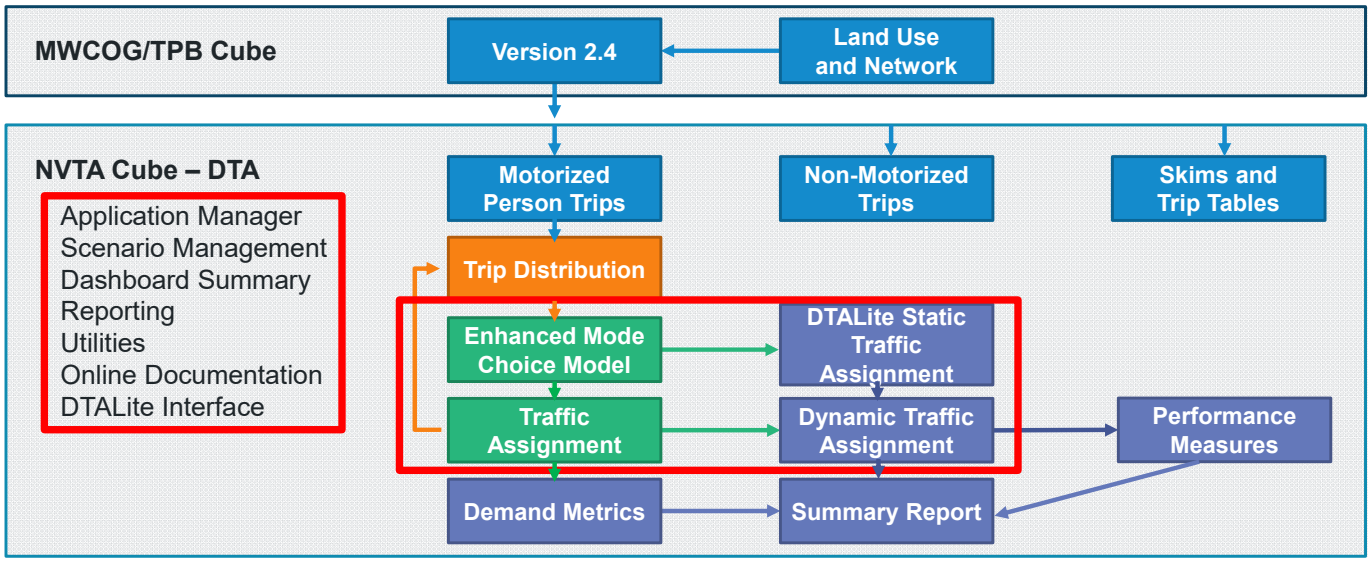
The modeling strategy developed for the TransAction update balances tradeoffs between functionality and efficiency, ensure consistency with the TransAction performance measures and consider the ability to build in-house modeling capabilities to improve upon the existing model system.

The modeling system framework is shown in Figure 57. Some of the key enhancements in this modeling strategy include:

- Integration of the COG/TPB model with a DTALite tool, which is an open-source, queue-based mesoscopic simulation package that provides a simpler, user-friendly, and more economical solution to conducting mesoscopic modeling and better representation and simulation of traffic congestion at a large regional scale
- New capability to model emerging travel behavior of transportation network company (TNC) travel
- New capability to conduct scenario analysis of travel via CAVs
- Updating representation of travel behavior (trip rates and mode choices) reflecting the latest Regional Travel Survey (RTS 2017/8)
- A robust scenario management system with flexibility for users and customized features
- A Modeling Dashboard that facilitates comparisons between scenarios and allows model users to quickly visualize information, with a variety of portable summary reports with a wealth of information about each scenario

- Enhanced postprocessing utilities that will empower users with analytical capabilities to gain insights from the model results, with specialized module for easy use, such as highway assignment only run and select link analysis.

Figure 57 TransAction Modeling Framework



The macroscopic model calibration and validation were conducted using the latest observed data (including 2017/18 Regional Travel Survey, traffic counts, and transit ridership) to make the macroscopic model better replicate observed data for the base year and produce more reasonable results in the study area (i.e., the Northern Virginia region). The focus is on the model components that have been refined, especially trip productions, mode choice, and traffic assignments. The DTA model calibration and validation leveraged the RITIS speed data to identify the locations and extents of congestion at a high level of spatial and temporal detail, with a focus on key corridors in Northern Virginia. For detailed information on model functionalities, calibration and validation can be found in Appendix B: *NVTA Model Development: Calibration and Validation*.

6.1.3 Other Evaluation Tools

In addition to the travel demand model, the evaluation included some off-model tools and procedures, as well as qualitative evaluation for some of the performance measures. These include a GIS-based process to quantify the accessibility by bicycle (the number of jobs accessible by bike within 30 minutes) used in the calculation of the C1 and C2 measures.

Additional detail on the methodology used for calculation of the TransAction measures is documented in the *Technical Memorandum: Performance Measures Methodology*, which can be found in Appendix C.

6.2 Transportation Network Evaluated

6.2.1 2045 No Build Network

The TransAction No-Build network represents the most likely future transportation network for Northern Virginia, in the absence of the projects being evaluated for TransAction. The basis for the network is the MWCOG/TPB's Constrained Long-Range Plan (CLRP) transportation network, specifically the CLRP network from the Air Quality Conformity (AQC) Analysis of the 2020 Amendment to Visualize 2045 and FY2021–2024 Transportation Improvement Program (TIP).

Within Northern Virginia, changes were made to the CLRP network to support evaluation of the TransAction Plan including:

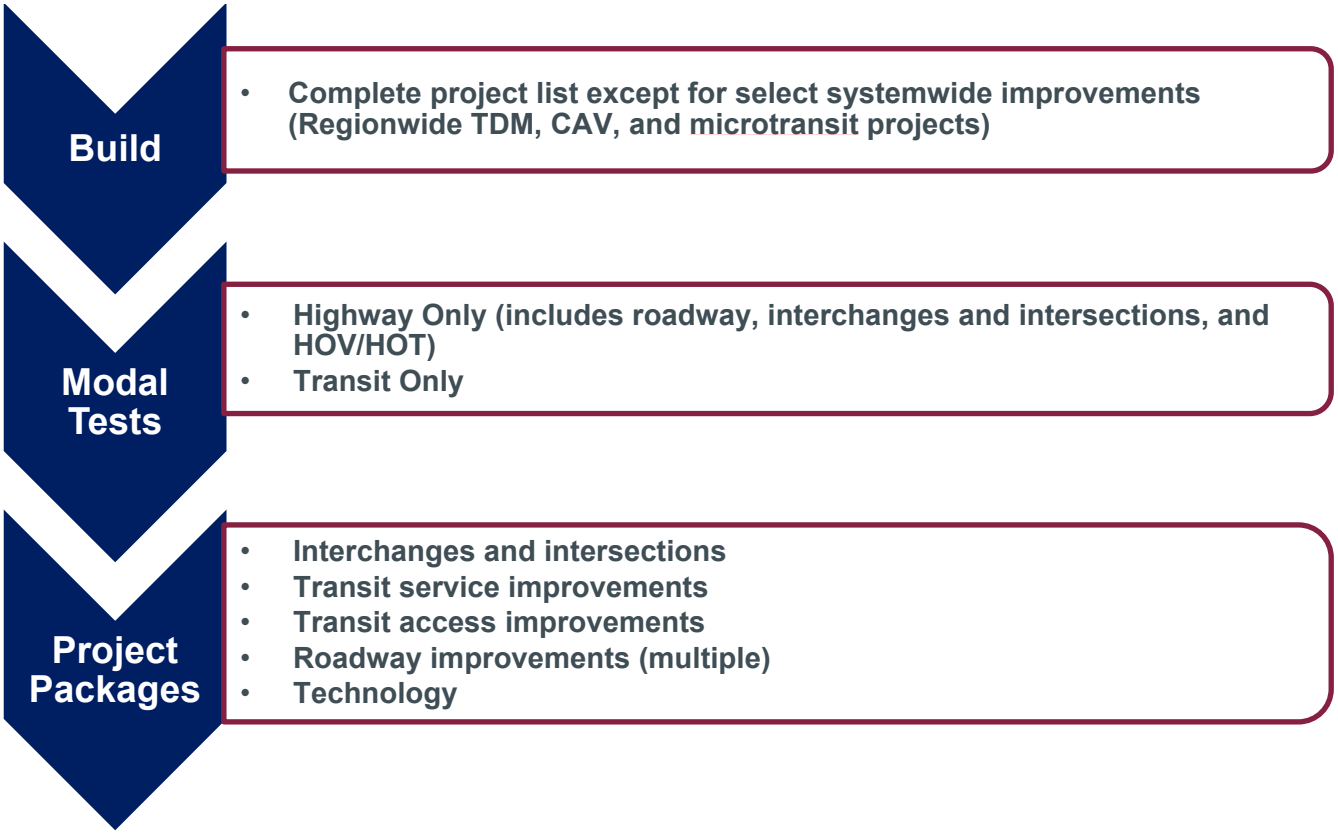
- Keeps projects fully funded by NVTA and other agencies; and
- Removes projects on the TransAction "Build" project list.

Outside of Northern Virginia, the CLRP network is retained.

6.2.2 2045 Build Networks

The TransAction evaluation used multiple travel forecasts to evaluate the travel impacts and performance benefits of the TransAction projects. The complete project list consisting of nearly all of the 424 projects comprise the "Build" network and is used to show the benefits of the plan, in totality. A small number of regionwide projects is not included in the Build network—TDM, CAV, and microtransit projects—that were evaluated separately. Separate mode-based tests evaluated the impacts of the highway and transit projects separately to gain a better understanding of the contributions of each type of project to overall performance.

Figure 58 TransAction 2045 Build Networks for Testing



6.3 Regional and Subregional Results—2045 Build Network

Between 2017 and 2045, the expected growth in the region, in terms of increases in population and employment, will have a significant impact on the amount and type of travel in the region. Under the 'No-Build' (if no proposed projects are built) conditions (Table 24), the following changes are expected between 2017 and 2045:

- Total person trips increase by 26.9 percent, with a higher percentage of growth expected for transit trips (47.1 percent) than for automobile trips (22.0 percent);
- Person miles traveled increase by 29.2 percent and vehicle miles traveled (VMT) increase by 26.4 percent; and
- Total person-hours of delay are forecast to increase by 94.2 percent.

Thus, the 2045 'No-Build' scenario has significantly more travel on roadways and transit than current conditions. The large increase in transit travel likely reflects the combination of a growing population, increased densities, and new transit facilities contained in the CLRP (not including transit projects on the TransAction project list).

Overall, the results of this model-based analysis show the improvements included in the 'Build' network (if all projects proposed in TransAction are built) would benefit the entire Northern Virginia region and improve travel conditions when compared to the 2045 'No Build' conditions:

- Total person trips remain essentially the same between the 2045 No-Build and 2045 Build analysis, but the number of transit trips increases by 12.4 percent due to the significant investment in proposed in transit projects.

- VMT increase by 3.4 percent between the 2045 No-Build and 2045 Build analysis, as highway capacity improvements and reduced travel delay lead to some increases in the length of auto trips.

Table 24 Weekday Travel Forecasts, Northern Virginia Regional Totals

Daily Travel	2017 Base	2045 No-Build	2045 Build	% Change 2017 to 2045 No-Build	% Change 2045 Build versus 2045 No-Build
Auto Person Trips	6,742,000	8,223,000	8,154,000	22.0%	-0.8%
Transit Person Trips	263,000	387,000	435,000	47.1%	12.4%
Non-Motorized Person Trips	852,000	1,357,000	1,354,000	59.3%	-0.2%
Total Person Trips	7,857,000	9,967,000	9,943,000	26.9%	-0.2%
Commercial/Truck Trips	583,000	788,000	787,000	35.2%	-0.1%
Person Miles Traveled (PMT)	70,690,000	91,338,000	94,703,000	29.2%	3.7%
Vehicle Miles Traveled (VMT)	52,422,000	66,251,000	68,529,000	26.4%	3.4%
Total Person-Hours of Delay	**413,000**	**802,000**	**649,000**	**94.2%**	**-19.1%**

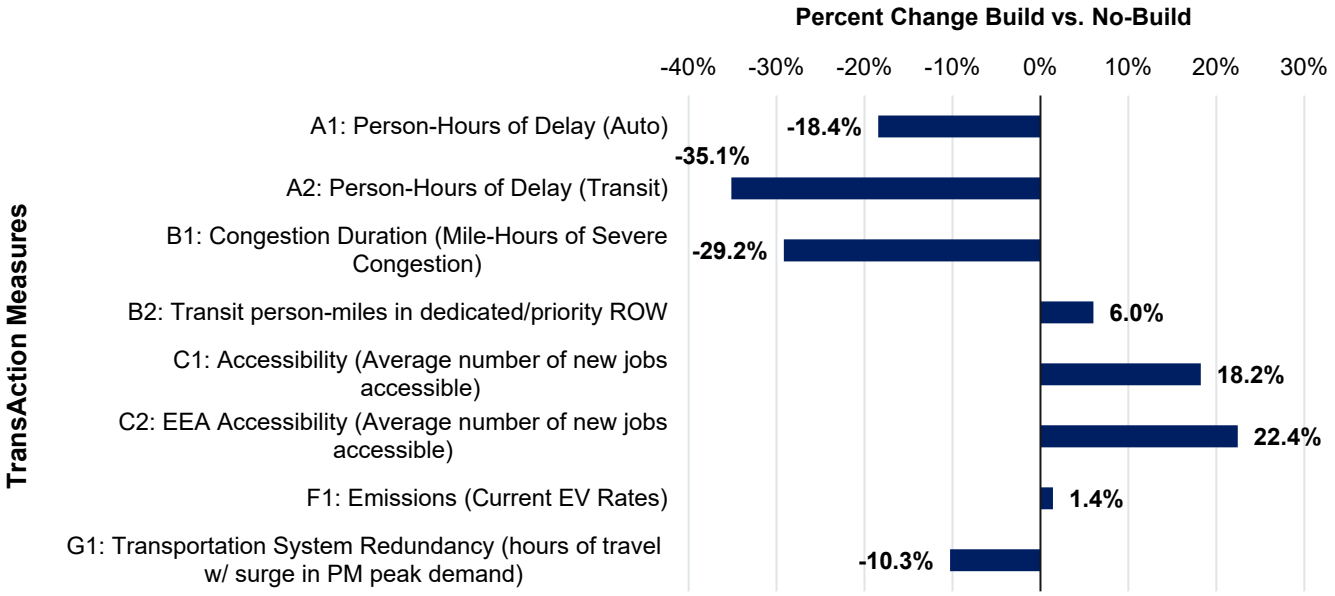
Source: NVTA TransAction Model

Performance of the regional transportation system in 2045 with the 'Build' network improvements, measured across key travel indicators and with the TransAction performance measures, shows significant improvements across Northern Virginia (Figure 59 and Table 25):

- The 2045 Build significantly improves the performance of the transportation system, relative to the No-Build:
  - » Person hours of delay decrease by 18.4 percent for auto trips and by 35.1 percent for transit trips representing significant improvements in congestion across the region.
  - » Hours of severe congestion decrease by 29.2 percent.
  - » Accessibility to jobs improves by 18.2 percent overall, and slightly more (approximately 22.4 percent) for EEA residents.
  - » The impacts of the full TransAction project list on emissions depend on the effectiveness of the three TransAction projects focused on fleet electrification. If those projects are very effective at transitioning to ZEVs, emissions could be reduced by as much as 54 percent[24] (assuming that the composition of the energy sources utilized in the Commonwealth is maintained). If they have no impact on encouraging ZEV adoption, then the TransAction project list could increase emissions by as much as 1.4 percent. The likely outcome will be somewhere between these two values.

[24] The TransAction analysis assumes existing electrification rates: 4% light-duty vehicles, 1% buses, and 0% trucks. With investment in EV infrastructure contained in the TransAction Plan, the analysis assumed the following potential future EV participation rates: 77% light-duty vehicles, 100% buses, and 8.4% trucks.

Figure 59 Percentage Change in TransAction Measures, Build versus No-Build



Notes: See Section 2 for full list of performance measures. D1 (quality of access to transit and walk/bike network) and E1 (potential for safety and security improvements) measures are evaluated at the project-level only. The value shown for F1 represents only the worst case scenario—results could fall in a wide range as discussed above.

Table 25 TransAction Measures, Northern Virginia Regional Totals

Performance Measure	2017 Base	2045 No-Build	2045 Build	% Change 2045 Build versus No-Build
A1. Total person-hours of delay in autos	394,000	765,000	624,000	-18.4%
A2. Total person-hours of delay on transit	19,000	37,000	24,000	-35.1%
B1. Duration of severe congestion	360	840	595	-29.2%
B2. Transit person-miles in dedicated/ priority ROW	8,701,000	9,971,000	10,573,000	6.0%
C1. Access to jobs by car, transit and bike	1,830,000	2,155,000	2,548,000	18.2%
C2. Access to jobs by car, transit and bike for EEA populations	1,906,000	2,157,000	2,641,000	22.4%
G1. Transportation system redundancy	NA	1,149,000	1,031,000	-10.3%

Notes: D1 (quality of access to transit and walk/bike network) and E1 (potential for safety and security improvements) measures are evaluated at the project-level only.

