Northern Virginia Transportation Authority
The Authority for Transportation in Northern Virginia

TECHNICAL ADVISORY COMMITTEE
Wednesday, March 16, 2022, 7:00pm
3040 Williams Drive, Suite 200
Fairfax, Virginia 22031
(In-person meeting and livestreamed via YouTube)

AGENDA

I.	**Call to Order/Welcome**	Chairman Boice

Action

II.	**Summary Notes of November 22nd, 2021 Meeting** *Recommended action: Approve meeting notes*	Chairman Boice
III.	**Approval of Meeting Schedule for Calendar Year 2022** *Recommended action: Approve Meeting Schedule*	Dr. Nampoothiri, Senior Transportation Planner

Discussion/Information

IV.	**Status of FY2022-2027 Six Year Program Update**	Dr. Nampoothiri, Senior Transportation Planner
V.	**Status of TransAction Plan Update**	Dr. Nampoothiri, Senior Transportation Planner
VI.	**NVTA Updates**	Ms. Monica Backmon, CEO

Adjournment

VII. Adjourn

Next Meeting
April 20th, 2022

Northern Virginia Transportation Authority
The Authority for Transportation in Northern Virginia

TECHNICAL ADVISORY COMMITTEE
Wednesday, November 22, 2021, 7:00 pm
Live-streamed on YouTube

MEETING SUMMARY

I. Call to Order/Welcome

- Chairman Boice called the meeting to order at 7:05 pm at the NVTA Office.
- Attendees:
  - **Members:** Randy Boice, Karen Campblin, Amy Morris, Frank Spielberg, Pat Turner and, Dr. Shanjiang Zhu.
  - **NVTA Staff:** Keith Jasper, Principal, Transportation Planning and Programming; Dr. Sree Nampoothiri, Senior Transportation Planner; Mackenzie Love, Regional Transportation Planner and Harun Rashid, Transportation Planner.
  - **Consultants:** Dalia Leven (Cambridge Systematics Inc.)
  - **Others:** On YouTube live stream.

II. Summary of October 20, 2021, Meeting

- The motion to accept the meeting summary was approved unanimously.

III. TransAction: Weightings for Performance Measures

- Dr. Nampoothiri provided an overview of progress that has been made on the development and approval of TransAction Goals, Objectives, and Measures thus far, including Authority approval on November 18th, 2021.
  i. Mr. Jasper added that the Authority recommended adding a note to the description of the Performance Measures which states: "transit may include High Occupancy Vehicles (HOV)". Although the effects of HOV will be fully captured in the TransAction approach to modeling, the Authority determined that a direct mention of the mode was important in this context, to recognize the significance of its impacts.
  ii. There was a brief discussion of how this modification may impact modeling, in which Ms. Leven noted that the full impacts were still being evaluated, since the change occurred a few days before this meeting.
- Dr. Nampoothiri described the process that will be undertaken to establish weightings for performance measures. He explained that the Technical Advisory Committee (TAC), Planning Coordination and Advisory Committee (PCAC) and, Planning and

Programming Committee (PPC) will each be asked to recommend weights for the approved Performance Measures, for Authority approval in December.

i. The weights suggested by each Committee in November will be averaged and rounded to the nearest 5%. The averaged weights, along with sums of these for each core value, will be presented to the NVTA Authority in December. The Authority may accept or modify these recommendations prior to approval.
ii. He then shared responses from the TransAction public survey, as a point of reference for the Committee to consider in recommending their own weightings.

- Chairman Boice then lead the Committee members in an open discussion of the Performance Measures and potential weightings. During this time, Committee members were also able to ask Ms. Leven and Dr. Nampoothiri technical questions, to inform their deliberations. The most salient topics of discussion and questions were:
  i. Mr. Spielberg recommended that the Committee begin the process of assigning weights by dividing the total available points equally across the three TransAction goals, and then allocating points across the Performance Measures that comprise them.
  ii. Chairman Boice recommended that Measures concerning congestion reduction be given priority, since that is NVTA's primary charge.
  iii. There was discussion of the difference between Performance Measures A1 and A2, which focus on reducing delay for autos and transit, respectively.
    1. Ms. Leven explained that the two were combined in one measure in the past, but were disaggregated here, to allow for more nuance. She noted that equity considerations could be one reason to consider different weightings.
    2. Dr. Zhu indicated that he would prefer to align his recommendations for these measures with the percentage mode split between auto and transit travel observed in the region.
  iv. There was discussion of the differences between Performance Measures C1; "Access to jobs by car, transit and bike" and C2, "Access to jobs by car, transit and bike for EEA populations"
    1. Ms. Campblin and Ms. Morris both described how historical disinvestment in areas with high concentrations of low-income and minority populations (which are now identified as Equity Emphasis Areas, or EEA, by the Metropolitan Washington Council of Governments, or MWCOG) has resulted in greater need in those areas. Ms. Campblin added that an increased focus on those areas may help address that deficit.

v. The Committee members each provided their recommendations for weightings for each Performance Measure, which were averaged together, in real-time. The Committee then rounded these averages to the nearest whole numbers.
    1. A motion was made and seconded to recommend these rounded averages for Authority approval, which ultimately passed unanimously.

vi. The Performance Measures weightings recommended by the TAC are:

Technical Advisory Committee			
Goal		**Performance Measure**	**Recommended Weight**
Mobility	A1	Total Person-Hours of Delay in autos	**16.0**
	A2	Total Person-Hours of Delay on Transit	**6.0**
	B1	Duration of Severe Congestion	**12.0**
	B2	Transit person-miles in dedicated/priority ROW	**8.0**
Accessibility	C1	Access to jobs by car, transit, and bike	**10.0**
	C2	Access to jobs by car, transit, and bike for EEA populations	**10.0**
	D1	Quality of access to transit and the walk/bike network	**12.0**
Resiliency	E1	Potential for safety and security improvements	**9.0**
	F1	Vehicle Emissions	**8.0**
	G1	Transportation System Redundancy	**9.0**

IV. TransAction: Scenario Analysis

- Ms. Leven described how scenario analysis will be used in the TransAction update process to help provide a better understanding of uncertainty. She emphasized that this effort will explore plausible futures, not necessarily those that are preferred or predicted.
- Four scenarios are proposed for inclusion in the TransAction update process. Ms. Leven described each briefly, and asked for Committee feedback on a few specific points for each:

    i. Pandemic-created 'New Normal'
        1. In response to a question from Ms. Leven, the Committee members indicated that land use would likely need to be addressed, to some extent, to fully evaluate this scenario.

