Existing Conditions

Technical Report

January 2023

CONTENTS

Overview

As part of the Better Bus Network Redesign (BBNR) process, it is important to have a firm understanding of which current bus lines are providing current customers with a useful, efficient, and reliable service—as well as where service could be improved based on availability, design, performance, and efficiency across the system. This report provides a high-level overview of the existing conditions assessment. The assessment of existing service will also be used **to understand where transit does not provide a reasonable option for certain trips, where there are gaps in service across the region, and to check if service levels and existing connections are sufficient to serve the needs of the community or if more (or less) service is warranted.**

This report evaluates all aspects of the existing bus service, using Metrobus' Service Guidelines, to answer questions about what parts of the current service could be improved, added to, or altered to improve ridership, operations, reliability, equity, or other needs. While the BBNR is looking holistically at where and how much bus service to provide, the redesigned networks will aim to keep the parts of the system that are working well for customers today.

Looking at how bus service is performing today is an important input to developing comprehensive network service recommendations. Metro evaluated a variety of factors and metrics for current lines and routes to determine where, when, and how bus service should be improved. This evaluation of existing service will then be used to accomplish the following:

- Design two comprehensive bus networks for the region:
  - A constrained network that can be implemented in FY2025 using the same level of resources as the current bus network but better matches existing demand for transit service.
  - A visionary network that creates a great bus system for the region to make bus the mode of choice, that could be implemented as soon as more resources are available.
- Identify areas that would benefit from enhanced transit infrastructure to support increased reliability across the system.

This analysis was conducted in coordination with an assessment of markets for transit in the region to highlight where service and demand are not properly aligned. Together, these assessments will provide an overview of the ways in which bus service can be improved in our region to better serve customers.

Introduction to Metrobus

Metrobus is a regional bus system that operates across eight different jurisdictions within two states and the District of Columbia. It is composed of a network of 132 lines that interact with both Metrorail and other service providers, both local and commuter services, to create a comprehensive transit network. Each line is composed of one to five routes (for a total of 189 routes), which typically share much of their alignment and main destinations. Metro currently operates five different types of services: Bus Rapid Transit, Framework, Coverage, Commuter and Gap services (**Figure 1**). Each service type is associated with specific design standards and productivity, reliability and cost-efficient performance metrics, as defined in the 2020 Metrobus Bus Service Guidelines. **Table 1** provides an overview of the number of Metrobus lines by classification and state.