Electrification and Emissions

The impact of the TransAction projects on emissions will depend heavily on how much electrification can be achieved and how much electrification is helped by the proposed projects as opposed to other external factors. TransAction includes three projects specifically designed to increase access to charging/fueling infrastructure for low/Zero emissions vehicles of all types and helping them become more widespread on Northern Virginia's roads. If these projects are effective at helping to electrify trucks, buses and private cars, emissions could be reduced by up to 54 percent. However, if electrification rates in 2045 remain similar to current levels, TransAction may actually result in a slight increase in emissions (about 1.4 percent).

Figure 60 shows the change in daily traffic volumes and Figure 61 shows the change in daily vehicle hours of delay between the Build and No-Build networks.

Figure 60 Change in 2045 Daily Traffic Volumes, Build versus No-Build

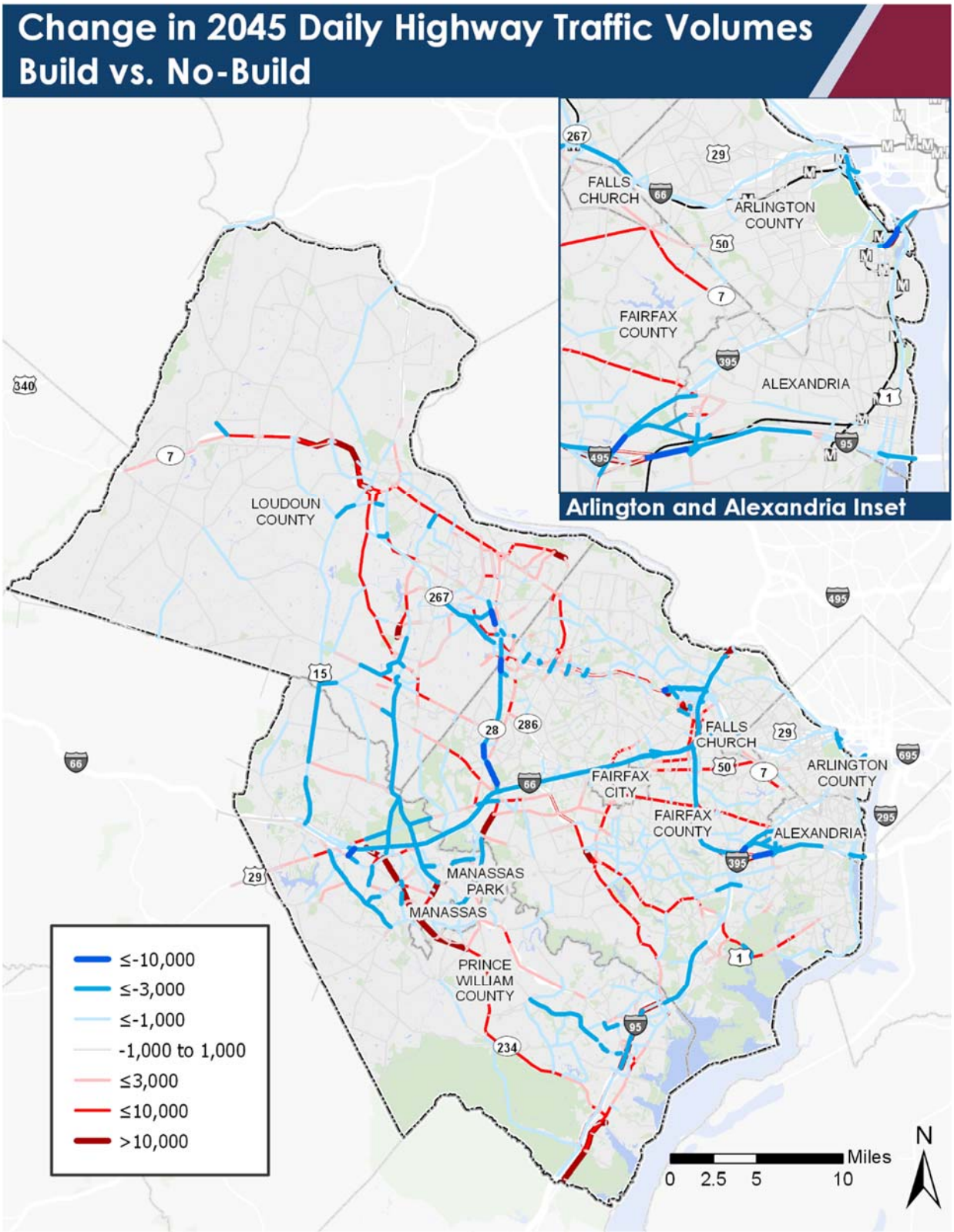
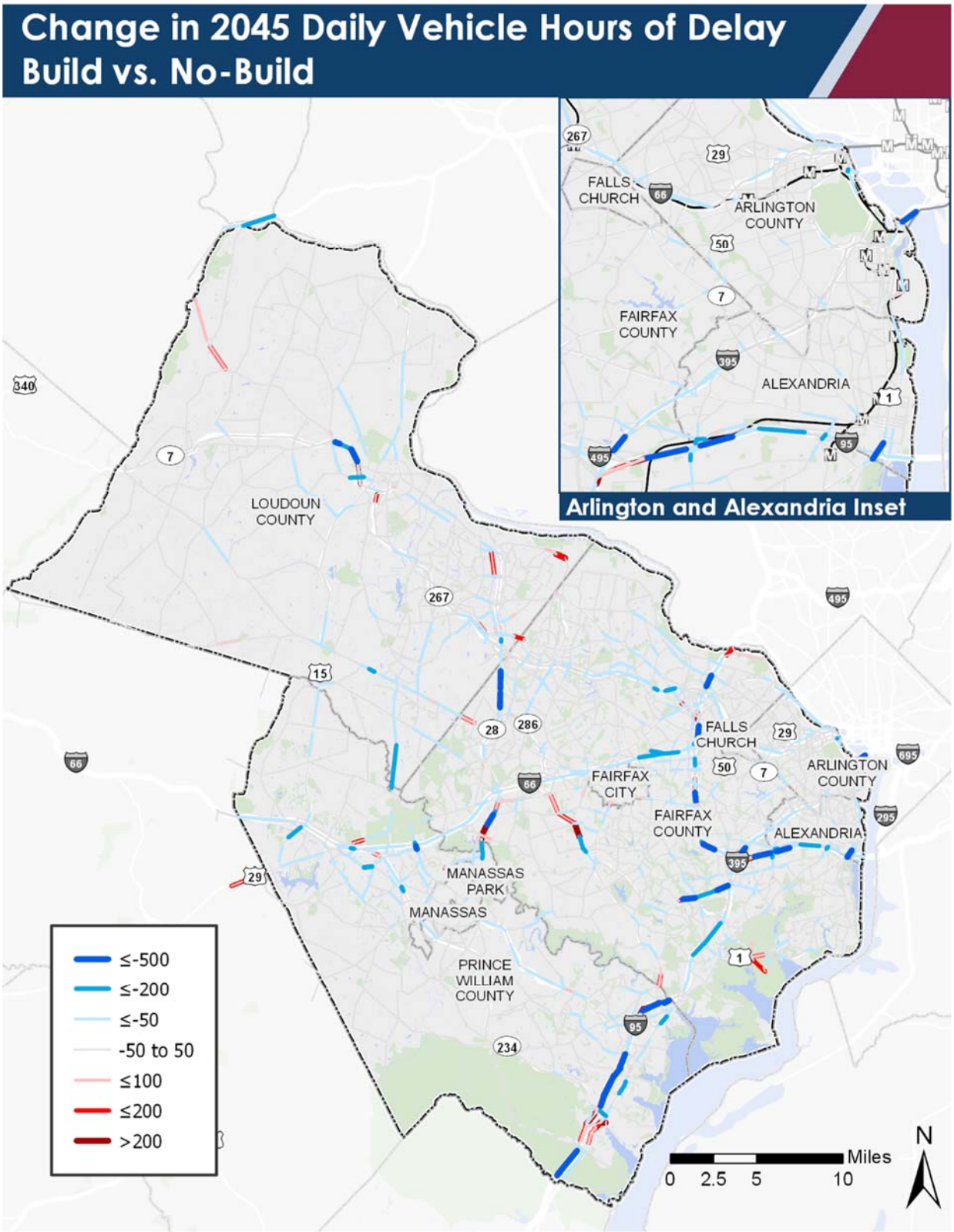


Figure 61 Change in 2045 Daily Vehicle Hours of Delay, Build versus No-Build

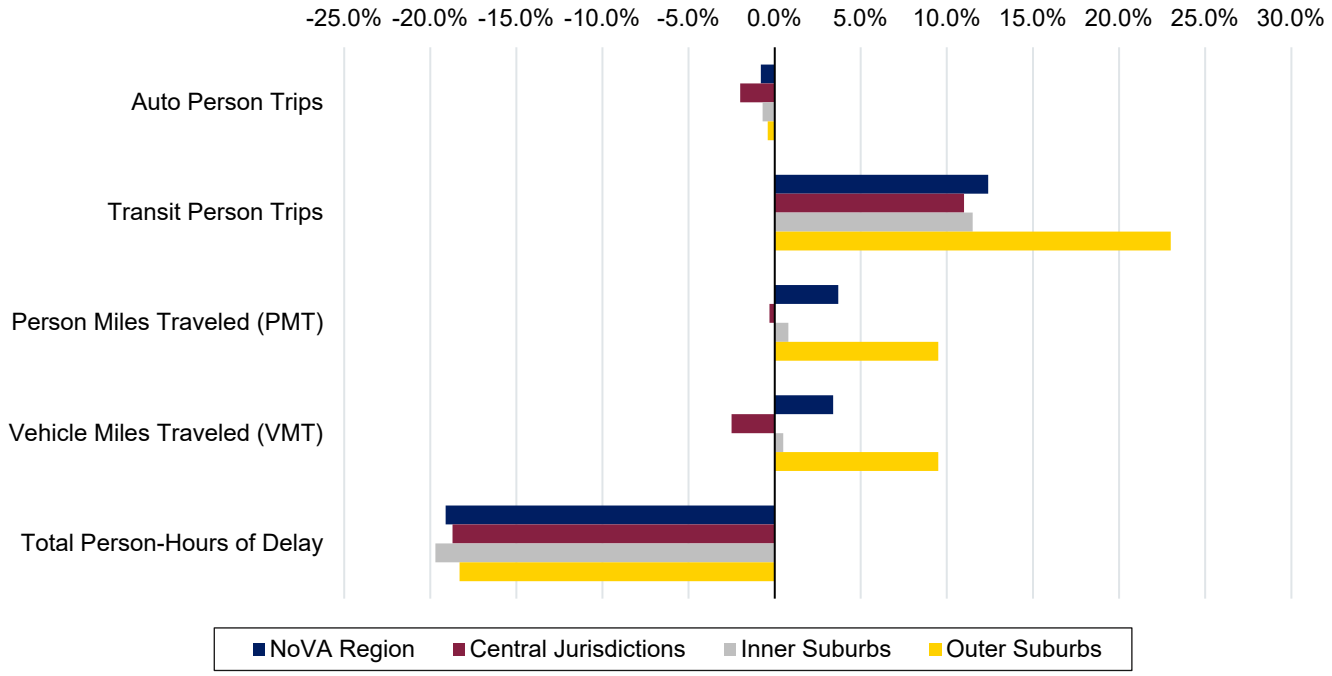


6.3.1 Subregional Results

Different patterns are observable across the region, as the projects included in the Plan have different impacts by Northern Virginia subregion:[25]

- Transit trips show the largest percentage increase (23 percent) in the Outer Suburbs as transit options expand.
- VMT changes vary considerably by subregion, with a decrease (-2.5 percent) in the Central jurisdictions; modest increase (+0.5 percent) for Inner Suburbs; and a larger increase (+9.5 percent) in the Outer Suburbs.
- Reductions in total person hours of delay (the combined total of A1 and A2 measures as listed in the graph above) are distributed more evenly throughout Northern Virginia, as each of the subregions decreases congestion through different means.

Figure 62 Percent Change in 2045 Build Relative to No-Build, Regional and Subregional Results



[25] Central: Arlington County, City of Alexandria; Inner: Fairfax County, Cities of Falls Church and Fairfax; Outer: Loudoun County, Prince William County, Cities of Manassas and Manassas Park.

Table 26 Change in 2045 Build Relative to No-Build, Regional and Subregional Results

Daily Travel	2045 Build Region	% Chg. Build versus No-Build Region	2045 Build Central	% Chg. Build versus No-Build Central	2045 Build Inner Suburbs	% Chg. Build versus No-Build Inner Suburbs	2045 Build Outer Suburbs	% Chg. Build versus No-Build Outer Suburbs
Auto Person Trips	8,154,000	-0.8%	987,000	-2.0%	3,883,000	-0.7%	3,285,000	-0.4%
Transit Person Trips	435,000	12.4%	177,000	11.0%	213,000	11.5%	46,000	23.0%
Person Miles Traveled (PMT)	94.70 M	3.7%	12.51 M	-0.3%	47.40 M	0.8%	34.80 M	9.5%
Vehicle Miles Traveled (VMT)	68.53 M	3.4%	7.57 M	-2.5%	34.81 M	0.5%	26.15 M	9.5%
Total Person Hours of Delay (Auto + Transit)	**649,000**	**-19.1%**	**95,000**	**-18.7%**	**344,000**	**-19.7%**	**210,000**	**-18.3%**

Note: M indicates values in millions.

6.3.2 Improved Access to Jobs

Accessibility is measured by calculating the increase in the average number of regional jobs accessible from households in Northern Virginia within a 45-minute drive, a 60-minute transit ride, and a 30-minute bike ride. The Plan results in widespread improvements in auto accessibility to jobs throughout the region. Overall, accessibility to jobs by all modes is expected to increase by 18.2 percent with the TransAction Plan (Build network) projects, when compared with no-build conditions. When only the residents of EEAs are considered, the average gain is 22.4 percent, indicating that the Plan improves accessibility for EEA residents more than the region as a whole. This would represent an improvement in the equity of the transportation network as a significant portion of the people that live in EEAs are included in NVTA's definition of under-served populations.

The maps below show the areas where accessibility improves (increase in jobs that are accessible) with the TransAction projects. Improvements in auto accessibility are widespread throughout the region, reflecting the geographic distribution of the projects, with larger improvements along I-495, Dulles Toll Road, Fairfax County Parkway, and Route 28 corridors. Improvements in transit accessibility to jobs are more prevalent in eastern parts of the region, including Alexandria, the Richmond Highway corridor of Fairfax County, and eastern Prince William County. Accessibility improvements are seen in the Route 28 and Fairfax County Parkway corridors where the Plan fills major gaps in the regional transit network. Bike accessibility gains are more focused on areas inside the Beltway where densities allow for more jobs to be reached within a 30-minute bike ride.