2. There was a consensus to wait as long as possible to determine if a potential post-pandemic aversion to riding transit should be evaluated, to have the most possible data to inform the verdict.

ii. Transportation Technology
   1. The Committee indicated that exploring the impacts of technologies on the operating costs of transit, may distract from the outcomes that impact that may more directly impact the functioning of the transportation system. (One example of this would be the potential impacts of like Connected/ Automated/ Shared/ Electric vehicles (CASEs) on staffing needs.)

iii. Transportation Policy/Mechanisms
   1. There was discussion about the different forms of roadway pricing that could be evaluated in this scenario, including VMT pricing, congestion pricing, cordon charges, carbon pricing and parking fees. Some Committee members expressed concerns about the equity of pricing. Ms. Leven indicated that analyzing a scenario that explored pricing mechanisms could help identify any equity issues and thus facilitate addressing them.

iv. Climate Change
   1. Ms. Leven offered two potential approaches to this scenario. The first is to evaluate what would happen if specific pieces of infrastructure were lost, due to things like flooding. The second is to combine aspects of the other three scenarios, to determine their joint impact on emissions. She also noted that the Regional Jurisdiction and Agency Coordination Committee (RJACC) expressed a desire to synergize with the work of MWCOG on climate change, rather than duplicating it. The Committee was interested in a scenario that would combine outcomes of these other three, but recommended waiting to see said outcomes before finalizing this approach.

V. NVTA Update

- Dr. Nampoothiri reminded the Committee that the Authority is expected to vote on weightings for the TransAction Performance Measures in their next meeting, which is scheduled for 6:00pm on Thursday, December 9th, 2021.

VI. Other

- Chairman Boice announced that Ms. Turner would be retiring from the TAC in January, after years of distinguished service. He thanked her for her commitment to the Committee and Dr. Nampoothiri expressed gratitude to her, on behalf of NVTA Staff as well.
- The Committee discussed if it would be necessary to meet in December. Dr. Nampoothiri advised the members that a meeting would likely not be needed unless the Authority action on weights for the TransAction Performance Measures requires the Committees to meet. However, the placeholder date of December 15th would be retained on NVTA calendars, should it be deemed appropriate to meet.

VII. Adjournment

- The meeting adjourned at 8:53 pm.

Northern Virginia Transportation Authority
The Authority for Transportation in Northern Virginia

TECHNICAL ADVISORY COMMITTEE
Wednesday, March 16th, 2022
7:00pm

DRAFT CY2022 MEETING SCHEDULE

Meetings are on the third Wednesday of each month at 7:00pm (/NVTA Offices)

March 16, 2022; 7:00 PM

April 20, 2022; 7:00 PM

May 18, 2022; 7:00 PM

June 15, 2022; 7:00 PM

July 20, 2022; 7:00 PM

August: Recess

September 21, 2022; 7:00 PM

October 19, 2022; 7:00 PM

November 16, 2022; 7:00 PM

December 21, 2022; 7:00 PM

Northern Virginia Transportation Authority
Summary of FY2022-2027 Six Year Program Candidate Projects