Figure 1: Metro Service Type Definitions

Table 1: Lines by Classification

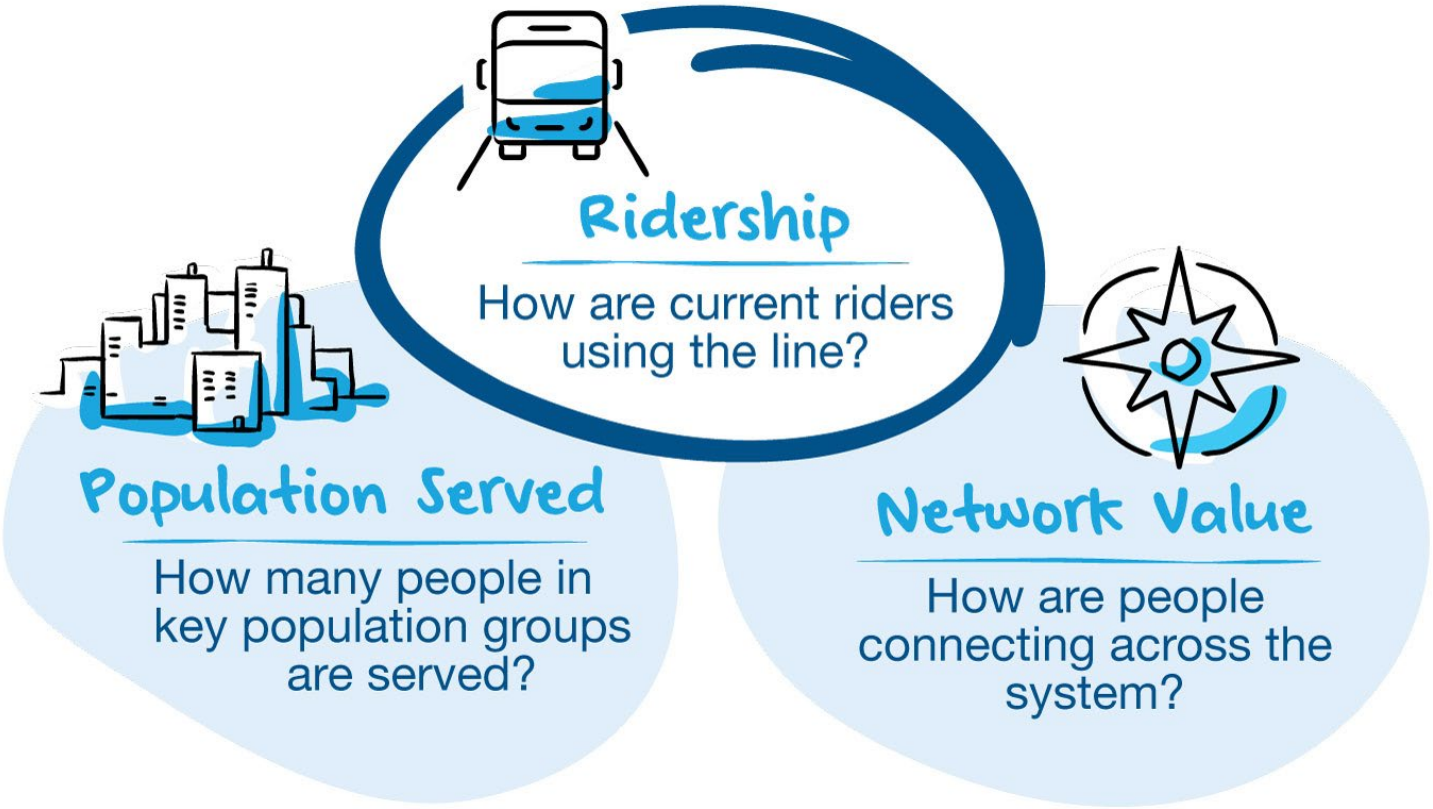
Classification	DC	Maryland	Virginia	Total
BRT	--	--	1	**1**
Framework	27	21	16	**64**
Coverage	20	19	3	**42**
Commuter	1	5	12	**18**
Gap	6	--	1	**7**
Total	**54**	**45**	**33**	**132**

Existing Service Assessment

Which Metrobus lines provide the most benefits to the region overall?

To understand the overall benefit each line provides to the transit network, the Line Benefit Score (LBS) was developed to quantify a bus line's relative contribution to the overall bus network based on ridership, demographics, and network value[1] (**Figure 2**). The LBS is calculated differently for each service classification since they fulfill different roles in the transit network. It is designed to provide a comprehensive understanding of the value of Metrobus lines when making decisions about where to add, adjust or remove service. For example, lines with a higher LBS may be a focus for increased or optimized service, while those performing poorly in one or more components of the LBS would be a focus for improvement during the redesign process.

Figure 2: Line Benefit Score Components[2]



Lines with high LBS values primarily operate and/or connect into Downtown DC, with the 14th Street Line (52, 54) and the Georgia Avenue-7th Street Line (70) receiving the highest score, scoring highly on all three components but especially the ridership and population served scores. Lines with lower LBS scores typically

[1] The value of the line to the network acknowledges that each bus line doesn't stand alone, bus services provide a critical element of transportation by enhancing connections to and throughout the overall transit network. This component includes three subcomponents: transfers, unique access for people, and access to destinations.
[2] All three components of the line benefit score are weighted equally.

serve more suburban areas in Virginia and Maryland. **Figure 3** shows all Metrobus lines in the region with their line benefit scores; the ***top 10 LBS scoring lines are labeled***. Higher scoring LBS lines may be prioritized for enhanced service when considered in conjunction with the other analyses conducted, including the Market Assessment. In general, lines that have lower LBS tend to perform lower in the ridership or network value metrics. The majority of the lower scoring lines operate in Prince George's County and are mainly Coverage services. In Virginia, the two lowest performing services are Commuter lines. As part of the service planning process, these lines will be considered for adjustments to make them more valuable to the network as a whole and to increase productivity.