Figure 63 Change in Auto Access to Jobs, Build versus No-Build

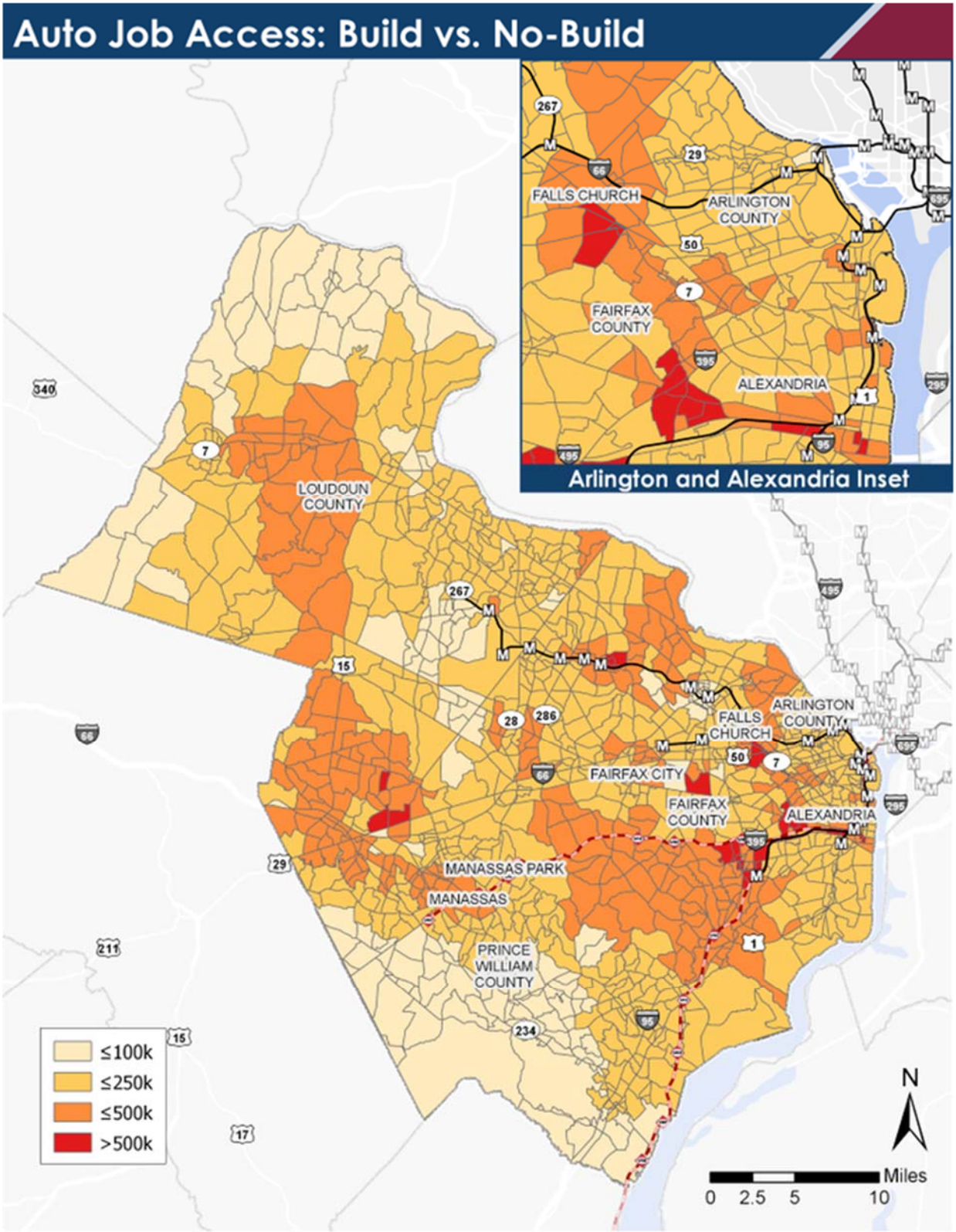


Figure 64 Change in Transit Access to Jobs, Build versus No-Build

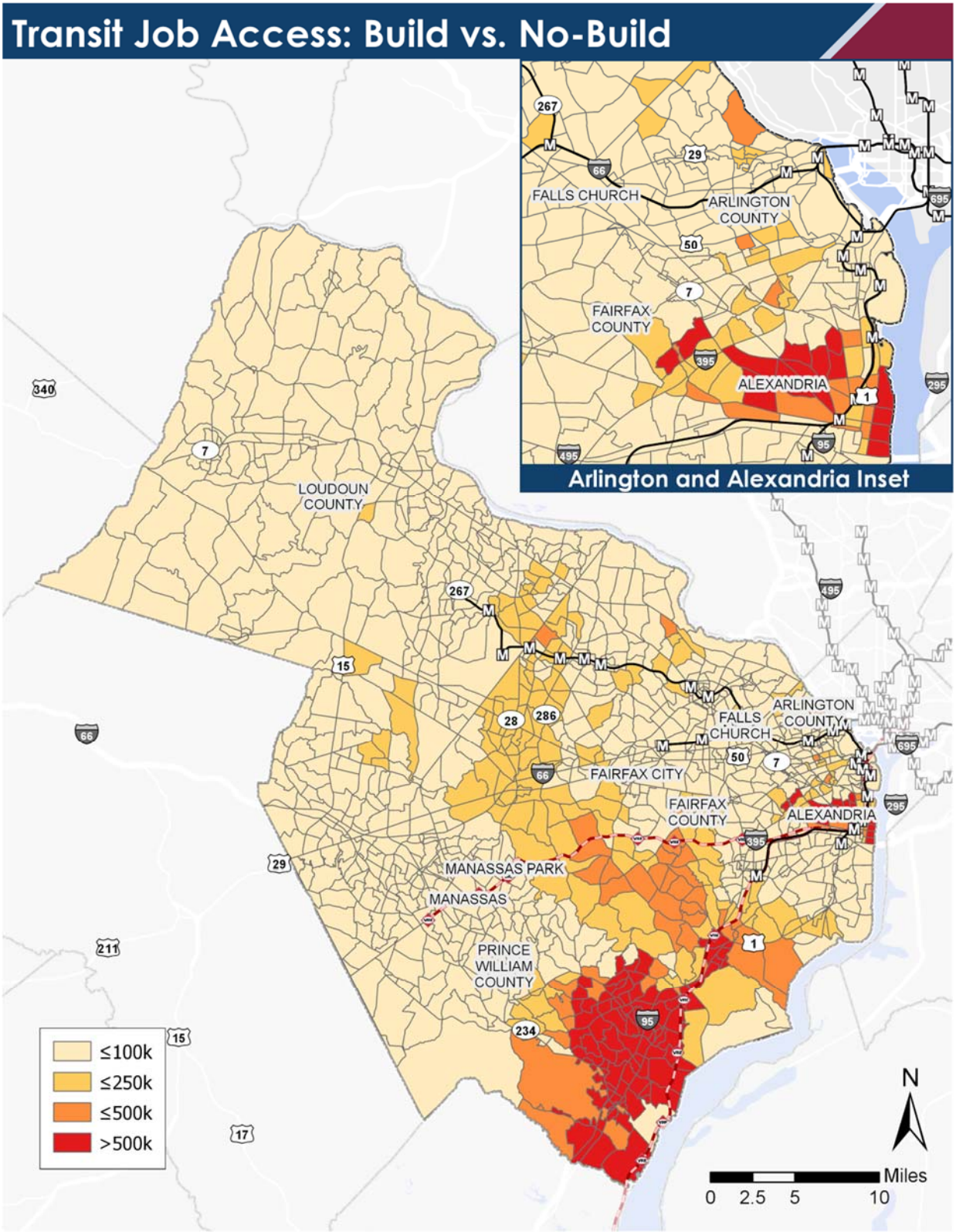
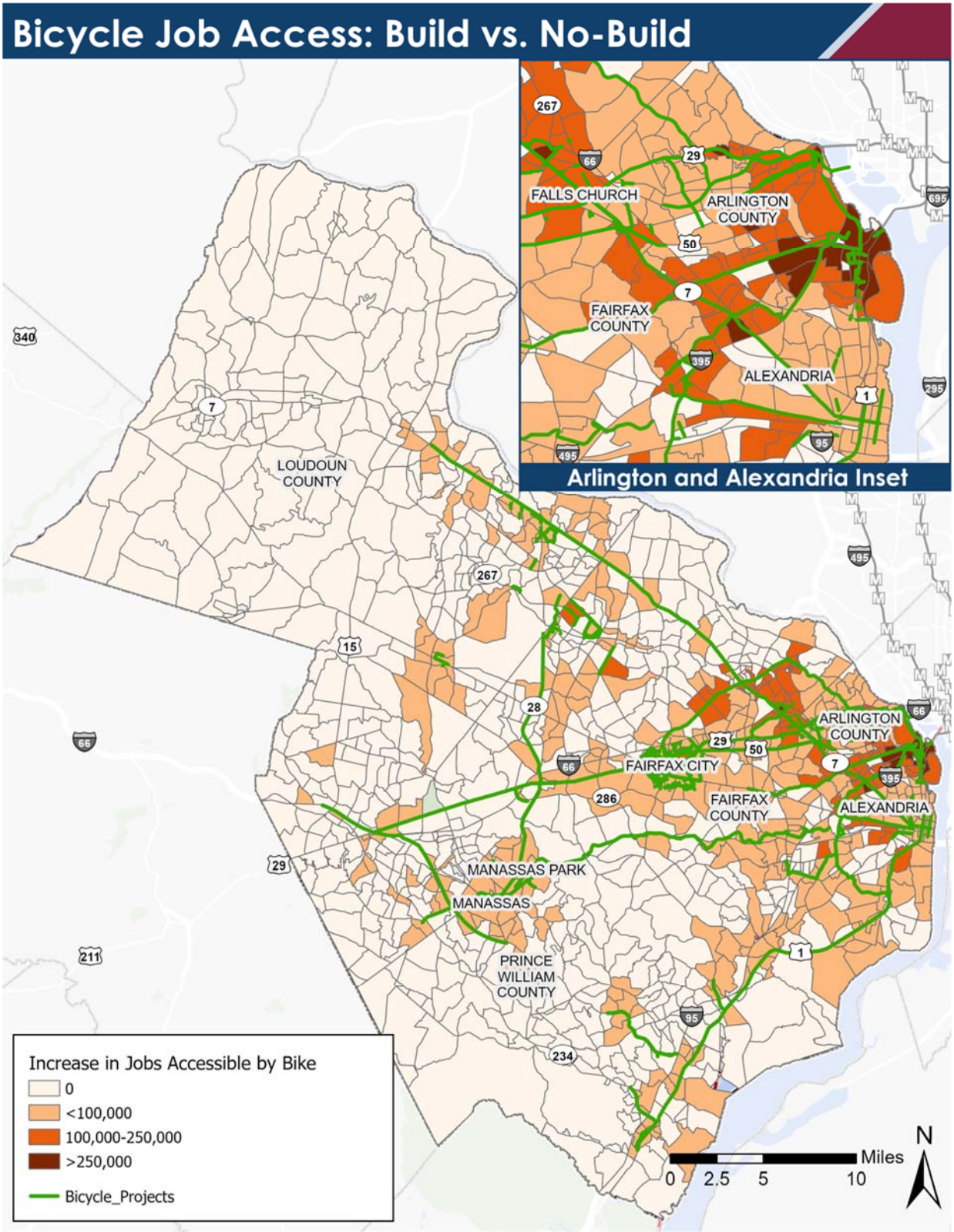


Figure 65 Change in Bicycle Access to Jobs, Build versus No-Build



6.4 Mode-Specific Results

Model runs were conducted separately for major categories of projects, including:

- Highway Only (includes roadway, interchanges and intersections, HOV/HOT, and ITS)
- Transit Only
- Bicycle/Pedestrian (Non-Motorized)

Separate project type/mode runs allow for a better understanding of how different types of projects on the TransAction project list perform and contribute to the overall findings of the Build network.

The results for these mode-based evaluations are shown in Figure 66 with detailed results listed in Table 27. Key findings regarding these mode-based tests are listed below in comparison with the No-Build results:

- Transit projects and highway projects appear to be serving very different markets and are only in competition with one another in very limited cases. For example, the analysis of the transit-only network shows only a small percentage increase in transit trips relative to the Build network (12.9 percent versus 12.4 percent), that would shift from driving when the highway projects are removed from the Build network, reducing VMT in the region by less than 1 percent.
  - » The planned BRT and HCT corridors earlier account for a 6.3 percent increase in the number of new transit trips, or nearly one-half of the 12.9 percent increase in transit trips. The BRT/HCT corridors would account for roughly one-half of other benefits shown for the Transit-Only network including delay reduction.
- Roadway projects have a bigger impact on reducing congestion in the region than other modes. The roadway projects alone reduce delay by 17 percent, while the addition of the remaining projects further reduces congestion to a total of 19 percent.
- Bicycle/Pedestrian (Non-Motorized) projects have much less impact on the quantitative TransAction measures than the highway and transit projects. Only the accessibility measures show a significant increase in jobs accessible, with a 1.7 percent increase in jobs accessible overall. These non-motorized projects due tend to have a bigger impact on the D1 (multimodal access) and E1 (safety) qualitative measures.

Figure 66 Percent Change in 2045 Build and Mode-Specific Results Relative to No-Build

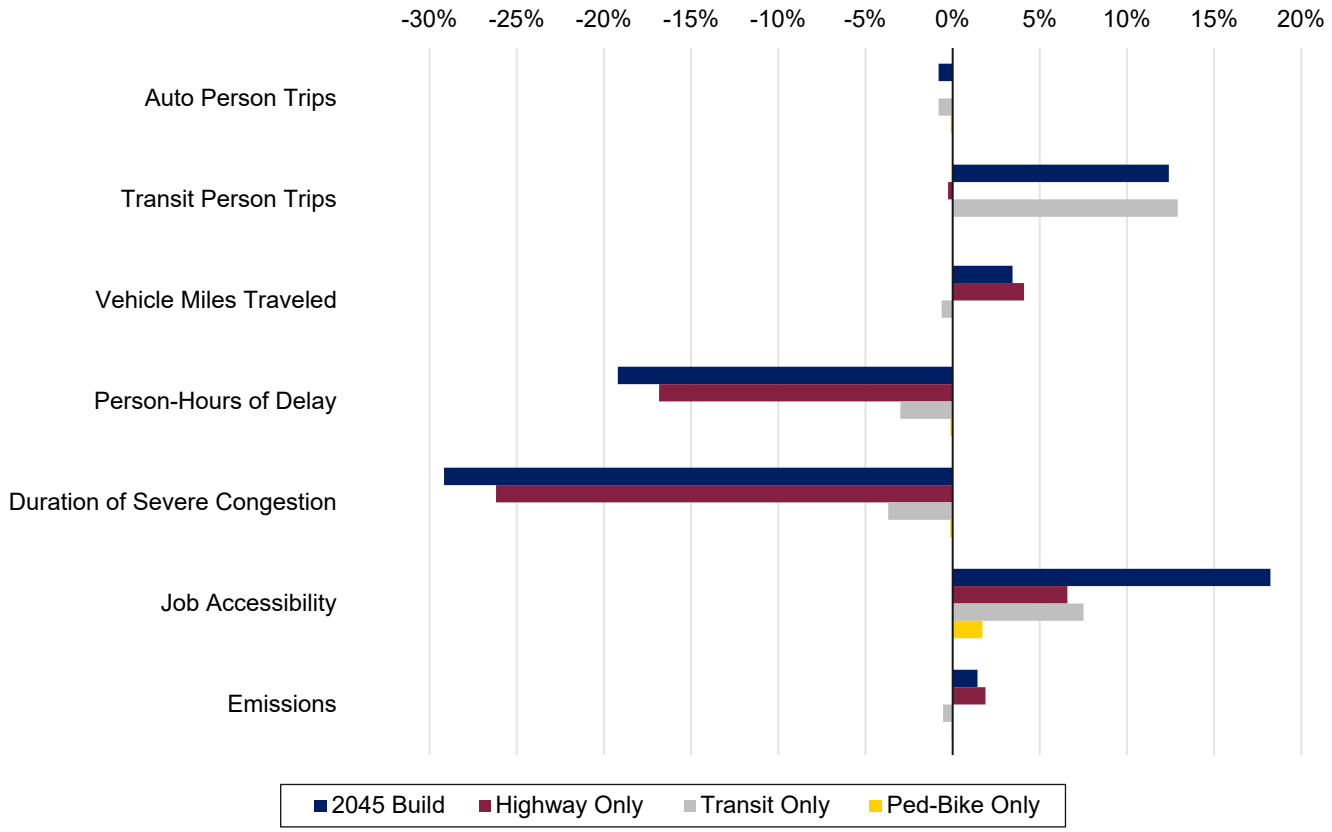


Table 27 TransAction Measures, Northern Virginia Regional Totals for Modal Networks

Performance Measure	2045 No-Build	2045 Build	% Chg versus No Build	Highway-Only	% Chg. versus No Build	Transit-Only	% Chg versus No Build	Bike/Ped	% Chg versus NB
Auto Person Trips	8,223,000	8,154,000	-0.8%	8,222,000	0.0%	8,156,000	-0.8%	8,213,000	-0.1%
Transit Person Trips	387,000	435,000	12.4%	386,000	-0.3%	437,000	12.9%	387,000	0.0%
Vehicle-Miles Traveled	66,251,000	68,529,000	3.4%	68,965,000	4.1%	65,837,000	-0.6%	66,236,000	0.0%
A1. Total person-hours of delay in autos	765,000	624,000	-18.4%	640,000	-16.3%	745,000	-2.6%	764,020	-0.1%
A2. Total person-hours of delay on transit	37,000	24,000	-35.1%	27,000	-27.0%	33,000	-10.8%	37,000	0.0%
B1. Duration of severe congestion	840	595	-29.2%	620	-26.2%	809	-3.7%	838.9	-0.1%
B2. Transit person-miles in dedicated/priority ROW	9,971,000	10,573,000	6.0%	10,438,000	4.7%	10,151,000	1.8%	9,971,000	0.0%
C1. Access to jobs by car, transit and bike	2,155,000	2,548,000	18.2%	2,297,000	6.6%	2,317,000	7.5%	2,192,000	1.7%
C2. Access to jobs by car, transit and bike for EEA populations	2,157,000	2,641,000	22.4%	2,296,000	6.4%	2,407,000	11.6%	2,202,000	2.1%
F1. Vehicle emissions	17,450	17,664	1.2%	17,780	1.9%	17,355	-0.5%	17,440	-0.1%
G1. Transportation system redundancy	1,149,000	1,031,000	-10.3%	1,050,000	-8.6%	1,138,000	-1.0%	1,145,400	-0.3%

Notes: Percent change is relative to No Build. D1 (quality of access to transit and walk/bike network) and E1 (potential for safety and security improvements) measures are evaluated at the project-level only. F1 vehicle emissions shown are based on existing EV participation rates.