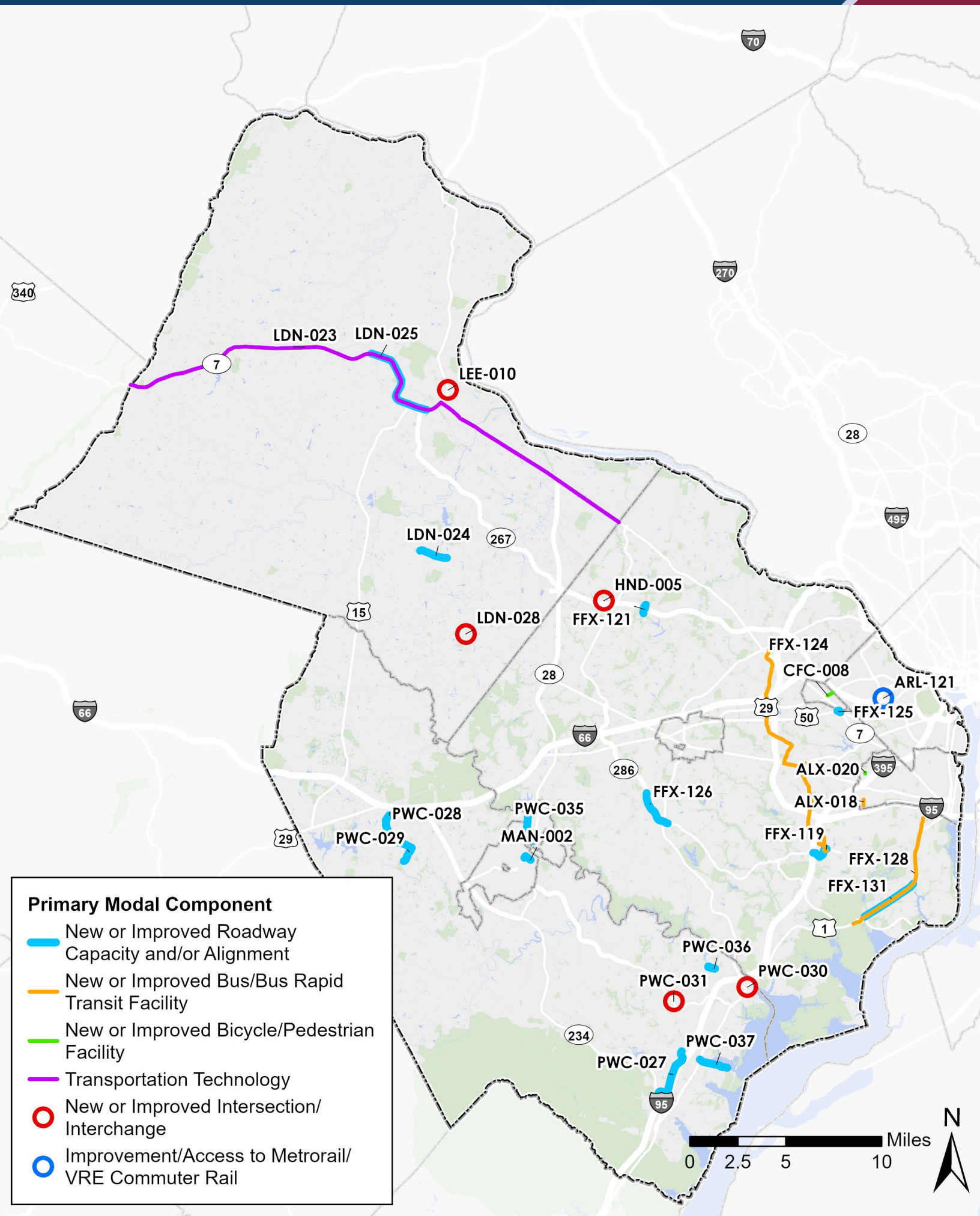
#	Application ID	Jurisdiction / Agency	Project	Fund request	Total project cost	Primary and supporting modal components
1	ARL-021	Arlington Co	Ballston-MU Metrorail Station West Entrance	$ 80,000,000	$ 140,000,000	
2	FFX-131	Fairfax Co	Richmond Highway Widening From Mt. Vernon Memorial Highway/Jeff Todd Way to Sherwood Hall Lane	$ 60,207,038	$ 415,000,000	
3	FFX-128	Fairfax Co	Richmond Highway (Route 1) BRT	$ 80,000,000	$ 730,000,000	
4	FFX-121	Fairfax Co	Soapstone Drive Extension: Sunset Hills Road to Sunrise Valley Drive	$ 73,793,037	$ 235,000,000	
5	FFX-119	Fairfax Co	Frontier Drive Extension and Intersection Improvements	$ 145,200,000	$ 180,200,000	
6	FFX-126	Fairfax Co	Fairfax County Parkway Widening: Nomes Court to Route 123	$ 108,000,000	$ 115,035,882	
7	FFX-125	Fairfax Co	Seven Corners Ring Road Improvements: Arlington Boulevard (Route 50) Westbound Ramp to Castle Place/Sleepy Hollow Road	$ 94,800,000	$ 94,800,000	
8	FFX-124	Fairfax Co	8 New Battery Electric Buses - Fairfax Connector Buses for Tysons to Franconia Service	$ 10,000,000	$ 10,000,000	
9	LDN-025	Loudoun Co	Route 7 Improvements: Route 9 to Dulles Greenway	$ 20,000,000	$ 130,992,500	
10	LDN-028	Loudoun Co	Loudoun County Parkway Interchange at US 50	$ 20,000,000	$ 181,152,680	
11	LDN-024	Loudoun Co	Ryan Road Widening (Phase 2): Evergreen Mills Road to Beaverdam Drive	$ 16,000,000	$ 31,500,000	
12	LDN-023	Loudoun Co	Route 7 Corridor ITS Implementation Program	$ 2,500,000	$ 3,777,000	
13	PWC-031	Prince William Co	Construct Interchange at Prince William Parkway and Minnieville Road	$ 67,500,000	$ 70,000,000	
14	PWC-030	Prince William Co	Route 1 at Route 123 Interchange	$ 61,200,000	$ 68,000,000	
15	PWC-027	Prince William Co	Van Buren Road North Extension: Route 234 to Cardinal Drive	$ 80,000,000	$ 82,000,000	
16	PWC-029	Prince William Co	Devlin Road (South) Widening: Linton Hall Road to University Boulevard	$ 35,000,000	$ 40,000,000	
17	PWC-028	Prince William Co	University Boulevard Extension: Devlin Road to Wellington Road	$ 53,000,000	$ 100,000,000	
18	PWC-036	Prince William Co	Old Bridge Road Widening: Colby Drive to Minnieville Road	$ 25,000,000	$ 25,000,000	
19	PWC-037	Prince William Co	Neabsco Road Improvements - Neabsco Road Widening: Route 1 to Daniel Ludwig Drive	$ 26,500,000	$ 26,500,000	
20	PWC-035	Prince William Co	Old Centreville Road Widening: Fairfax County Line to Route 28	$ 96,000,000	$ 96,000,000	
21	ALX-018	City of Alexandria	West End Transitway Phase 1b: South Van Dorn Street and Bridge Design	$ 5,000,000	$ 40,999,440	
22	ALX-020	City of Alexandria	Alexandria Bike and Pedestrian Trails Construction and Reconstruction: Holmes Run Trail - Dora Kelly Fair-weather Crossing Bridge	$ 5,000,000	$ 5,500,000	
23	CFC-008	City of Falls Church	North Washington Street Multimodal Improvements Project: Great Falls Street to Gresham Place	$ 22,500,000	$ 22,500,000	
24	MAN-002	City of Manassas	Liberia Avenue 3rd Lane Eastbound: Route 28 to Euclid Avenue	$ 8,851,639	$ 8,851,639	
25	HND-005	Town of Herndon	Herndon Parkway Improvements at Worldgate Drive Extension	$ 4,581,000	$ 6,536,000	
26	LEE-010	Town of Leesburg	Interchange Improvements at Route 15 Leesburg Bypass and Edwards Ferry Road	$ 13,283,839	$ 185,074,950	
26			**TOTAL**	**$ 1,213,916,553**	**$ 3,044,420,091**	

Modal Components

- New or improved roadway capacity and/or alignment
- New or improved intersection/interchange
- Improvement/access to Metrorail/VRE commuter rail
- New or improved bus/BRT facility
- New or improved bicycle/pedestrian facility
- New or improved bicycle facility
- New or improved pedestrian facility
- Transportation Technology

First symbol reflects the primary modal component, other symbols denote supporting modal components

FY2022-2027 Six Year Program Update - Candidate Project Locations



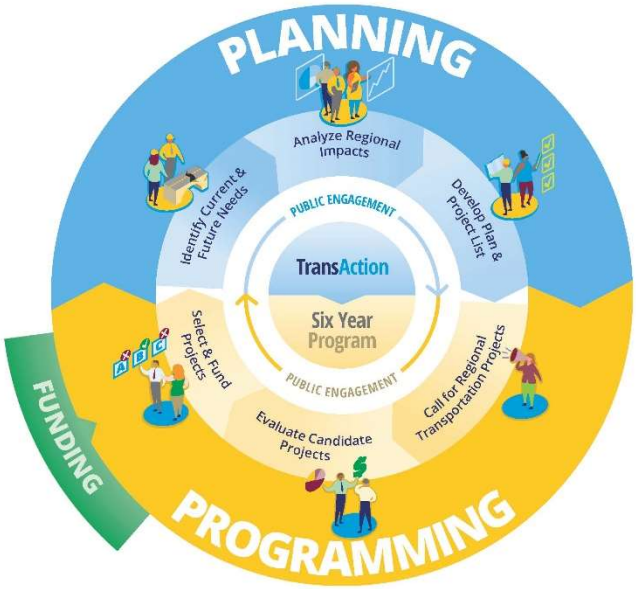
Task 1.5 Technical Memorandum

Performance Measures Methodology

February 2022

The Northern Virginia Transportation Authority (NVTA) is a regional body that is focused on delivering transportation solutions and value for Northern Virginia's transportation dollars by bringing NoVA jurisdictions and agencies together to plan and program regional multimodal transportation projects focused on relieving congestion. As shown in Figure 1, NVTA has two main functions in the planning and programming of the multimodal transportation network in Northern Virginia. TransAction is Northern Virginia's long range multimodal transportation plan, which is a financially and geographically unconstrained plan, that is updated every five years. As part of TransAction, NVTA analyzes the regional impacts of a slate of multimodal transportation projects using a set of performance measures designed to capture the range of potential benefits of all types of improvements.

Figure 1: NVTA's Planning and Programming Process



NVTA also is responsible for allocating regional transportation funds to specific projects as part of the programming process. Every two years, NVTA updates their Six Year Program to include projects selected to receive funding. These programming decisions are also based, in part, on an evaluation of candidate projects based on the same set of performance measures used in TransAction.

TransAction is currently being updated, which includes revisions to the TransAction Vision, Goals, Objectives, and Performance Measures. These new performance measures will be used to analyze the impacts of transportation projects as part of TransAction, and for at least the next three Six Year Program evaluations beginning with the FY2022-2027 Six Year Program. This memo outlines the methodology that is being used to calculate each of the ten performance measures based on results of the modeling process and/or other inputs, and how they will be combined in order to develop a combined TransAction rating.

Performance Measures

On November 18, 2021, NVTA approved the goals, objectives, and ten performance measures as shown in Table 1.

Table 1: Approved Goals, Objectives and Performance Measures

Goal	Objective	Performance Measure
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
		A2. Total Person-Hours of Delay on Transit
	B. Improve travel time reliability*	B1. Duration of Severe Congestion
		B2. Transit person-miles in dedicated/priority ROW
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
		C2. Access to jobs by car, transit, and bike for EEA populations
	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
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
	F. Reduce transportation related emissions	F1. Vehicle Emissions
	G. Maintain operations of the regional transportation system during extreme conditions*	G1. Transportation System Redundancy

*Objectives align with HB599 requirements Transit may include High Occupancy Vehicles (HOV)

Proposed Calculation Methodology

Each measure will need to be calculated on its own scale based on the methodology set out in the following sections. Regardless of the methodology used, the results of each measure will be normalized and reported on a scale of 1 to 100. The normalization process will assign the highest performance in each measure a score of 100; all other projects will be assigned a score based on how close they are to this highest performance. For example, if Project A reduces delay by the most of any project, it will be assigned 100 points as shown in Table 2 below. The other projects will be assigned a score relative to Project A. While projects will receive scores across all ten performance measures, the same project may not be the highest scoring project across each of the performance measures.

Table 2: Sample of Score Normalization

Project	Person-Hours of Delay in Autos Reduced	% Relative to Highest Performing Project	Performance Measure A1 Score
Project A	10,000	100%	100
Project B	1,018	10.18%	10.18
Project C	8,101	81.01%	81.01

A1. Total Person-Hours of Delay in Autos

Calculated for each link, as the difference between the number of person-hours spent traveling and the hypothetical person-hours that would be spent traveling if all roads were able to operate at free-flow speed. This is summed over the whole day.

$$\sum_{j=1}^{j} (TravelTime_j - TravelTime_{FreeFlow}) * AutoVolume * AutoOccupancy$$

Where *j*=number of time periods in the day.

Only people in autos (drivers and passengers) are included in this calculation. Projects of all modes are considered for their impact on congestion, including pedestrian and bike projects. Transit and highway projects can be easily represented within the confines of the mode choice model and the dynamic traffic assignment[1]. However, bike and pedestrian projects will also have some impact on congestion levels, by encouraging more people to switch to non-motorized modes.

To account for these impacts, after the mode choice model has created modal trip tables, some additional trips will be shifted from motorized to non-motorized modes. Since most non-motorized trips are short (pedestrian trips tend to be less than a mile and bicycle trips tend to be less than two miles long[2]) shorter trips will be more likely to be shifted than longer trips. These non-motorized trips (along with the other non-motorized trip productions developed by the model as part of the Trip Generation step) will not be assigned to the network. The number of trips that will be shifted into non-motorized modes will vary by the type/scale of project, and the location of the proposed improvements. There is limited data available on how many trips are shifted to non-motorized modes when improvements to the bike/walk infrastructure are made, but the most complete example comes from California. As shown in Table 3, the number of trips shifted is dependent on the length of the proposed enhancement and the amount of travel occurring on the adjacent/ parallel facilities.

[1] See the Modeling Strategy Memo for a more complete description of how the dynamic traffic assignment will be connected to other modeling steps.