7.0 MANAGING UNCERTAINTY WITH SCENARIOS

Uncertainty is a part of long-range transportation planning; it is impossible to know precisely what the future will look like as transportation technologies, preferences, and options evolve over time. Traditional long-range planning and travel demand forecasting have been built around the assumption that this evolution would be a slow process, and that future behaviors would look similar to current and past behaviors, with changes mostly influenced by natural growth in population and employment and changes to the underlying transportation networks. In fact, the whole process of model validation is designed to prove that a model is capable of replicating current observed conditions, so that it can then be applied to future conditions, generally with no changes to important assumptions like the number of trips produced by each household on a daily basis (trip generation rates) or how individuals choose their mode of travel (mode choice parameters and constants). This approach is a good approach; it uses the best data available (observed data is always the best data) and makes the very reasonable assumption that people in the future will still have to travel for the same reasons and will continue to make mode choices based on the familiar factors of time, cost, comfort, and convenience.

Sometimes, however, evolution takes a more dramatic pace and disrupts the transportation system so completely, that these assumptions may no longer be valid. It happened in the early 20th century with the introduction of automobiles; it happened again later in the century when the rise of two-income households essentially doubled trip generation rates as women joined the work force in massive numbers. The 21st century will include its share of disruptions as well. And while we do not know precisely what they will be, we can see glimpses of likely possibilities in current trends and market expectations.

NVTA is incorporating the uncertainty about these disruptions into the TransAction process to ensure that the Plan and the subsequent programming decisions that are made based on the Plan, account for the uncertainty of these types of disruptions. By analyzing multiple potential future scenarios, NVTA can ensure that the TransAction Plan is nimble enough to absorb these disruptions by understanding how they might change travel behaviors and transportation needs and opportunities across Northern Virginia. This analysis will also allow the Authority to make wise investment decisions, ensuring that the projects that NVTA funds will be good investments regardless of how the future plays out.

Scenarios Considered

In addition to a ‘standard’ forecast of the future in 2045, this scenario analysis identifies multiple ‘alternate’ futures that incorporate one or more plausible disruptions—behavioral, technological, or policy disruptions that could have significant impacts on individual travel choices and the operation of the multimodal transportation network in the future. These alternate futures are identified as plausible scenarios—but they are not necessarily preferred visions for the future, nor are they necessarily the most likely scenarios.

Three scenarios have been identified as plausible alternate futures for analysis:

- **Post-Pandemic ‘New Normal’** in which many of the behavioral changes observed during the COVID-19 pandemic continue into the long-term future;

- **Advanced Transportation Technology** focusing on implementation of Connected, Automated, Shared, Electric (CASE) Vehicles; and
- **Transportation Incentives/Pricing** focusing on policy strategies to shift travel behavior.

Each of these scenarios represents a plausible set of disruptions by 2045, but as disruptions, these are mostly elements that are out of NVTA's control. Of course, there are infinite variations of each of these disruptive scenarios that could be identified (e.g., different CASE penetration rates, varying levels of telework or grocery delivery, ranges of incentives for transit use, etc.) and this analysis was not able to address every possibility. These three scenarios also do not represent an 'either-or' view of the future. An increase in telework (from the Post-Pandemic New Normal scenario) could occur in tandem with the widespread adoption of CASE vehicles across the region (from the technology scenario). Instead, this scenario analysis was an assumption-based approach in which the best available research was used to identify a reasonable and plausible set of assumptions for each of the scenarios. The results provide a directional understanding of what could change given these assumptions (e.g., did congestion go up or down?) and provide guidance on where new problems may arise to help identify appropriate policy and project actions for NVTA and member jurisdictions in the future.

The scenarios tested as part of this analysis provide insight into the potential impacts if these disruptions occur. The analysis also identifies the extent to which the proposed TransAction projects are able to meet the goals of TransAction in these alternate futures. This analysis can help identify any projects that may be more/less beneficial to the region under a different set of assumptions, helping NVTA invest in projects that will be the most resilient to change, uncertainty and disruption.

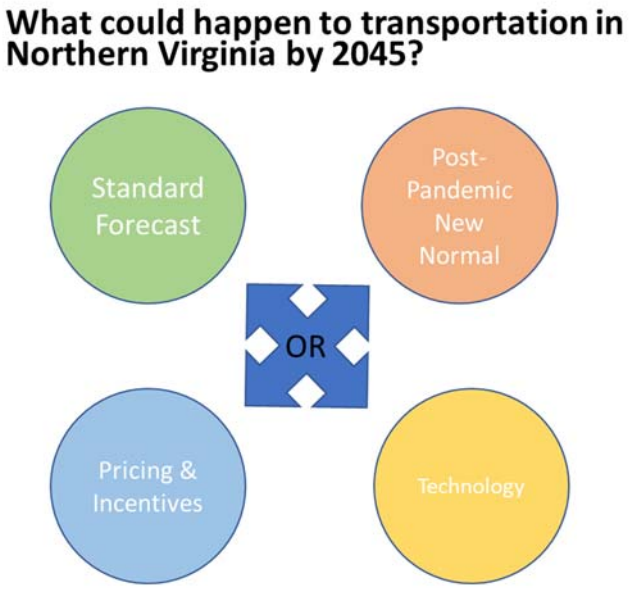
Scenario Testing Methodology

Each of these identified scenarios was analyzed using the model set developed for TransAction using assumptions identified in the following sections. Assumptions were represented in the model through changes in input values, network coding, or scripting changes, as appropriate. Each scenario was analyzed under No-Build conditions (based on the TransAction No-Build network) and Build conditions (based on the TransAction Build network which includes all 424 projects in the TransAction project list). These scenarios were evaluated based on the TransAction performance measures, to compare how well the regional transportation system performs under these potential future circumstances and provide answer to two specific questions as shown in Figure 66.

The first set of No-Build scenario tests help understand what could happen to transportation in Northern Virginia by 2045, including identifying new needs or challenges.

Within each scenario, the Build and No-Build runs were compared across the performance measures to answer the second question to understand how effective the TransAction projects are at meeting the region's goals and objectives even under significantly altered assumptions about the future.

Figure 67 TransAction Scenario Analysis



7.1 Scenario Assumptions

This section highlights the assumptions associated with each of the three scenarios, and the model results that indicate how these scenarios could change performance of the transportation system in 2045. These analyses consider No-Build conditions, without the inclusion of the 424 projects included in TransAction, and highlight how transportation needs in the region might change if these futures came to pass. Additional detail on the scenario assumptions is provided in the *Scenario Analysis* Methodology technical memorandum, Appendix D.

7.1.1 Scenario 1: Post-Pandemic New Normal

Since 2020, residents of Northern Virginia and around the country have dramatically changed their travel behaviors in response to the global coronavirus pandemic. While many changes began as short-term adaptations to social distancing requirements, as the pandemic has continued to linger, many seem likely to continue as part of normal travel patterns into the future. Hopefully, by 2045 the pandemic is only a distant memory, but it is possible that many of the behaviors that residents have adopted during the pandemic will be fully normalized as part of regular travel behaviors in the long term. Telework, for example, was initially assumed to be something that people would do for a few weeks until everyone could return to their offices. Two years later, many companies are questioning whether their employees will ever return to their offices full-time, and telework is considered an essential part of attracting/retaining employees. This scenario does not assume that an ongoing pandemic continues to shape travel patterns in 2045, but instead that the convenience associated with some of the new pandemic-related behaviors makes them attractive for people in the future.

Some of the key changes that are currently the most likely candidates for wide-scale, long-term adoption include:

1. Increased telework for workers that are able to telework, especially office workers;
2. Decrease in other work-based trips due to increased telework;
3. Replacement of shopping trips with at-home deliveries;
4. Increases in non-motorized trips;
5. No changes in car ownership levels; and
6. No changes to land use.

7.1.2 Scenario 2: Technology

A number of new vehicle technologies and applications are on the horizon and are expected to have achieved significant market penetration by 2045. This scenario focuses on a future in which multiple emerging technologies overlap:

- Connected Vehicle (CV) technologies allow vehicles to communicate with other vehicles, roadway infrastructure, and other roadway users. CV is expected to improve safety and operational efficiency by allowing infrastructure to adapt to demand and providing more information about the intentions of all roadway users.
- Automated Vehicle (AV) technologies allow part or all of the driving task to be performed by the vehicle itself. Fully automated vehicles (SAE Level 4 or 5) are able to drive independently without human intervention and are

expected to help increase roadway capacity and improve safety by removing human error and increasing reaction speeds. While some of the benefits associated with vehicle automation can be realized at lower levels of automation, this scenario is focused on vehicles that can be fully operated without a driver.

- Electric Vehicle (EV) technologies include battery and associated charging technologies that allow vehicles to be powered from the electric grid, instead of using internal combustion engines.
- Shared Vehicles (SV) use a range of technologies to enable multiple households and users to share vehicles. Similar to existing Transportation Network Companies (TNCs, such as Uber and Lyft), SV services would allow individuals to purchase mobility (i.e., rides) instead of purchasing a vehicle. SVs make more efficient use of vehicles, reduce vehicle ownership levels, and can encourage the use of a mix of modes to complete daily trips.

When combined, these four technologies have the potential to amplify the benefits of each technology alone. This scenario will focus on adoption of these technologies in combinations, including adoption into the private vehicle fleet (CAE), and through the introduction of shared vehicle fleets (CASE). The changes and impacts assumed as part of this scenario include:

1. Market Penetrations of Connected, Automated, Shared and Electric vehicles;
2. Changes in operating costs for automated vehicles—shared and privately owned;
3. Increases in effective roadway capacity;
4. Changes in trip generation;
5. Automated transit shuttles; and
6. No changes in land use.

7.1.3 Scenario 3: Incentives/Pricing Scenario

Northern Virginia's continued growth has led to ongoing growth in the demand for mobility as more people travel around the region for school, work, shopping and recreation. As vehicle miles traveled (VMT) and congestion have grown across the region, planners, stakeholders and politicians have proposed a range of ideas on how to encourage more of this travel to occur using transit and other shared-ride options. Expansion of the region's transit network, the introduction of High-Occupancy Vehicle (HOV/HOT) lanes, and concentrating residential and employment centers near transit stations in Transit Oriented Developments (TOD) have all helped to encourage transit usage, but the majority of travel in the region still occurs in Single Occupancy Vehicles (SOV).

The next evolution of this trend encouraging the use of transit is leveraging technology advances to incentivize shared rides through financial means. These market-based options may take the form of incentives for transit usage and/or pricing driving so that people more fully account for the external costs of driving, such as environmental impacts, congestion, safety risks, etc. This scenario incorporates a number of monetary inducements designed to encourage benefical behavior, and discourage undesirable behavior, including:

1. VMT Pricing;
2. Parking/Curbside Pricing;
3. Free Transit Fares; and
4. Incentives to shift travel times.

If pricing strategies are implemented, they could be used as a revenue stream to fund incentive programs, including making up for lost transit fare revenue.

7.2 No-Build Scenario Results

7.2.1 Scenario 1: Post-Pandemic New Normal

The changes in trip-making assumed as part of this scenario result in an overall reduction in total motorized travel occurring in Northern Virginia as shown in Table 28. The majority of the changes in trip-making behaviors are related to commute travel, and therefore the biggest impacts are observed during the peak periods. In total, there is a decrease in auto trips of more than four percent as trips that would have otherwise occurred are replaced by telecommuting and e-commerce, while transit trips decrease by nearly 11 percent for two reasons. The decrease in transit trips is proportionally larger than for auto trips because 1) a larger portion of transit trips are commute trips being replaced by telework, and 2) a general decrease in congestion makes transit less attractive for those who have the option to drive. This results in a decrease in Vehicle Miles Traveled (VMT) across the region of 3.9 percent.

Table 28 Scenario 1 Impacts

Measure	Difference between Standard Forecast and Scenario 1 Results
Total Person Trips	-3.7%
Auto Trips	-4.2%
Transit Trips	-10.9%
Non-Motorized Trips	1.8%
Vehicle Miles Traveled (VMT)	-3.9%
Person Miles Traveled (PMT)	-3.7%
Total Delay Reduction (Autos + Transit)	-15.0%
A1: Auto Delay Reduction	-13.9%
A2: Transit Delay Reduction	-37.8%
B1: Congestion Duration	-21.0%
B2: Transit person-miles in dedicated/priority ROW	-7.3%
C1: Accessibility	8.2%
C2: EEA Accessibility	8.4%
F1: Emissions	-3.5%

TransAction Performance Measures are labeled A1-F1

Figure 68 illustrates where daily vehicle volumes change in the New Normal scenario. As shown, the locations with the biggest volume decreases are major freeways in the region, including I-496, I-66, I-95 and the Dulles Toll Road. The majority of these decreases in trip making occur in the peak period and therefore have a significant impact on congestion levels. The 4 percent decrease in auto trips results in a decrease of 15 percent in total delay and a 21 percent decrease in the duration of severe congestion. This decrease in congestion results in improvements in accessibility for Northern Virginia, as residents are able to access more jobs in a given amount of time. Fewer drivers on the road also result in a decrease in tailpipe emissions of around 3.5 percent. Figure 69 illustrates that reductions in congestion in this scenario occur across all of Northern Virginia, with major reductions along major freeway corridors, and especially large reductions near major merge points.

Figure 68 Change in 2045 Daily Highway Traffic Volumes (New Normal No-Build versus TransAction No-Build)