[2] National Survey of Bicyclist and Pedestrian Behavior and Attitudes, National Highway Traffic Safety Administration (NHTSA), 2008. https://rosap.ntl.bts.gov/view/dot/1845.

Table 3: Active Transportation Adjustment Factors

Average Daily Traffic (ADT)	Project Length (one- direction)	Adjustment Factors
ADT ≤12,000 vehicles per day	≤1 mile	.0019
	>1 mile & ≤2 miles	.0029
	>2 miles	.0038
12,000<ADT ≤24,000 vehicles per day	≤1 mile	.0014
	>1 mile & ≤2 miles	.0020
	>2 miles	.0027
24,000<ADT vehicles per day	≤1 mile	.0010
	>1 mile & ≤2 miles	.0014
	>2 miles	.0019

Source: California Air Resources Board (2020) Quantification Methodology for the CARB STEP Pilot.

The CARB methodology also includes bonus adjustments for improvements located near "key destinations" – although no definition is provided. In a similar spirit, the adjustment factors will be scaled up by 0.003 if the improvement is located within a Regional Activity Center or a Transit Access Focus Area as defined by TPB. The total number of trips shifted from motorized to non-motorized travel will therefore be calculated as:

$$Trips\ Shifted = ADT * (AdjFactor + RACFactor)$$

A2. Total Person-Hours of Delay on Transit

This measure calculates congestion's impact on delaying transit passengers. It is not meant to account for delay caused by incidents on the transit system, nor as a measure of on-time performance for transit. Because this measure is tied to congestion, it only needs to be calculated on roadway links where bus transit operates in mixed traffic, or for HOVs in dedicated HOV/HOT facilities. Similar to the formulation of A1, it is calculated as the difference in travel times traveling at free-flow speed as compared to actual conditions.

$$\sum_{j=1}^{j} (TravelTime_j - TravelTime_{FreeFlow}) * TransitPassengerVolume$$

Where *j*=number of time periods in the day.

Delay for HOVs traveling in dedicated HOV lanes will be included in this measure. Delay incurred by SOVs using HOT facilities will not be included as transit delay, and will instead be included in the auto delay (Performance Measure A1). Travel on rail transit, including Metrorail, are not included in the measure. Projects of all modes are considered for their impact on congestion, including pedestrian and bike projects. The same process outlined for Performance Measure A1 will be conducted to account for the impacts of increased use of non-motorized modes on congestion.

B1. Duration of Severe Congestion

Duration of severe congestion is being used as a proxy for locations on the highway system with major reliability issues. As such, the measure calculates the portion of the day (number of hours) that each link experiences severe congestion – defined as a travel time ratio of 2.0 or higher.

$$Congestion\ Duration = \sum Hours_{SC} * FacilityMiles$$

Where $Hours_{sc}$=number of hours with a travel time ratio ≥ 2.0.

Projects of all modes should be considered for their impact on congestion, including pedestrian and bike projects. The same process outlined for Measure A1 will be conducted to account for the impacts of increased use of non-motorized modes on congestion.

B2. Transit Person-Miles in Dedicated/Prioritized ROW

To measure improvements in transit reliability, this measure quantifies the person-miles of travel occurring on transit in dedicated and prioritized right of way. This will essentially sum the person-miles dedicated/prioritized transitway across the network, including HOVs traveling in dedicated HOV lanes. Links on the network will need to be identified in advance using an attribute that categorizes their level of prioritization. Transit person-miles will then be calculated and summed as shown in Table 4. As shown in the table, travel on fully dedicated running-way is counted as 100 percent of the passenger miles traveled in the calculation. Other treatments, in which prioritization is provided for transit vehicles use a factor to discount the person-miles calculation to account for the fact that prioritized transit must still interact with congestion and other vehicles between intersections (in the case of TSP and queue jumps) or at intersections (in the case of BAT lanes). The factors in Table 4 have been developed based on a literature review of the relative travel time benefits of different types of bus priority treatments.

Table 4: Calculating Person-Miles on Dedicated/Prioritized ROW

Type of Treatment	Person-Miles Calculation
Separate Right-of-Way (e.g. Metrorail, VRE)	Passengers * distance traveled
Dedicated Bus Lanes	Passengers * distance traveled
Dedicated HOV/HOT Lanes	HOV Passengers * distance traveled
Business Access and Transit (BAT) Lanes[3]	Passengers * distance traveled *0.8
Transit Signal Priority	Passengers * distance traveled * 0.5
Queue Jump Lanes	Passengers * distance traveled *0.25

[3] BAT Lanes are curb-side lanes used exclusively by buses and right-turning vehicles, primarily to access businesses and driveways along a corridor.

C1. Access to jobs by car, transit, and bike

For each Traffic Analysis Zone (TAZ[4]) in Northern Virginia, this measure will calculate the number of jobs accessible by:

- Auto in 45 minutes
- Transit (including bus, rail, and on-demand transit) in 60 minutes
- Bike in 30 minutes

These numbers will be summed together for each TAZ to calculate the accessibility to jobs for each TAZ.

$$Accessibility_{TAZ} = Jobs_A + Jobs_T + Jobs_B$$

Where:

$Jobs_A$=number of jobs accessible within 45 minutes by auto

$Jobs_T$=number of jobs accessible within 60 minutes by transit

$Jobs_B$=number of jobs accessible within 30 minutes by bike

Jobs accessible by Auto and Transit will be calculated directly in the model. Jobs accessible by bike will be calculated using ArcGIS Network Analyzer, and will only include jobs accessible on facilities categorized as having a "Bicycle Level of Traffic Stress" of 2 or better. The bicycle network used for analysis includes both on-road and off-road facilities.

A regional value for this measure will be calculated by taking the average of all TAZ values weighted by their total population:

$$\frac{\sum_{TAZ=1}^{3722} Accessibility_{TAZ} * Pop_{TAZ}}{Regional\ Population}$$

It should be noted that this measure will double and triple count access to jobs that are accessible by multiple modes. This is intentional, and helps account for the benefits of having multiple modal options to complete the same trip.