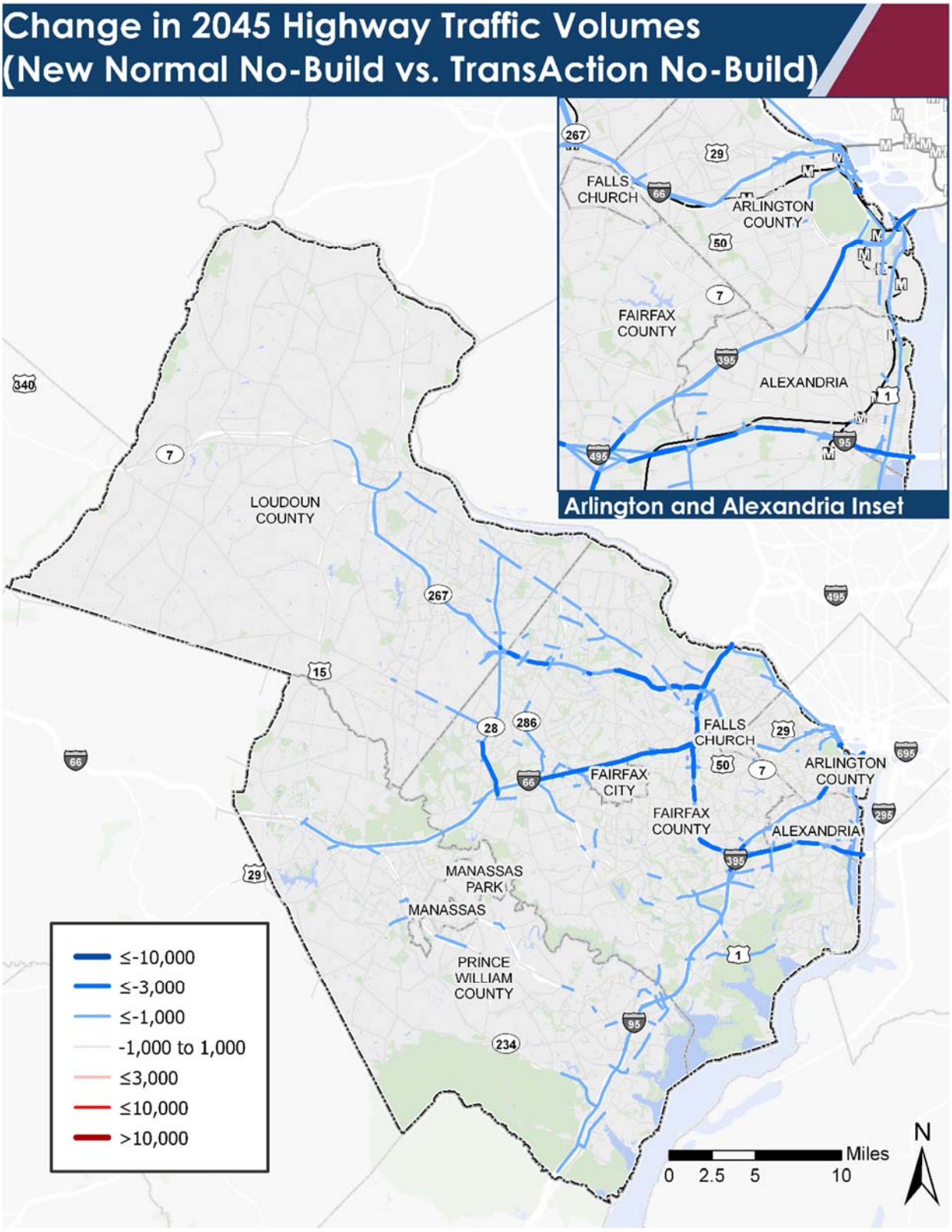
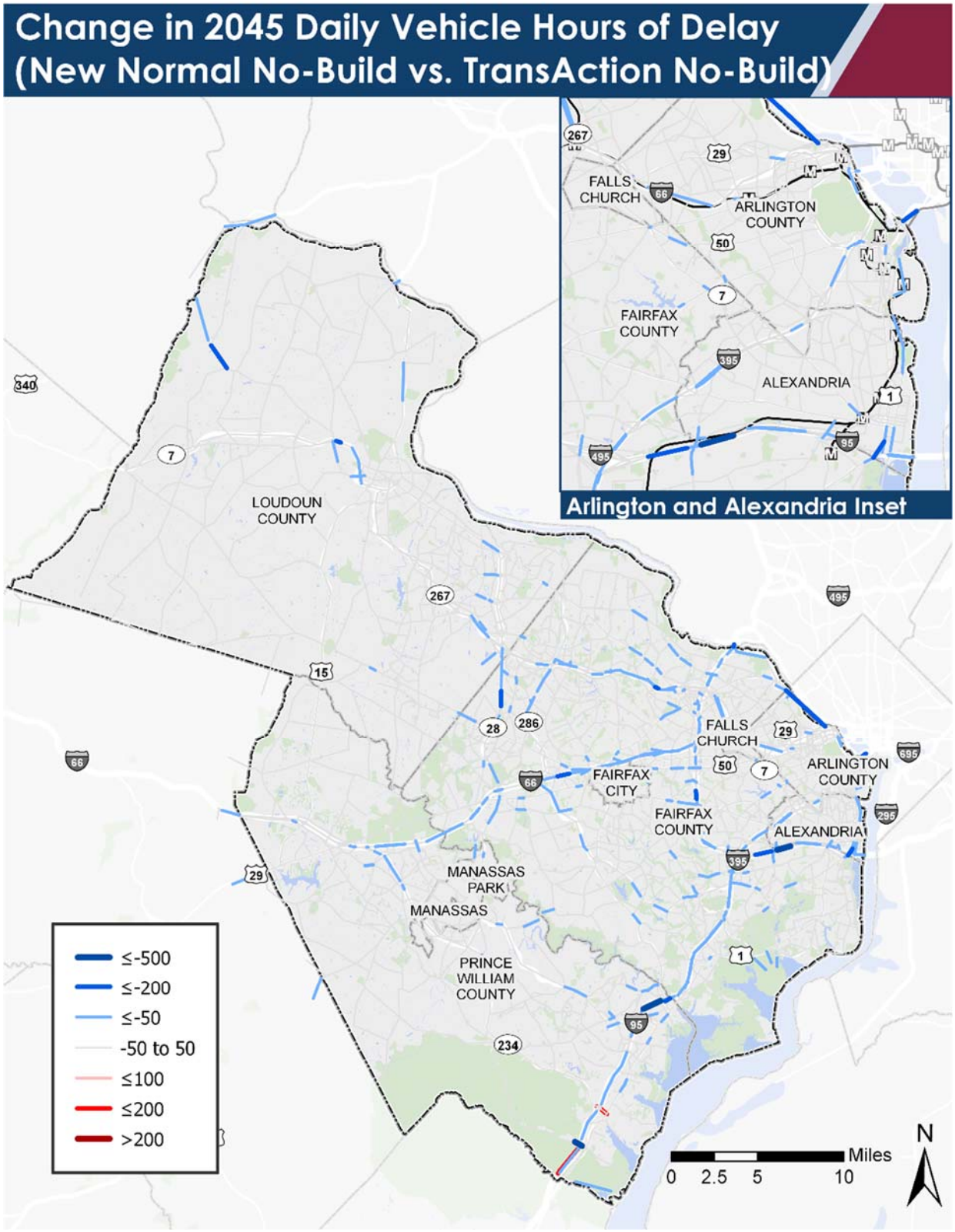


Figure 69 Change in 2045 Daily Vehicle Hours of Delay (New Normal No-Build versus TransAction No-Build)



7.2.2 Scenario 2: Technology

This scenario results in several major impacts, as detailed in Table 29 below. The availability of new options in the form of CASE vehicles increases both the number of motorized and total person trips. CASE vehicles provide a relatively affordable, convenient and comfortable door-to-door option for many users, and do attract some transit users, resulting in a 2.3 percent decrease in transit trips in Northern Virginia (equal to approximately 9,000 trips). Due to the introduction of Zero Occupancy Vehicle (ZOV) trips with automated vehicles, VMT grows more than PMT.

Despite increases in auto trips, congestion is expected to decrease across the region due to the increased carrying capacity of roadways associated with automated and connected vehicle technologies. This results in a 9.1 percent reduction in delay and an almost 20 percent reduction in congestion duration. Reductions in congestion also result in improved accessibility to job for residents across the region (2.2 percent) and in EEAs (2.3 percent). Figure 70 illustrates that the scenario results in increases in volumes on many facilities, particularly in Loudoun and Prince William Counties and the GW Parkway through Arlington County. As shown in Figure 71, congestion reduction is spread across the region, and focused on freeway corridors, which saw the biggest increase in effective capacity due to the AV and CV technologies.

Table 29 Scenario 2 Impacts

Measure	Difference between Standard Forecast and Scenario 2 Results
Total Person Trips	0.8%
Auto Trips	1.0%
Transit Trips	-2.3%
Non-Motorized Trips	0.7%
Vehicle Miles Traveled (VMT)	2.7%
Person Miles Traveled (PMT)	1.8%
Total Delay Reduction (Autos + Transit)	-9.1%
A1: Auto Delay Reduction	-9.9%
A2: Transit Delay Reduction	8.1%
B1: Congestion Duration	-19.6%
B2: Transit person-miles in dedicated/priority ROW	-4.9%
C1: Accessibility	2.2%
C2: EEA Accessibility	2.3%
F1: Emissions	-25.0%

TransAction Performance Measures are labeled A1-F1

The other major impact of this scenario is a 25 percent decrease in vehicle emissions. This improvement occurs despite the increase in VMT due to the electrification assumptions built into the scenario.

Figure 70 Change in 2045 Daily Highway Traffic Volumes (Technology No-Build versus TransAction No-Build)

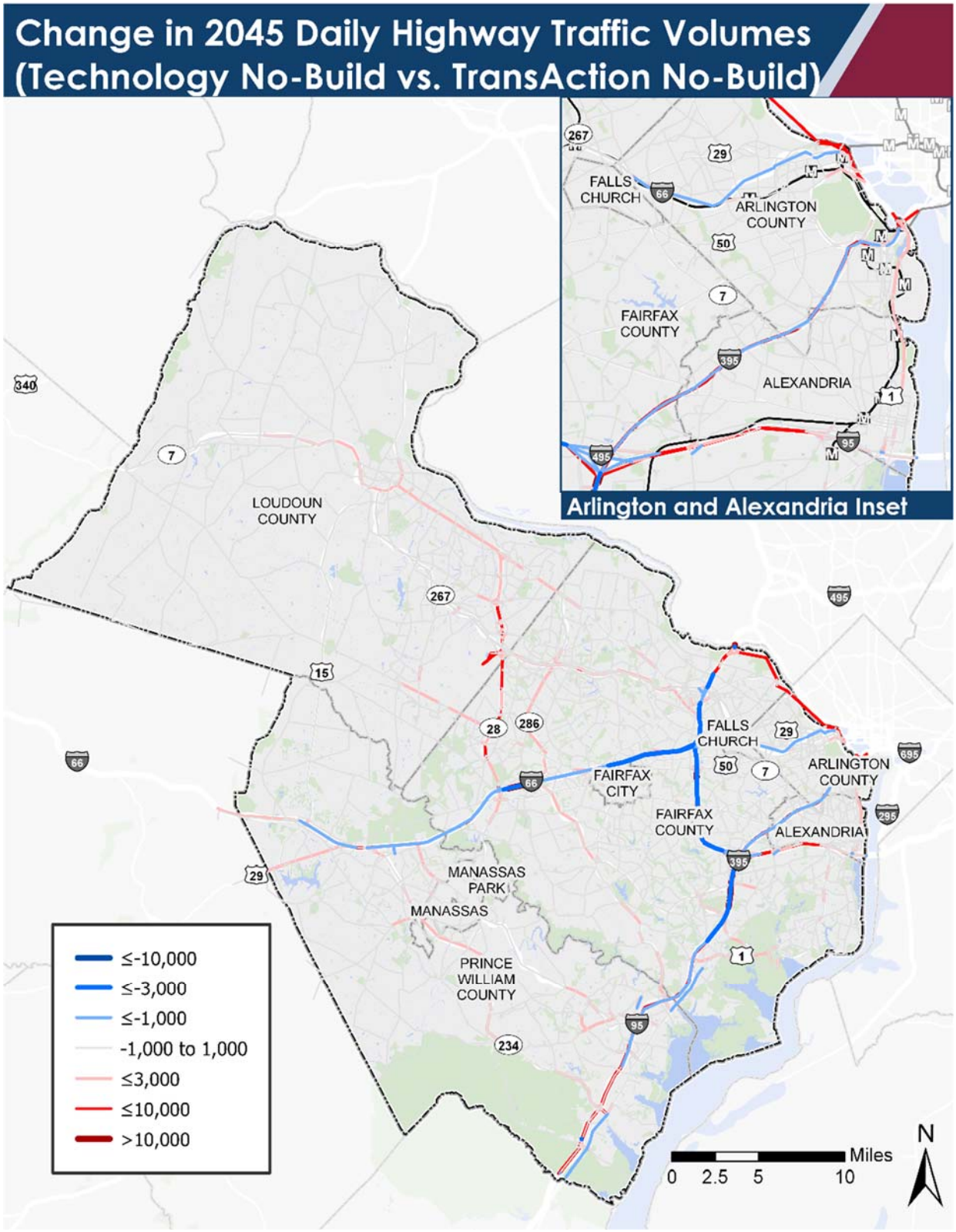
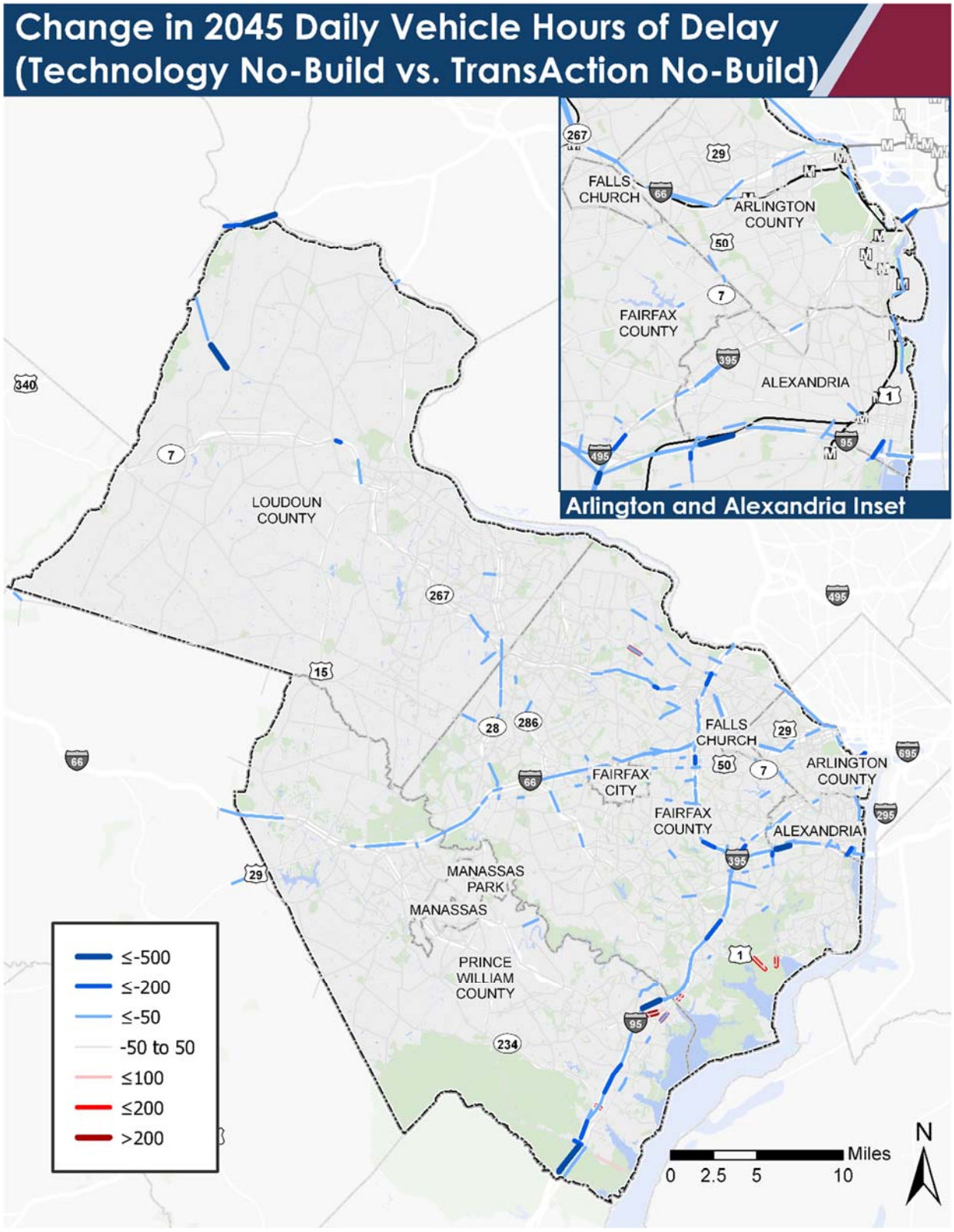


Figure 71 Change in 2045 Daily Vehicle Hours of Delay (Technology No-Build versus TransAction No-Build)



7.2.3 Scenario 3: Incentives/Pricing Scenario

The range of incentives assumed to be part of this scenario has the impact of encouraging people to shift from driving to transit. The incentives result in shifting approximately 100,000 driving trips onto transit, representing a 25.6 percent increase in transit ridership and a 5.4 percent decrease in VMT in Northern Virginia. This shift has significant impacts on congestion, by removing cars from the region's roads. Figure 72 illustrates how this change in volume is spread across the region. Because of the financial disincentives for driving, this scenario does not experience the induced demand that often occurs when congestion drops, and more people find it attractive to use the roads. The 8.9 percent reduction in delay also results in some improved accessibility to jobs for residents of the region, although the accessibility improvements are more significant for the region as a whole than for residents of EEAs. Congestion reduction across the region is illustrated in Figure 73.