Figure 2: Equity Emphasis Area Definitions

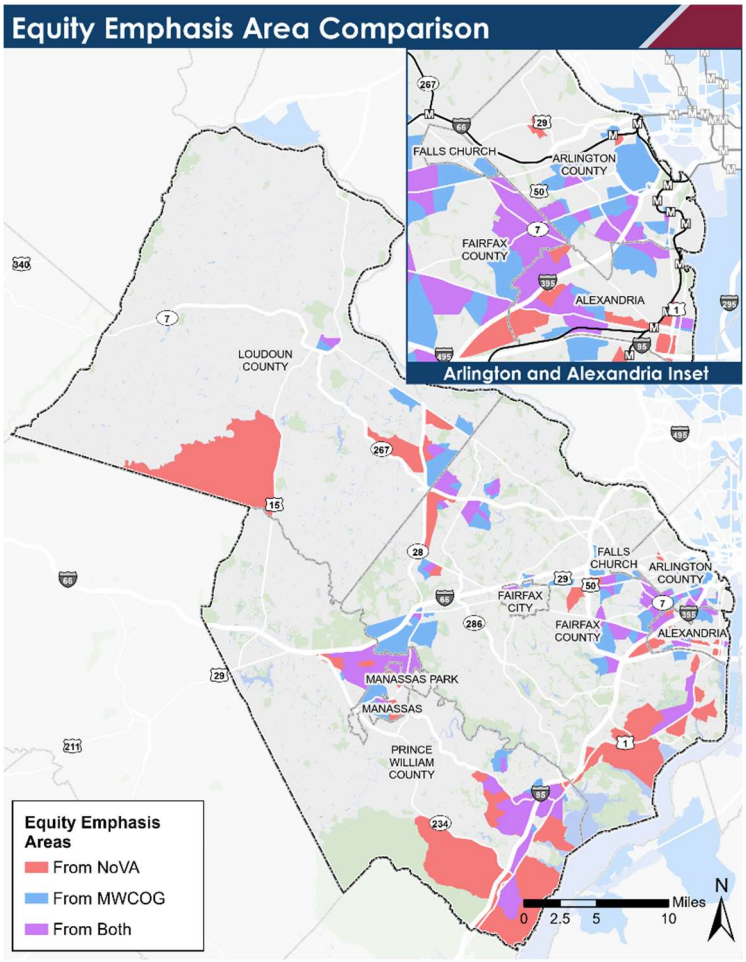
[4] For modeling purposes, the region is divided into a series of Traffic Analysis Zones (TAZs) that represent a specific geographic area.

C2. Access to jobs by car, transit, and bike by EEA Populations

This measure will be calculated in exactly the same way as Measure C1, except it will only be calculated for TAZs identified as being part of an Equity Emphasis Areas (EEA). As such, the regional measure will be calculated as the population-weighted average of the TAZ accessibility values only for EEA TAZs.

$$\frac{\sum Accessibility_{TAZ} * Population_{TAZ}}{Regional\ EEA\ Population}$$

EEAs will be defined as any TAZ that is defined as either an MWCOG regional EEA[5] or as a Northern Virginia Equity Area, as highlighted in Figure 2. Both were defined using similar methodologies with two significant differences:



1. 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.

2. The MWCOG EEAs were defined at the TAZ level, while the Northern Virginia EEAs were defined at the census tract level.

As shown in Figure 2, the results show that some locations were identified as an EEA in both definitions, while some areas were included only one or the other. To be inclusive of both definitions, while maintaining a focus on those areas with the most acute equity needs, TransAction will define EEAs as any TAZ that was defined as an MWCOG EEA or any TAZ for which 50 percent or more of the constituent census tracts were defined as a Northern Virginia EEA. The resulting areas that will be considered as part of this measure are shaded in Figure 3. This EEA definition covers approximately 32% of Northern Virginia's total current population, but more than 41 percent of the region's non-white population and more than 55 percent of the region's population living in poverty, as shown in Table 5Table 5: Percent of Regional Populations Covered by NVTA Equity Emphasis Areas.

[5] Equity Emphasis Areas (EEAs) are defined by MWCOG. https://www.mwcog.org/maps/map-listing/equity-emphasis-areas-eeas/

Figure 3: NVTA Equity Emphasis Areas for TransAction

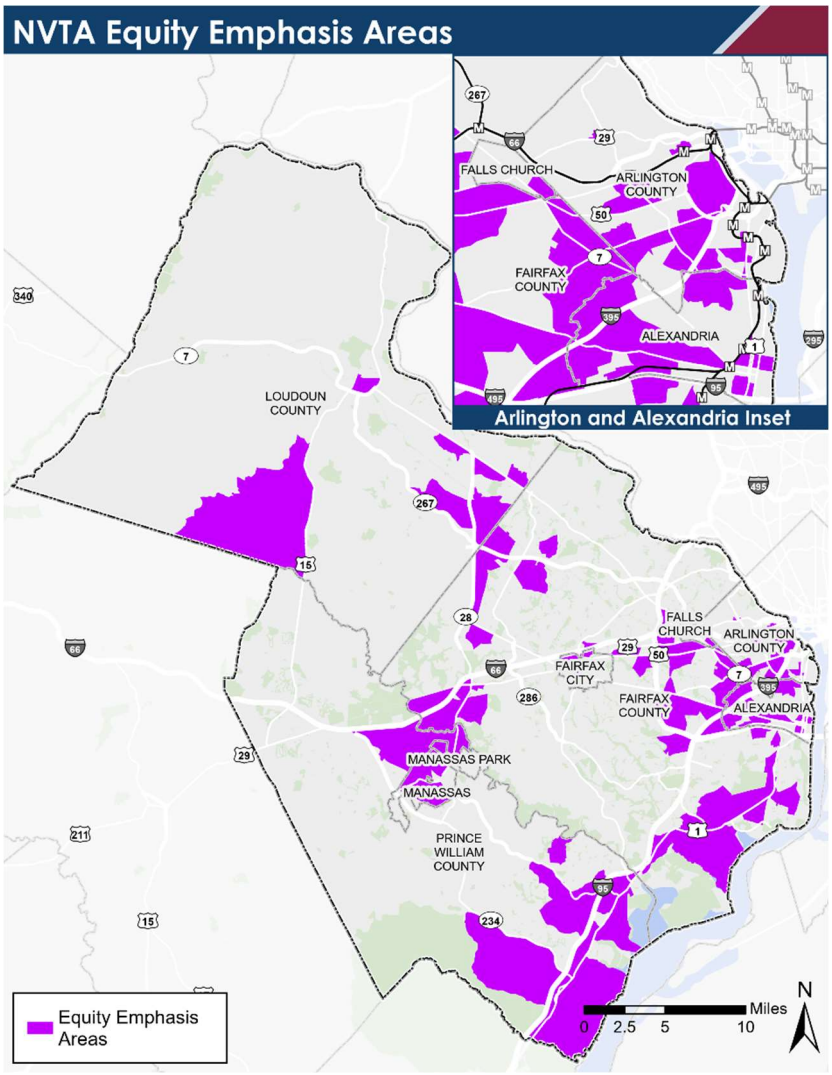


Table 5: Percent of Regional Populations Covered by NVTA Equity Emphasis Areas

Northern Virginia Regional Statistics	NVTA Equity Emphasis Areas
Total Population (2020)	31.7%
Total Population (2045)	32.6%
Non-White Population	41.9%
Population in Poverty	55.9%

D1. Quality of Access to Transit and the Walk/Bike Network

This measure will be qualitative, based on a definition of idealized conditions. Points (ranging from 0 to 4) will be allocated based on what percentage of these idealized amenities would be added as compared to the existing conditions. The idealized conditions envisioned by a score of four include:

Dense grid of arterial streets with wide sidewalks, crosswalks, pedestrian signals; bike lanes on most major arterials and bike sharing stations at frequent intervals; pick-up/drop-off locations for ridesharing/taxis; availability of shared micromobility (e.g. electric scooters); and transit circulator or shuttle bus routes connecting most activity locations and regional transit services, including park-and-ride lots; easy access to major transit stations.

The score will be awarded points ranging from 0 to 4, based on the approximate percentage of the listed features that are being added. For example, the installation of bike lanes, sidewalks and a circulator bus or microtransit service might be awarded a score of two points. The additional inclusion of grade-separated bike lanes and dedicated pick-up/drop-off locations could increase the score to three points. The points will then be weighted by the activity density (population and employment) within a half mile of the proposed improvements to calculate the score for this performance measure.

E1. Potential for Safety and Security Improvements

This measure will be based on the SmartScale safety analysis, which considers the potential for crash reduction in association with the number of current crashes to quantify the number of crashes that will be avoided. Because we do not have the data on the number of crashes at every location, this measure will look only at the potential for crash reduction through the lens of Crash Modification Factors (CMF). For this measure, each type of safety and security improvement will be assigned to a category based on the CMF identified by VDOT. A sample of the CMF factors is shown in Table 6 the full CMF list is incorporated as an appendix. Some additional project types have been added to the list below to incorporate the broader definition of safety being used in TransAction.

Table 6: Sample Categorization of Safety/Security Project Scores

High (3 points) CMF ≤ 0.33	Medium (2 points) 0.33 < CMF < 0.67	Low (1 point) CMF ≥ 0.67
Add new sidewalk	Add median	Addition of turn lanes
Convert stop/yield control to roundabout	Implement ramp metering	ITS for incident management, variable speed limits, ATM
Install pedestrian countdown timer	Adaptive signal control	Roadway widening
	Add bicycle lane	High Visibility Crosswalks
	Major transit projects that will significantly decrease VMT	Intersection lighting
		Transit projects that will have a smaller impact on VMT
		Improved lighting at transit stops

Where projects include multiple types of safety improvement, the points will be added together to calculate the project score. (CMFs should not be added, because lower CMFs are better.) For example, projects that add high-visibility crosswalks at three intersections would receive three points. Similarly, a project that added two miles of sidewalk would receive six points. This table can be revised if additional project types need to be included.

F1. Vehicle Emissions

Vehicle emissions will be approximated using Vehicle Miles Traveled (VMT) as a proxy. Total VMT by speed class will be calculated directly from the model. In the No-Build scenario, electrification assumptions will mirror the fleet mix on the ground today to a large extent. The following assumptions will be used:

- 4 percent of light-duty vehicles will be ZEV[6]
- 1 percent of buses will be ZEV[7]
- No heavy trucks will be ZEV

In the future Build network analyses, projects will be included that increase these electrification rates significantly.

Table 7 shows the CO_2 emissions rates for 16 different speed classes and two types of vehicles. For the purpose of calculating this metric, the change in CO2 emissions will be multiplying the VMT by the appropriate factor.

Table 7: Running CO_2 Emissions Rates (g/mile) by Speed

Speed (mph)	Light-Duty Vehicles	Buses	Trucks[8]
< 2.5	1,193.27	7,325.32	8,160.82
2.5 – 5	650.44	4,011.37	4,312.85
5 – 10	380.17	2,590.43	2,586.80
10- 15	297.07	2,142.19	2,163.03
15 – 20	248.23	1,885.14	1,874.54
20 - 25	220.00	1,727.80	1,708.10
25 – 30	203.51	1,681.17	1,660.44
30 – 35	198.06	1,434.48	1,430.85
35 – 40	193.92	1,390.28	1,379.48
40 – 45	190.17	1,354.12	1,336.62
45 - 50	184.58	1,325.92	1,273.75
50 – 55	179.37	1,302.15	1,214.71
55 - 60	175.76	1,286.11	1,195.29
60 – 65	176.88	1,355.77	1,245.24
65 – 70	181.83	1,421.19	1,290.19
> 70	189.88	1,500.28	1,362.54

Source: MWCOG/TPB Emissions Analysis for Fairfax County

[6] https://cleanairpartners.net/sites/default/files/SemaConnect%20-%20EVs%20in%20the%20DMV%20Region%20Final.pdf. Vehicle electrification rates vary by jurisdiction, but are higher closest to DC.