Table 30 Scenario 3 Impacts

Measure	Difference between Standard Forecast and Scenario 3 Results
Total Person Trips	0.0%
Auto Trips	-1.2%
Transit Trips	25.6%
Non-Motorized Trips	0.0%
Vehicle Miles Traveled (VMT)	-5.4%
Person Miles Traveled (PMT)	-2.9%
Total Delay Reduction (Autos + Transit)	-8.9%
A1: Auto Delay Reduction	-8.2%
A2: Transit Delay Reduction	-21.6%
B1: Congestion Duration	-7.7%
B2: Transit person-miles in dedicated/priority ROW	7.7%
C1: Accessibility	0.3%
C2: EEA Accessibility	0.2%
F1: Emissions	-4.8%

TransAction Performance Measures are labeled A1-F1

Figure 72 Change in 2045 Daily Highway Traffic Volumes (Pricing/Incentives No-Build versus TransAction No-Build)

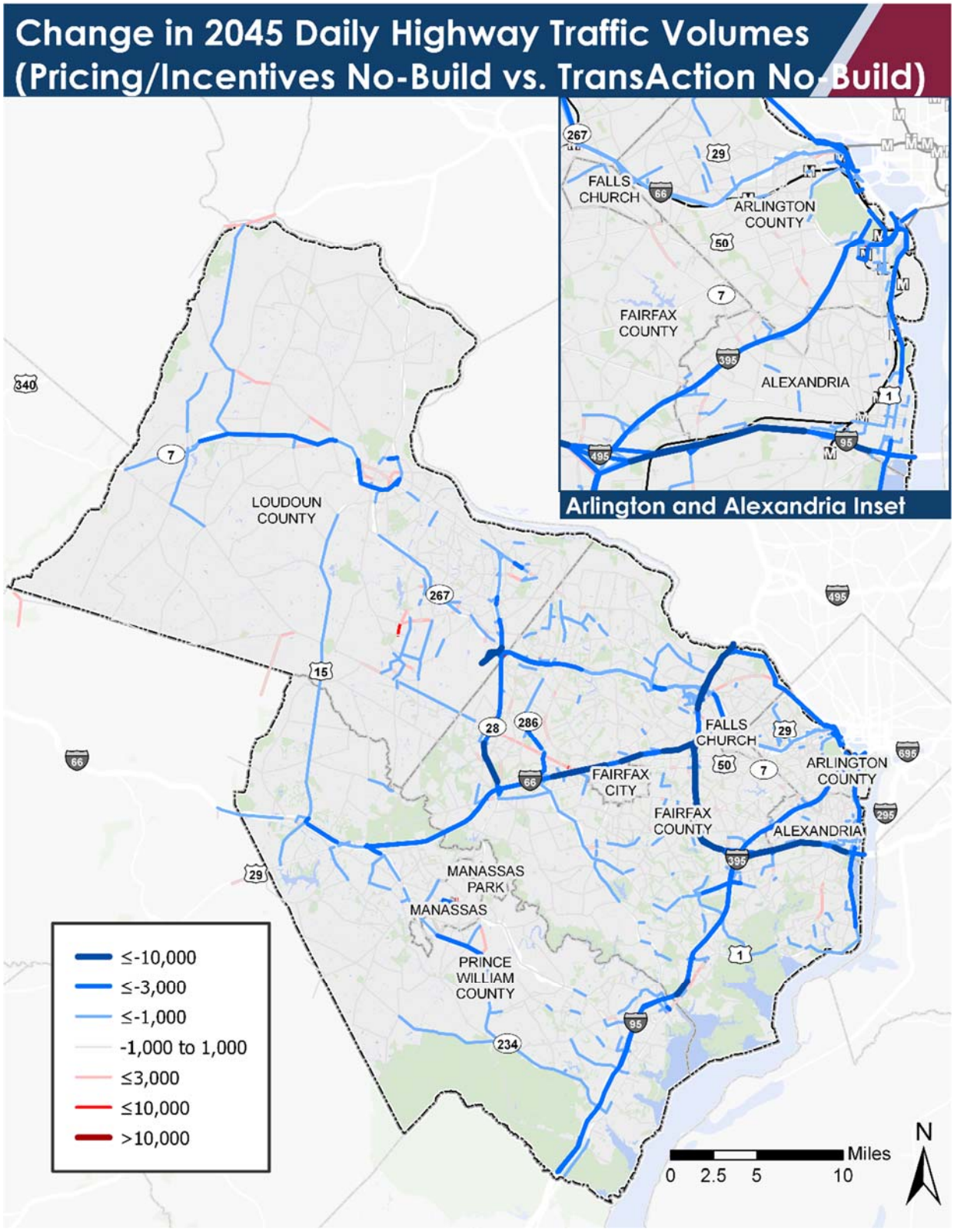
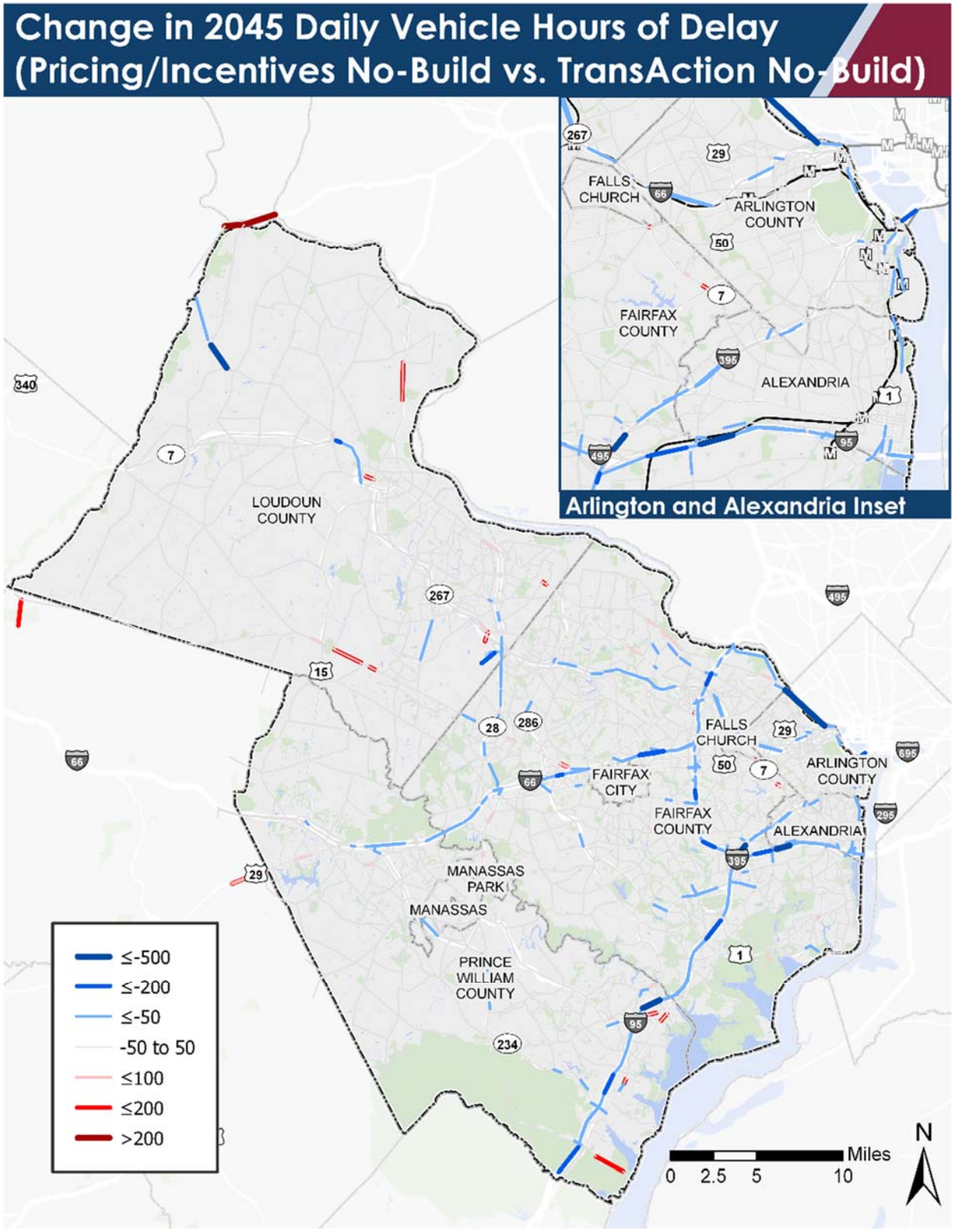


Figure 73 Change in 2045 Daily Vehicle Hours of Delay (Pricing/Incentives No-Build versus TransAction No-Build)



7.2.4 Scenario 4: New Normal + Technology

This scenario also analyzed the potential impacts of futures that combine the assumptions in multiple scenarios. This scenario combines the assumptions of both the Post-Pandemic New Normal scenario and the Technology Scenario. This includes changes to trip generation rates and telework, along with the introduction of connected, automated, shared electric vehicles and improvements in roadway carrying capacity.

Table 31 shows the results of Scenario 4 and includes the results of Scenarios 1 and 2 for reference. As shown, the combination of the New Normal and Technology assumptions has synergy, resulting in higher impacts for several metrics than either of the scenarios alone. The reduction in trips caused by telework and other changes to trip generation more than offset the additional trips generated by the new technology options, resulting in a decrease in auto and transit trips. Congestion in the region decreases by 22.8 percent, higher than any of the other scenarios. The congestion reduction also results in increases in accessibility, both for the region as a whole and for EEAs. The 27.7 percent reduction in emissions is the result of the electrification assumptions built into the technology portion of the scenario.

Table 31 Scenario 4 Impacts

Measure	Difference between Standard Forecast and Scenario 1 Results	Difference between Standard Forecast and Scenario 2 Results	Difference between Standard Forecast and Scenario 4 Results
Total Person Trips	-3.7%	0.8%	-2.2%
Auto Trips	-4.2%	1.0%	-2.5%
Transit Trips	-10.9%	-2.3%	-12.9%
Non-Motorized Trips	1.8%	0.7%	2.4%
Vehicle Miles Traveled (VMT)	-3.9%	2.7%	-1.3%
Person Miles Traveled (PMT)	-3.7%	1.8%	-2.0%
Total Delay Reduction (Autos + Transit)	-15.0%	-9.1%	-22.8%
A1: Auto Delay Reduction	-13.9%	-9.9%	-22.2%
A2: Transit Delay Reduction	-37.8%	8.1%	-35.1%
B1: Congestion Duration	-21.0%	-19.6%	-36.4%
B2: Transit person-miles in dedicated/priority ROW	-7.3%	-4.9%	-12.4%
C1: Accessibility	8.2%	2.2%	7.0%
C2: EEA Accessibility	8.4%	2.3%	7.0%
F1: Emissions	-3.5%	-25.0%	-27.7%

TransAction Performance Measures are labeled A1-F1

Volume change for this scenario is shown in Figure 74, with decreases on many major corridors across Northern Virginia. Some increases are also seen, particularly on I-95 in southern Prince William County. Similarly, the reduction in congestion is spread across major corridors—particularly on freeways—as shown in Figure 75.

Figure 74 Change in 2045 Daily Highway Traffic Volumes (New Normal + Technology No-Build versus TransAction No-Build)

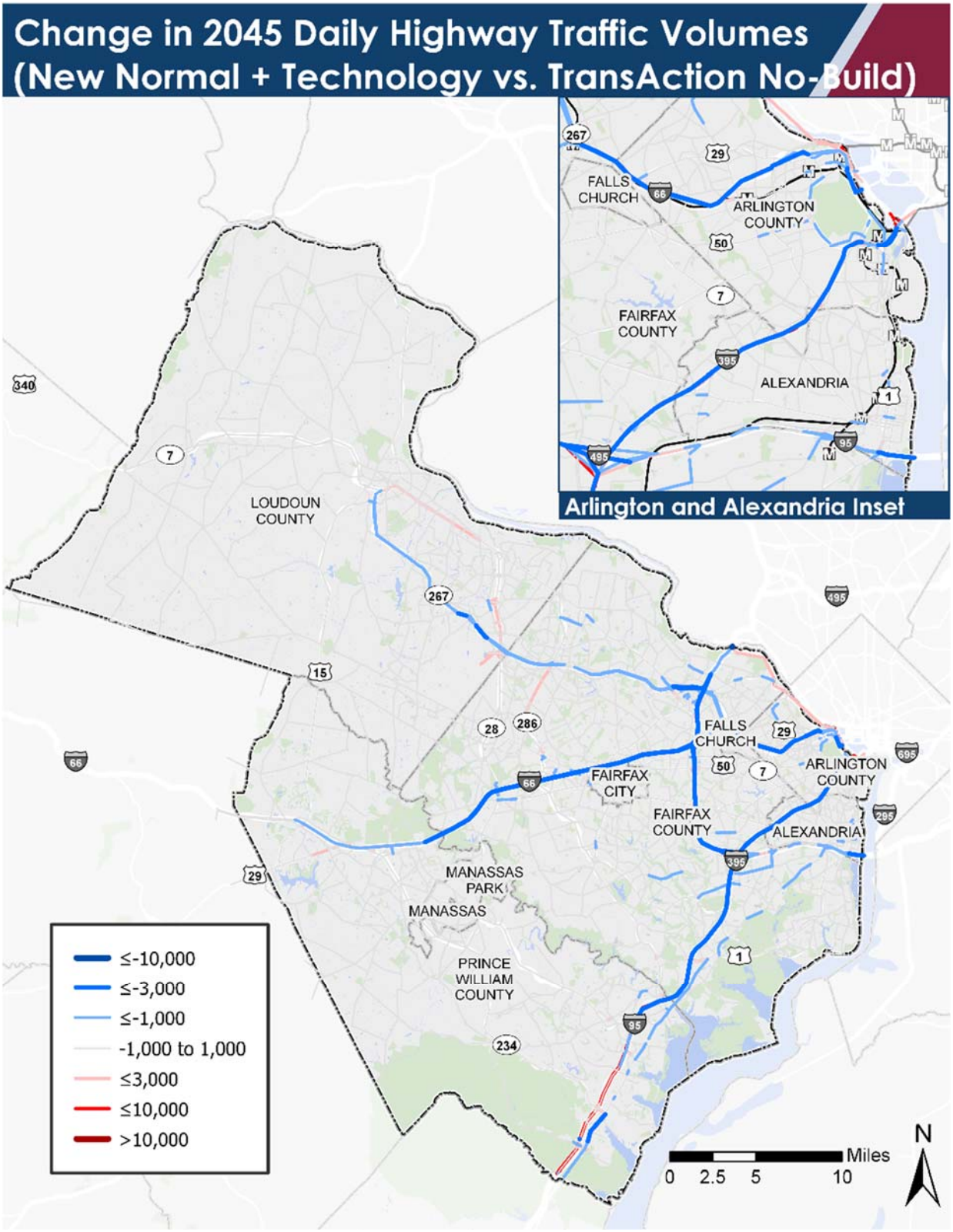
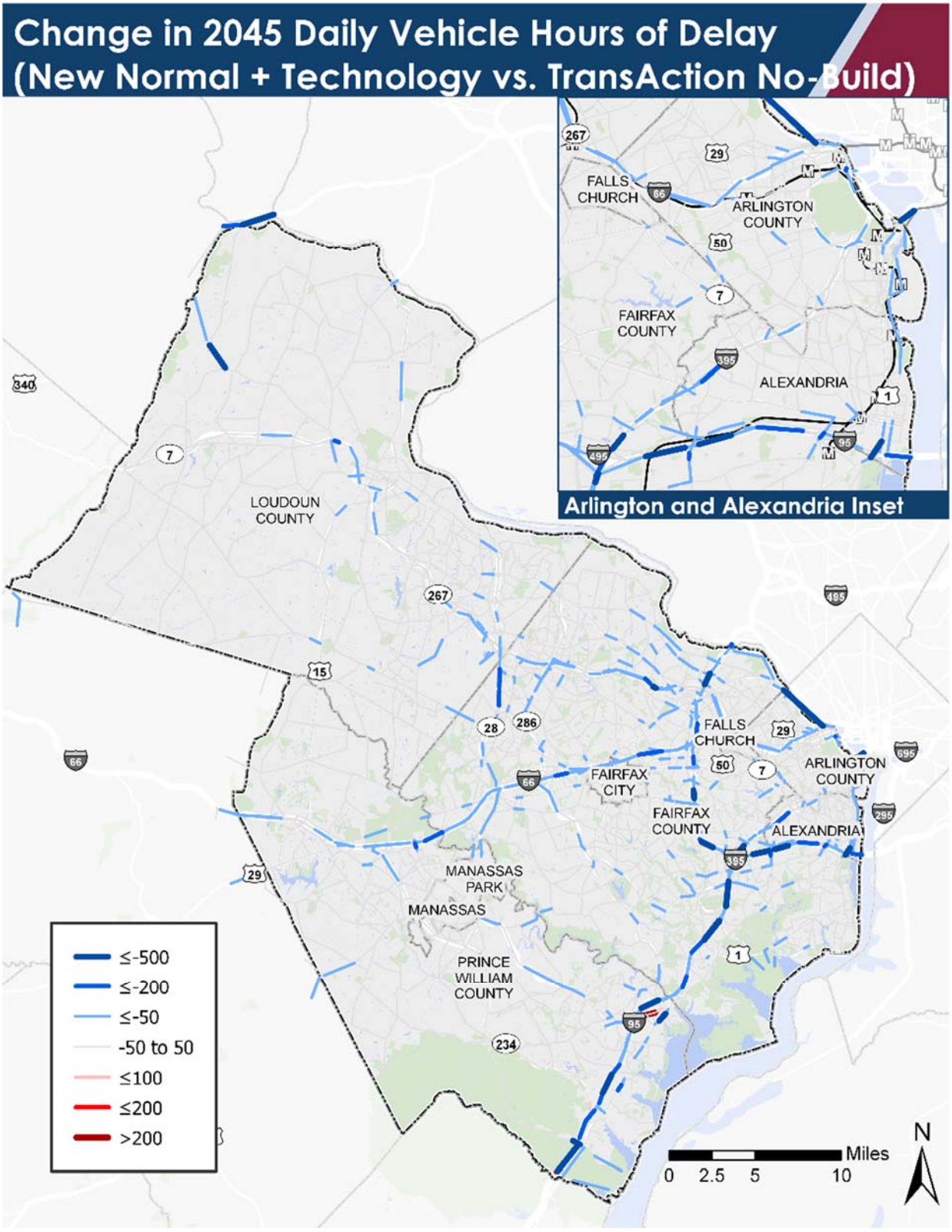


Figure 75 Change in 2045 Daily Vehicle Hours of Delay (New Normal + Technology No-Build versus TransAction No-Build)



7.2.5 Scenario 5: New Normal + Incentives/Pricing

This scenario also analyzed the potential impacts of futures that combine the assumptions in multiple scenarios. This scenario combines the assumptions of both the Post-Pandemic New Normal scenario and the Incentives/ Pricing Scenario. This includes changes to trip generation rates and telework, along with the introduction of pricing and incentive policies designed to encourage the use of shared ride options.

Table 32 shows the results of Scenario 5 and includes the results of Scenarios 1 and 3 for reference. As shown, the combination of the New Normal and Incentives/Pricing assumptions have synergy, resulting in higher impacts for several metrics than either of the scenarios alone. The reduction in trips caused by telework and other changes to trip generation are actually offset by the incentives, resulting in a 12.9 percent increase in transit trips, despite a reduction in total trips. By reducing overall trips and shifting trips onto transit, congestion in the region decreases by 21 percent and emissions reduce by eight percent.

Table 32 Scenario 5 Impacts

Measure	Difference between Standard Forecast and Scenario 1 Results	Difference between Standard Forecast and Scenario 3 Results	Difference between Standard Forecast and Scenario 5 Results
Total Person Trips	-3.7%	0.0%	-3.6%
Auto Trips	-4.2%	-1.2%	-5.3%
Transit Trips	-10.9%	25.6%	12.9%
Non-Motorized Trips	1.8%	0.0%	1.8%
Vehicle Miles Traveled (VMT)	-3.9%	-5.4%	-9.0%
Person Miles Traveled (PMT)	-3.7%	-2.9%	-6.6%
Total Delay Reduction (Autos + Transit)	-15.0%	-8.9%	-21.3%
A1: Auto Delay Reduction	-13.9%	-8.2%	-20.3%
A2: Transit Delay Reduction	-37.8%	-21.6%	-43.2%
B1: Congestion Duration	-21.0%	-7.7%	-25.8%
B2: Transit person-miles in dedicated/priority ROW	-7.3%	7.7%	-2.4%
C1: Accessibility	8.2%	0.3%	6.0%
C2: EEA Accessibility	8.4%	0.2%	6.2%
F1: Emissions	-3.5%	-4.8%	-7.9%

TransAction Performance Measures are labeled A1-F1

Volume change for this scenario is shown in Figure 76, with decreases on across Northern Virginia. Similarly, the reduction in congestion is spread across major corridors—particularly on freeways—as shown in Figure 77.

Generally speaking, the decrease in travel and especially peak period travel observed in this scenario could decrease the need for projects that further reduce congestion in specific locations and/or increase transit capacity.

Figure 76 Change in 2045 Daily Highway Traffic Volume (New Normal + Incentives/Pricing No-Build versus TransAction No-Build)

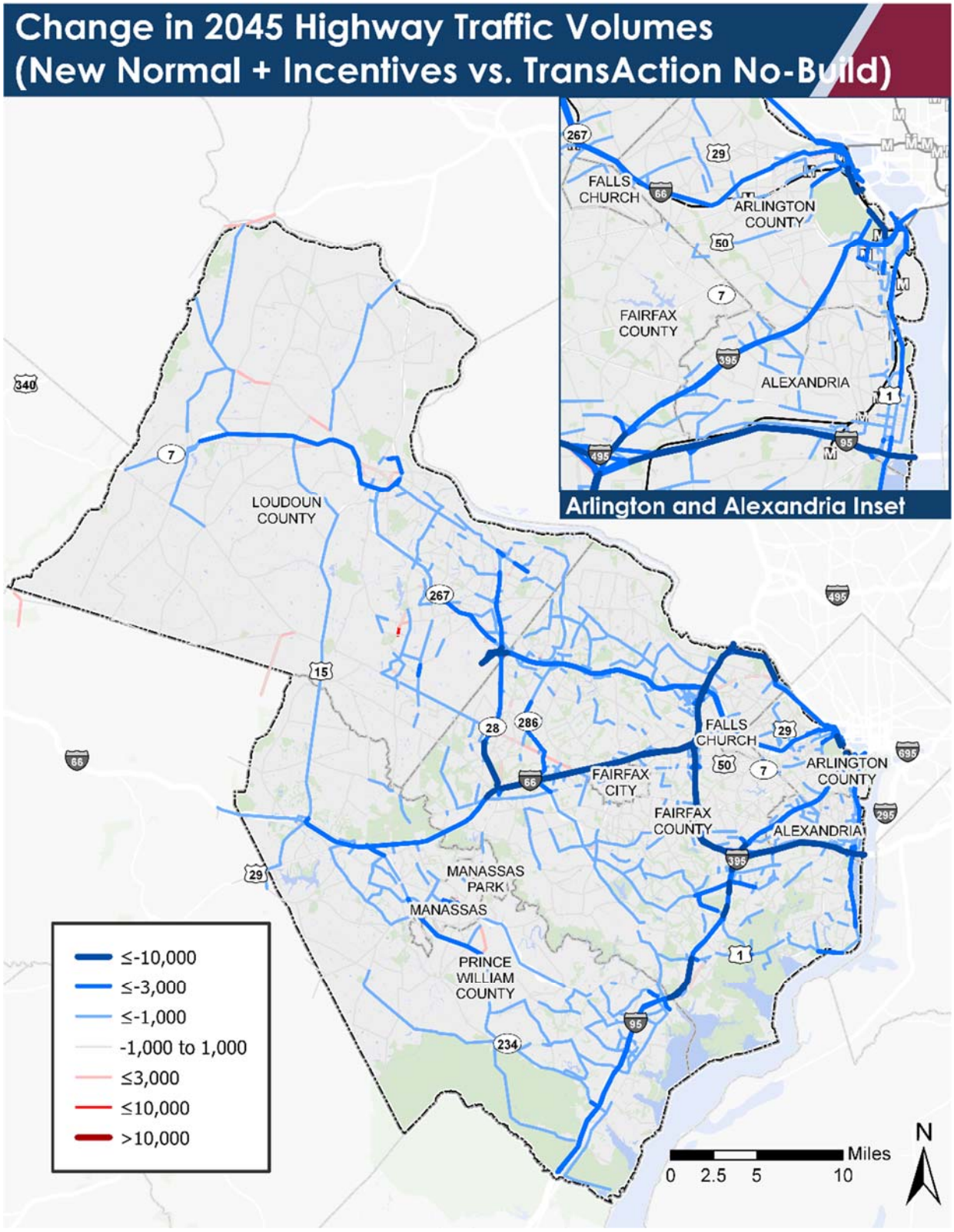
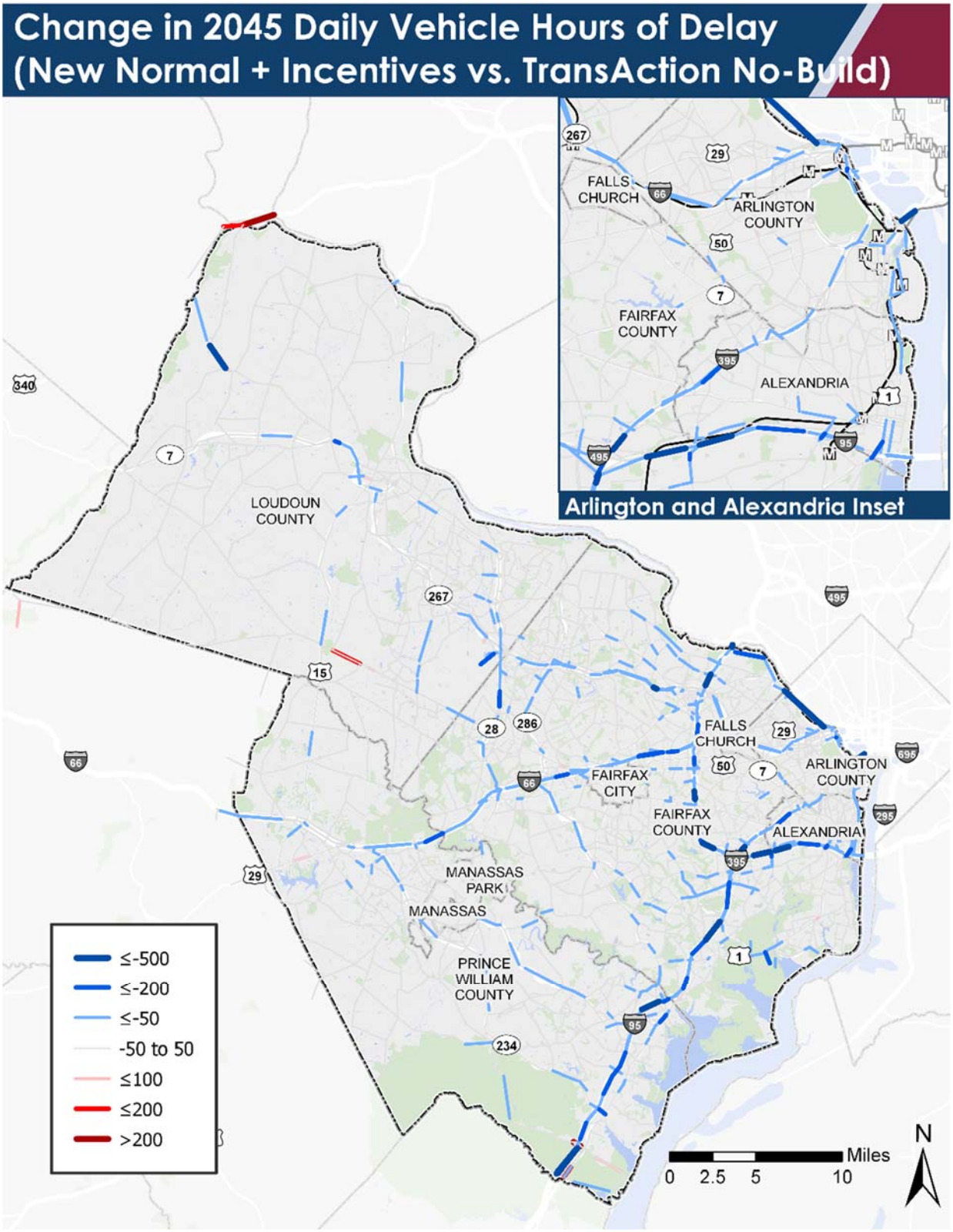


Figure 77 Change in 2045 Daily Vehicle Hours of Delay (New Normal + Incentives/Pricing No-Build versus TransAction No-Build)



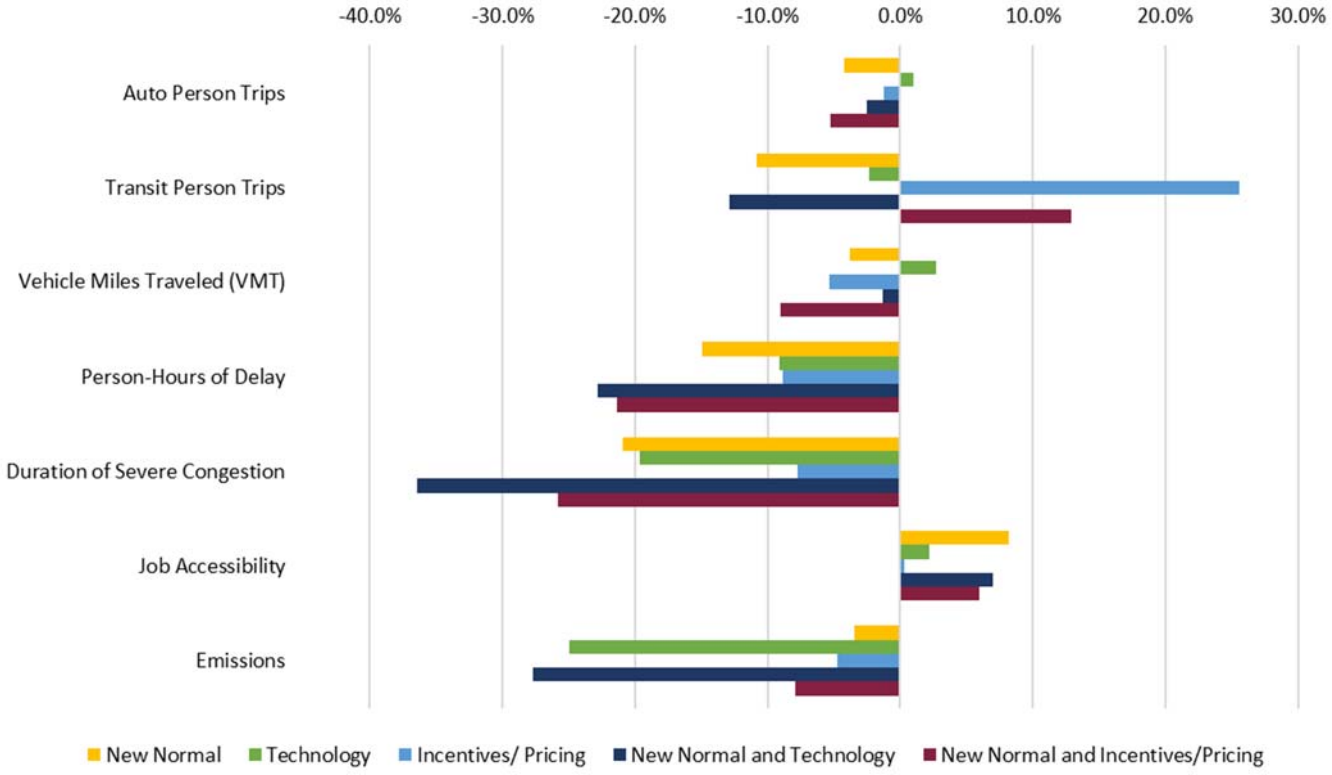
7.2.6 No-Build Scenario Results Comparison

Figure 78 compares some of the key performance metrics across the three alternate future scenarios and two combined scenarios, as compared to the standard forecasts. As shown, both the New Normal and Incentives/Pricing scenarios decrease the number of auto trips and thereby congestion; but they achieve these reductions in different ways. The overall reduction in trips (especially commute trips) in the New Normal scenario decreases both car trips and transit trips, while the package of incentives in the Incentives scenario causes people to shift from car trips to transit. Conversely, the Technology scenario results in a shift toward auto travel as CASE vehicles provide new convenient options for many trips. While the Incentives/Pricing scenario results in the largest decrease in VMT, different assumptions around telework, VMT fees, and parking costs could change which approach is the most effective at reducing VMT.

All three scenarios reduce congestion in Northern Virginia, although that reduction is achieved in different ways: demand reduction, capacity increases, and mode shift. The New Normal scenario generally decreases demand during peak periods, and fewer trips result in less congestion. The Technology scenario accommodates a larger number of trips and vehicles with less congestion by leveraging technology to increase the carrying capacity of existing roadways. The Incentives/Pricing scenario has the biggest impact on mode choice, encouraging behavioral change that results in a 25.6 percent increase in transit ridership (13% increase when paired with New Normal trip changes) due to the mix of transit incentives (i.e. free transit) and auto pricing (VMT and parking charges). The Incentives/Pricing scenario reduces the number of auto trips on the roadway network, resulting in less congestion. All three approaches to congestion reduction also increase accessibility across the region by making it possible to get further in the same amount of time.

Both the New Normal and Incentives/Pricing scenarios show emissions reduction in proportion to their reduction in VMT. In contrast, the Technology scenario includes significant assumptions around vehicle electrification, and therefore sees a 25 percent decrease in emissions despite a 2.7 percent increase in VMT. This illustrated the importance of vehicle electrification in achieving emissions reduction goals in Northern Virginia.

Figure 78 Percent Change in 2045 No-Build Results under Each Scenario



7.3 Robustness of TransAction Investments

NVTA also tested how well the TransAction projects would perform in each of these potential futures. This analysis helps to understand if the projects in TransAction would result in the same level of improvement under a range of potential future conditions. The performance of the TransAction projects under the standard forecast are discussed in detail in a different Technical Memo. By comparing the No-Build and Build conditions of each scenario, it is possible to understand whether the TransAction projects will be more necessary (if the improvement is greater than in the standard forecast) or less necessary (if the improvement is less than in the standard forecast).

The scenarios and the resulting analysis are summarized in Table 33. Figure 79 and Table 34 compare the performance of the TransAction projects in each of the alternative scenario—Build version of the scenario compared with No-Build version of the scenario. The Build compared with No-Build for the standard forecasts is shown in gray. In all five of the scenarios, the TransAction projects provide tangible benefits to the region, helping to decrease congestion, improve accessibility and reduce emissions.