[7] Current bus fleet in Northern Virginia is approximately 58% diesel, 17% CNG, 1% Battery Electric, and 25% Diesel Hybrid.

[8] Assumes a truck fleet that is evenly split between single unit and combination trucks.

The total value of the performance measure will be the weighted sum of the non-ZEV VMT as shown below:

$$Emissions = \sum(VMT * Weight)$$

G1. Transportation System Redundancy

This measure is calculated from the model, by calculating the change in person-hours of travel resulting from a 10 percent increase in PM peak hour trip making. The PM peak hour is defined as the hour with the most trips being made in Northern Virginia, and equate to the 5-6 pm hour. This measure is essentially identifying if there is excess capacity in the transportation system by adding additional travel to the busiest hour on the network. In a network with more excess/redundant capacity, the amount of person-hours of travel will be lower than on a network with less redundancy.

TransAction Score Calculation Methodology

The final performance measures will be combined into a single TransAction Score by combining the scores for each individual measure with its assigned weight as follows:

$$TransAction\ Score = \sum PerformanceMeasure * Weight$$

The weights approved by the Authority in December 2021 are shown in Table 8.

Table 8: Performance Measures and Final Weights

Performance Measure	Weight
A1. Total Person-Hours of Delay in autos	10%
A2. Total Person-Hours of Delay on Transit	10%
B1. Duration of Severe Congestion	10%
B2. Transit person-miles in dedicated/priority ROW	10%
C1. Access to jobs by car, transit, and bike	10%
C2. Access to jobs by car, transit, and bike for EEA populations	10%
D1. Quality of access to transit and the walk/bike network	15%
E1. Potential for safety and security improvements	10%
F1. Vehicle Emissions	10%
G1. Transportation System Redundancy	5%

Appendix: Crash Mitigation Factors

Based on the following Crash Mitigation Factors used by SMARTSCALE, the following CMF categories will be applied to Measure E1. Should additional project types be proposed that are not explicitly included in this list, appropriate categories will be added that are consistent with the potential safety benefits.

Project Extent	Improvement Type/Features	Crash Mitigation Category
Intersection	Convert stop control to yield control (when warranted)	Med
	Convert stop/yield control to signal	Med
	Convert stop/yield control to roundabout	High
	Convert signal to roundabout	Med
	Convert two-way stop control to unsignalized RCUT	Med
	Convert signal control to signalized RCUT	Med
	Convert signal control to continuous green T signal	Low
	Displaced left turn intersection	Low
	Median U-turn intersection	Low
	Convert pedestal to mast arm	Med
	Enhanced signal conspicuity	Low
	Convert unsignalized intersection warning beacons from static to dynamic	Low
	Install conflict warning system – 4-lane at 2-lane intersection	Low
	Install conflict warning system – 2-lane at 2-lane intersection	Low
	New turn lane (none present)	Low
	Add turn lane (to existing)	Low
	Extend turn lane	Low
	Median acceleration lane	Low
	Add median or close median opening (convert to right-in/right-out)	Med
	Increase intersection radii	Low
Interchange	At-grade to new interchange	Med
	Convert stop-control diamond interchange to DDI	High
	Convert signalized diamond interchange to DDI	Med
	Convert diamond interchange to SPUI	Med
	Change loop ramp to flyover ramp	Volume-based
	Non-freeway: replace arterial turns with loops or directional ramps	Med
	Add freeway collector-distributor roads	Low
	Add freeway independent loop or directional ramp entrances	Low
	Extend ramp acceleration lane length	Function

	Add entrance ramp lane (1 to 2 lanes)	Low
	Add exit ramp lane (1 to 2 lanes)	Low
	Extend ramp deceleration lane length 250-500 ft up to 700 ft in total length	Low
	Implement ramp metering	Med
Bridge	Widen shoulders	Low
Freeway Segment	ITS for incident management	Low
	ITS for ATM	Low
	ITS for variable speed limits	Low
	Add auxiliary lanes between ramps	Low
	Directional widening 2 to 3 lanes – Rural	Low
	Directional widening 2 to 3 lanes – Urban	Low
	Directional widening 2 to 4+ lanes – Urban	Low
	Directional widening 3 to 4+ lanes – Urban	Low
Non-Freeway Segment	Adaptive signal control – Urban Intersection – 3-leg intersection	Med
	Adaptive signal control – Urban Intersection – 4-leg intersection	Med
	Adaptive signal control – Suburban Intersection	Low
	Signal retiming/optimization	Low
	ITS for Advanced Traffic Management (ATM)	Low
	Close driveway	Low
	Widen shoulder	function
	Provide median (right-in/right-out only)	Med
	Alignment reconstruction	Low
	Convert two-way road to one-way road	Med
	Addition of two-way left turn lane (four to five lane conversion)	Med
	Addition of two-way left turn lane (two to three lane conversion)	Low
	Pavement re-utilization (road diet)	Med
	Widen 2-lane to multilane divided – Rural	Low
	Widen 2-lane to 4-lane divided – Urban	Low
	Widen 2-lane to 6-lane divided – Urban	Low
	Widen 4-lane to 6+-lane divided – Urban	Low
	Widen travel lanes – Rural	Function
	Widen travel lanes – Urban	Function
	Add or widen shoulder	Function
Roadway Segmen	Install centerline rumble strips	Med
	Install edge rumble strips	Med
	Install truck climbing lane	Med

	Improve Roadside Hazard Rating (RHR)	function
Ped & Pike	Add new sidewalk (does not apply to sidewalk upgrades or widening)	High
	Add bicycle lane	Med
	Add shared-use path of mixed-use trail	High
	Add high-visibility crosswalk (new crosswalk or crosswalk upgrade)	Low
	Install countdown pedestrian timer	High
	Install leading pedestrian interval (LPI)	Med
	Install HAWK	Med
	Install RRFB	Med
Lighting	Install lighting at intersection	Low
	Install lighting at interchange	Low
	Install lighting on segment	Low
Transit	Install lighting at transit stops	Low
	Major transit projects that will significantly decrease VMT	Med
	Smaller transit projects that will have a smaller impact on VMT	Low