Some key findings from this analysis include:

- The TransAction Plan results in a larger increase in transit trips in the Incentives (21 percent) scenario, with and without the New Normal trip changes, than in the other scenarios (12–13 percent). This indicates that the transit projects included in the Plan are more attractive under the assumptions of the Pricing/Incentives scenario.
- The TransAction projects have a slightly smaller impact on congestion in the alternative future scenarios, with the exception of the Incentives/Pricing Scenario which manages to improve congestion slightly more than in the standard forecast. Even considering that there is less congestion to begin with in the No-Build versions of these scenarios, the TransAction projects are still effective at reducing congestion as a group. However, this may not be true for each individual project, and NVTA will continue to monitor and evaluate changes in travel patterns and performance to ensure that each project selected for funding as part of the Six-Year Program will be beneficial for the region in the long-term.
- The TransAction projects have the biggest impacts in the Incentives/Pricing scenario; increasing transit trips by 21 percent, decreasing emissions by 53 percent and resulting in the smallest increase in VMT of any of the futures considered. The assumptions of this scenario, such as free transit and discounted VMT charges for low-income households, make many of the transit projects in TransAction more attractive while, at the same time, support more equitable impacts.

These three scenarios are based on assumptions about ways that the future could be different from today, some of which the region has more control over than others. For example, post-pandemic hybrid work schedules may be a permanent change in commuting that is the choice of thousands of individual employers (including the Federal Government) and millions of individual workers. Meanwhile, Government policy can play an important role in regulating and managing the impacts of emerging technologies, but the proliferation of electric and automated vehicles will be a market-driven process. On the other hand, the types of policies and strategies included in the Incentives/Pricing scenario can only be implemented through proactive action by governments at the local, regional, state, and Federal levels.

Table 33 Summary of Scenario Analysis Findings

Scenario	Description	Assumptions	Impacts	Robustness of TransAction Projects
 Post-Pandemic 'New Normal'	Illustrates a future in which many of the behavioral changes observed during the COVID-19 pandemic continue into the long-term future. NVTA has minimal influence over this scenario.	• Reduction of work-related trips • Reduction of shopping trips • Increase in delivery trips • Increase in non-motorized trips	• Less travel by all modes decreases VMT, congestion, and emissions • More congestion reduction in the peak period due to fewer commute trips	• Congestion will continue to be an issue in NoVA, even with less commuting and overall trip-making • The TransAction projects are still effective at achieving the region's transportation goals
 Technology	Focuses on adoption of connected, automated, shared, and electric (CASE) vehicles. The scenario evaluates how travel behavior and the operations of the transportation system might change with the adoption and integration of these emerging technologies. NVTA has minimal influence over this scenario.	'New Normal' trip assumptions plus: • Increased market penetration of CASE vehicles • Changes in operating costs for automated vehicles (shared and privately owned) • Increases in effective roadway capacity • Automated transit shuttles at rail stations	• Increased carrying capacity of the roadway network improves operations and reduces congestion all day • Transit trips decrease as CASE options become more attractive • Electrification helps reduce vehicle emissions	• Congestion will continue to be an issue in NoVA, even with increased capacity of roads • Even with new CASE-enabled travel options, TransAction projects encourage more use of transit • The TransAction projects are still effective at achieving the region's transportation goals
 Incentives/ Pricing	Centers on policy strategies to change travel behavior to mitigate congestion and its negative impacts. The scenario incorporates a number of monetary inducements designed to encourage a reduction/reversal in driving alone.	'New Normal' trip assumptions plus: • VMT pricing on all roads with discounts for lower-income households • Increase in parking costs across the region • Free transit (no fares) • Less travel in peak hours	• Policies and pricing strategies show ability to change travel behavior as more people chose transit and other non-SOV modes • Fewer cars on the road result in less congestion and emissions • Significant increase in transit ridership	• Incentives/Pricing policies amplify the impacts of adding new transit services by making those options more attractive • Congestion will continue to be an issue in NoVA, even with VMT pricing and free transit

Figure 79 Performance of TransAction Plan Projects by Scenario

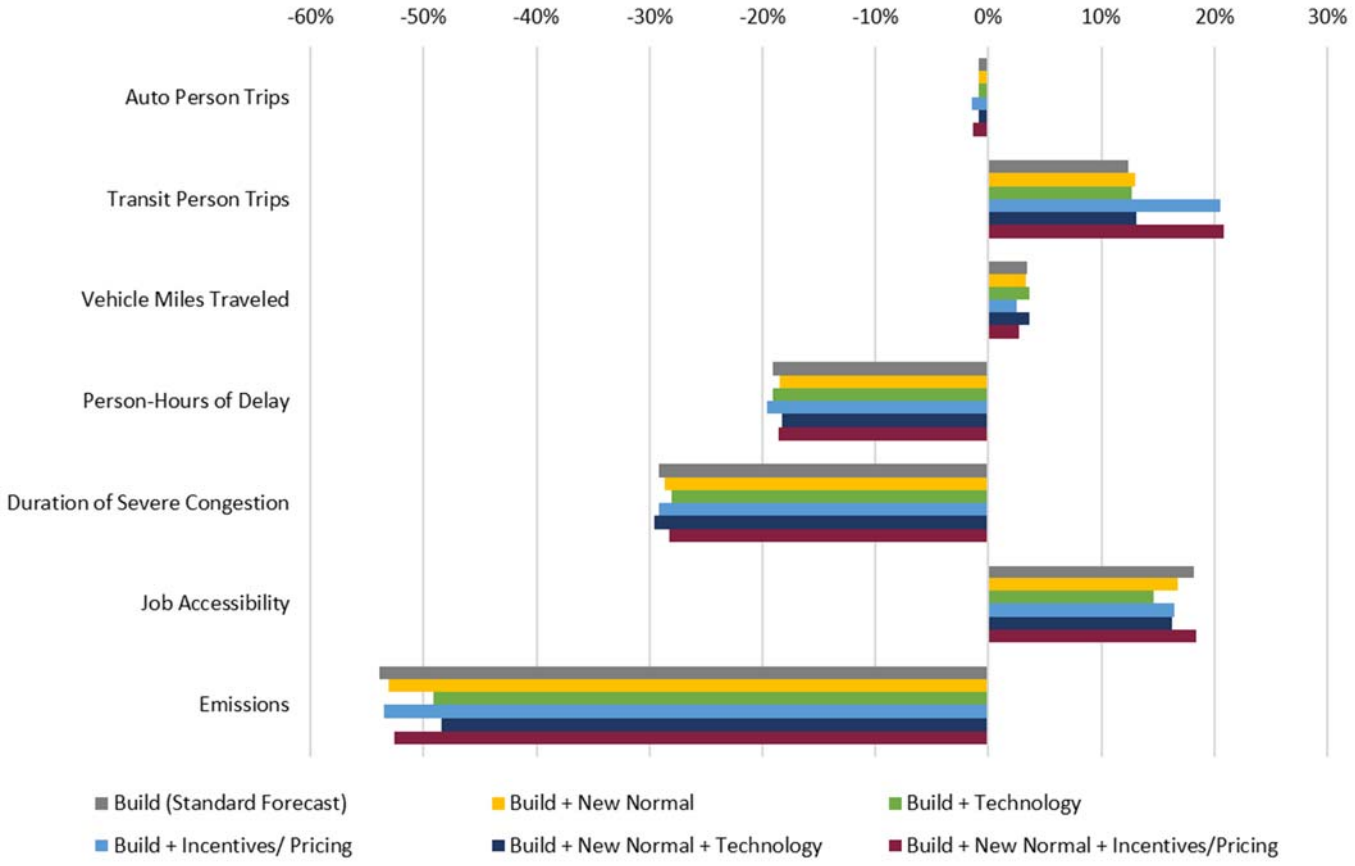


Table 34 Performance of TransAction Plan Projects by Scenario (2045 Build versus 2045 No-Build Comparison)

Measure	Build (Standard Forecast)	Scenario 1: Build + New Normal	Scenario 2: Build + Technology	Scenario 3: Build + Incentives/ Pricing	Scenario 4: Build + New Normal + Technology	Scenario 5: Build + New Normal + Incentives/ Pricing
Total Person Trips	-0.2%	-0.2%	-0.2%	-0.2%	-0.3%	-0.2%
Auto Trips	-0.8%	-0.8%	-0.8%	-1.5%	-0.8%	-1.4%
Transit Trips	12.4%	13.0%	12.7%	20.6%	13.1%	20.8%
Non-Motorized Trips	-0.2%	-0.2%	-0.2%	-0.2%	-0.3%	-0.2%
Vehicle Miles Traveled (VMT)	3.4%	3.3%	3.6%	2.5%	3.6%	2.7%
Person Miles Traveled (PMT)	3.7%	3.5%	3.9%	3.4%	3.9%	3.5%
Total Delay Reduction (Autos + Transit)	-19.1%	-18.5%	-19.1%	-19.6%	-18.3%	-18.5%
A1: Auto Delay Reduction	-18.4%	-18.2%	-18.1%	-19.7%	-18.0%	-19.2%
A2: Transit Delay Reduction	-35.1%	-26.1%	-35.0%	-17.2%	-25.0%	0.0%
B1: Congestion Duration	-29.2%	-28.7%	-28.0%	-29.2%	-29.5%	-28.2%
B2: Transit person-miles in dedicated/priority ROW	6.0%	6.4%	9.0%	8.4%	7.0%	9.6%
C1: Accessibility	18.2%	16.8%	14.7%	16.4%	16.3%	18.4%
C2: EEA Accessibility	22.4%	20.5%	18.8%	20.0%	19.6%	21.6%
F1: Emissions	-53.9%	-53.1%	-49.1%	-53.5%	-48.4%	-52.6%

8.0 KEY FINDINGS

TransAction outlines a range of projects that represent options for how Northern Virginia can achieve its transportation vision and the goals of enhancing mobility, increasing accessibility, and improving resiliency. TransAction is not a prescriptive Plan that dictates how these goals must be realized, but instead provides a menu of options that the region can consider to meet its priorities. When combined, the projects included in TransAction help realize significant improvements across the region. Any project seeking NVTA regional funding will be further evaluated as part of NVTA's biannual Six-Year Program process.

Northern Virginia will face continued growth, adding to the travel demand and delay experienced today. Without significant investment in transportation, congestion, delay and accessibility will continue to worsen through 2045, reducing quality of life in Northern Virginia. The TransAction Plan provides improvements that help to meet the needs of the growing population and job market in Northern Virginia.

8.1 TransAction Enhances Mobility

- **Reduces travel delay—**The combined effects of the multimodal investments in TransAction are projected to decrease person-hours of delay by 19 percent and reduce the duration of severe congestion by 29 percent. The Plan includes 1,040 new lane miles of roadway, numerous interchanges and intersection improvements, significant improvements to the transit network to attract people away from driving and HOV/HOT lanes and ITS improvements that reduce bottlenecks on the road system and move people more efficiently. A reduction in delay also benefits transit riders as well, with a 35 percent decrease in delay on transit.
- **Builds regional connections—**The Plan addresses gaps in the current transportation system for roads, transit and trails. In particular, the Plan includes over 90 miles of BRT, as part of a BRT/HCT system totaling approximately 280 miles to create a truly regional system that expands the reach of the current transit system and provides critical suburban-to-suburban connections. The Plan also includes improvements to fill gaps in the network of regional trails and making connections to activity centers and to multimodal hubs at transit stations.
- **Provides transportation choices—**The Plan provides alternatives to driving through meaningful multimodal travel choices. Transit ridership increases by 12 percent with the TransAction projects. The Plan includes 50 non-motorized projects intended to support biking and walking around the region.

8.2 TransAction Increases Accessibility

- **Connects people to jobs and opportunities—**The Plan creates a multimodal transportation network that is more accessible, providing an 18 percent increase in the jobs that can be reached within a reasonable commute across all modes, whether via transit, roadway or bike.
- **Provides equitable access—**Accessibility gains are even greater (22 percent) for communities that fall within the region's EEAs. These neighborhoods can benefit significantly from having additional travel choices.

8.3 TransAction Improves Resiliency

- **Improves transportation safety—**Provides continued investment in multimodal projects that put safety first, reducing conflicts on roadways and pedestrian/bike facilities in the region and reducing risk for the most vulnerable users (i.e., pedestrians and bicyclists).
- **Support reduction of vehicle emissions—**TransAction includes significant alternatives to driving in single-occupancy vehicles. The two most common ways to reduce transportation GHG emissions are less driving and use of low/ZEVs. TransAction supports both. The analysis shows that supporting widespread electrification leads to the largest decreases in transportation emissions.

8.4 Key Takeaways

It takes a region.

The 424 candidate regional projects identified in the Plan exceed the NVTA's expected funding available through 2045. Other funding sources, including federal, state, local, and private dollars, may be available to help close the gap. Regional collaboration and the ability to work beyond jurisdictional lines is key to keeping Northern Virginia moving.

- Forecasted population and employment growth through 2045 necessitates continued investments in transportation, but no single project, program, policy or mode will address all the region's transportation needs.
- TransAction includes 424 multimodal transportation projects that support the region's vision and goals and address the transportation needs of Northern Virginians. However, there are more projects in TransAction than can be reasonably funded by the region. Some projects are intentionally included despite being located beyond Northern Virginia, as they address regional transportation needs of Northern Virginians and the region's businesses.
- TransAction is well-aligned with NVTA's core values of equity, sustainability and safety.
- TransAction does not make project or modal recommendations but does highlight a potential role for a regional BRT system and the opportunity to leverage transportation technologies at a regional scale. Each of these opportunities is worthy of further evaluation after TransAction is adopted, the latter under the auspices of NVTA's TTSP.
- Long-range transportation planning always involves a degree of uncertainty, particularly with respect to the potential for unanticipated changes in future travel behavior and other external factors beyond the control of the region. TransAction addresses uncertainty through a technique known as scenario analysis, in which three scenarios, or alternative futures, were explored in addition to the standard forecast. Each scenario demonstrated that the TransAction projects are still effective at achieving the region's transportation vision and goals, but congestion and delay will continue to be challenges. The extent to which individual projects support the vision and goals is worthy of further evaluation, including as part of NVTA's Six-Year Program process.
- Of the three scenarios analyzed, Incentives/Pricing lends itself to Government action while the region will primarily need to be reactive in the New Normal and Technology scenarios. While TransAction does not recommend advancing this or any scenario, NVTA will continue to monitor travel behaviors and other trends after TransAction is adopted to ensure project evaluations as part of NVTA's Six-Year Program process are as accurate as possible.
- A regional BRT system could begin to be implemented in the short to medium term, offering the potential to provide Northern Virginians with new and meaningful travel choices. Such a system could reduce traffic

congestion, increase access to jobs, reduce (and possibly reverse) dependency on driving alone, increase transit ridership and reduce GHG emissions. These impacts and benefits could be further amplified if a regional BRT system is combined with various technology initiatives as informed by the TTSP.

TRANSACTION IS NOT THE END OF THE PLANNING PROCESS.

TransAction is a starting point for transportation planning in Northern Virginia and is one input to identifying how NVTA regional revenues are invested. As part of the Six Year Program, which gets updated every two years, jurisdictions will be able to apply to use NVTA regional revenues to advance projects from TransAction Plan that match their local priorities. NVTA will evaluate each application based on the TransAction performance measures to fund a portfolio of projects that equitably, sustainably and safely meet the region's goals of enhancing mobility, increasing accessibility and improving resiliency.

GLOSSARY

AADT	Average Annual Daily Traffic
BEV	Battery Electric Vehicle
BLTS	Bicycle Level of Traffic Stress
BRT	Bus Rapid Transit
CAA	Clean Air Act
CASE	Connected, Automated, Shared, Electric (Vehicles)
CTC	Capital Trails Coalition
DRPT	Department of Rail and Public Transportation
EEA	Equity Emphasis Area
EPA	United States Environmental Protection Agency
EV	Electric Vehicle
GHG	Greenhouse Gases
HOV/HOT	High-Occupancy Vehicle
ICM	Integrated Corridor Management
ITS	Intelligent Transportation Systems
LOTTR	Level of Travel Time Reliability
MWCOG	Metropolitan Washington Council of Governments
NAAQS	National Ambient Air Quality Standards
NoVA	Northern Virginia
NVRC	Northern Virginia Regional Commission
NVTA	Northern Virginia Transportation Authority
PCAC	Planning Coordination Advisory Committee
PHEV	Plug-In Hybrid Electric Vehicles
PSAP	Pedestrian Safety Action Plan
RM3P	Regional Multimodal Mobility Program

SOV	Single-Occupancy Vehicle
TAC	Technical Advisory Committee
TAZ	Traffic Analysis Zone
TDM	Traffic Demand Management
TOD	Transit-Oriented Development
TPB	National Capital Region Transportation Planning Board
TSP	Transit Signal Priority
TTSP	Transportation Technology Strategic Plan
VDOT	Virginia Department of Transportation
VMT	Vehicle Miles Traveled
VRE	Virginia Railway Express
VRM	Vehicle Revenue Miles
WMATA	Washington Metropolitan Area Transit Authority
ZEV	Zero-Emission Vehicle