Figure 3: Line Benefit Score

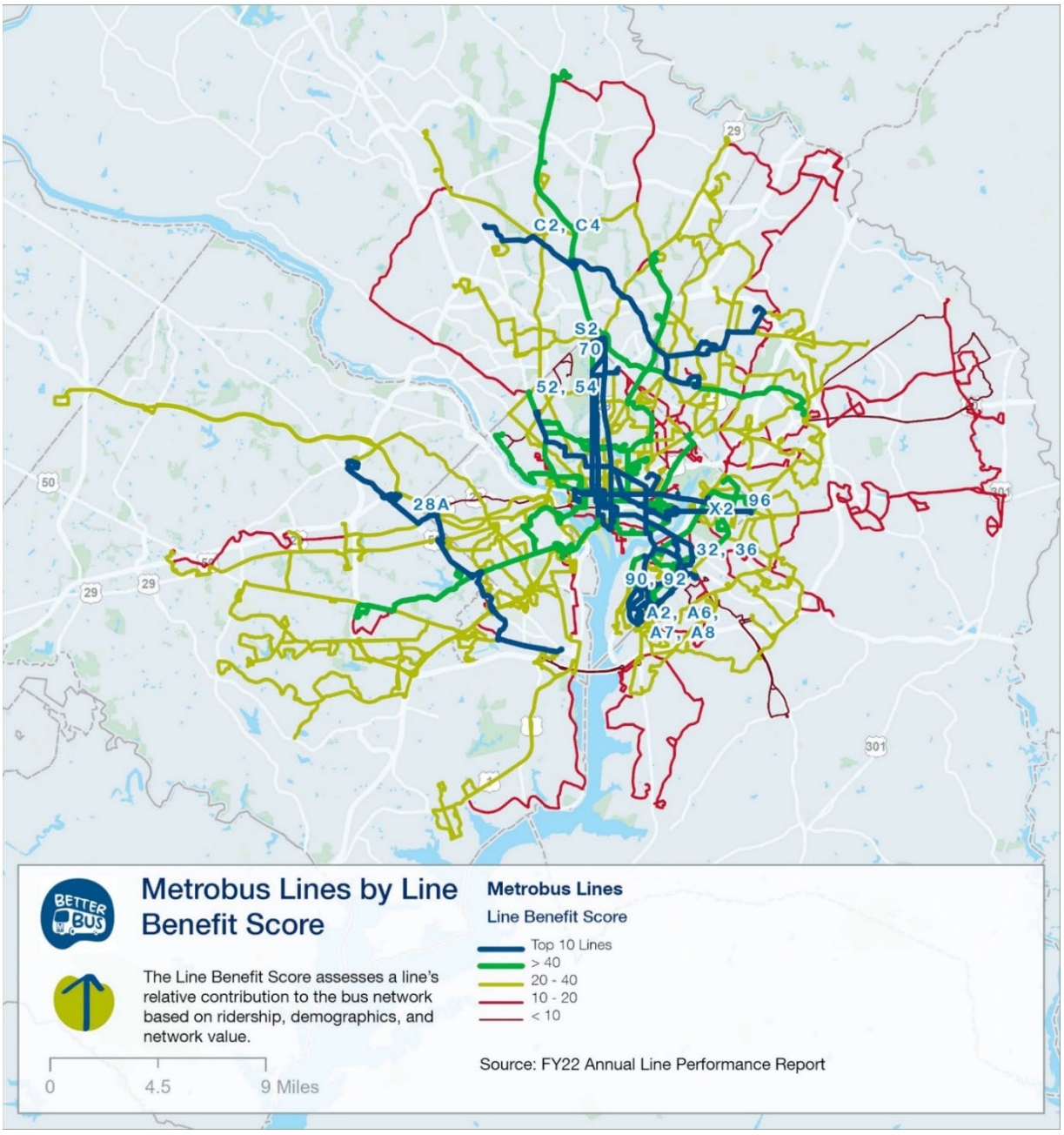
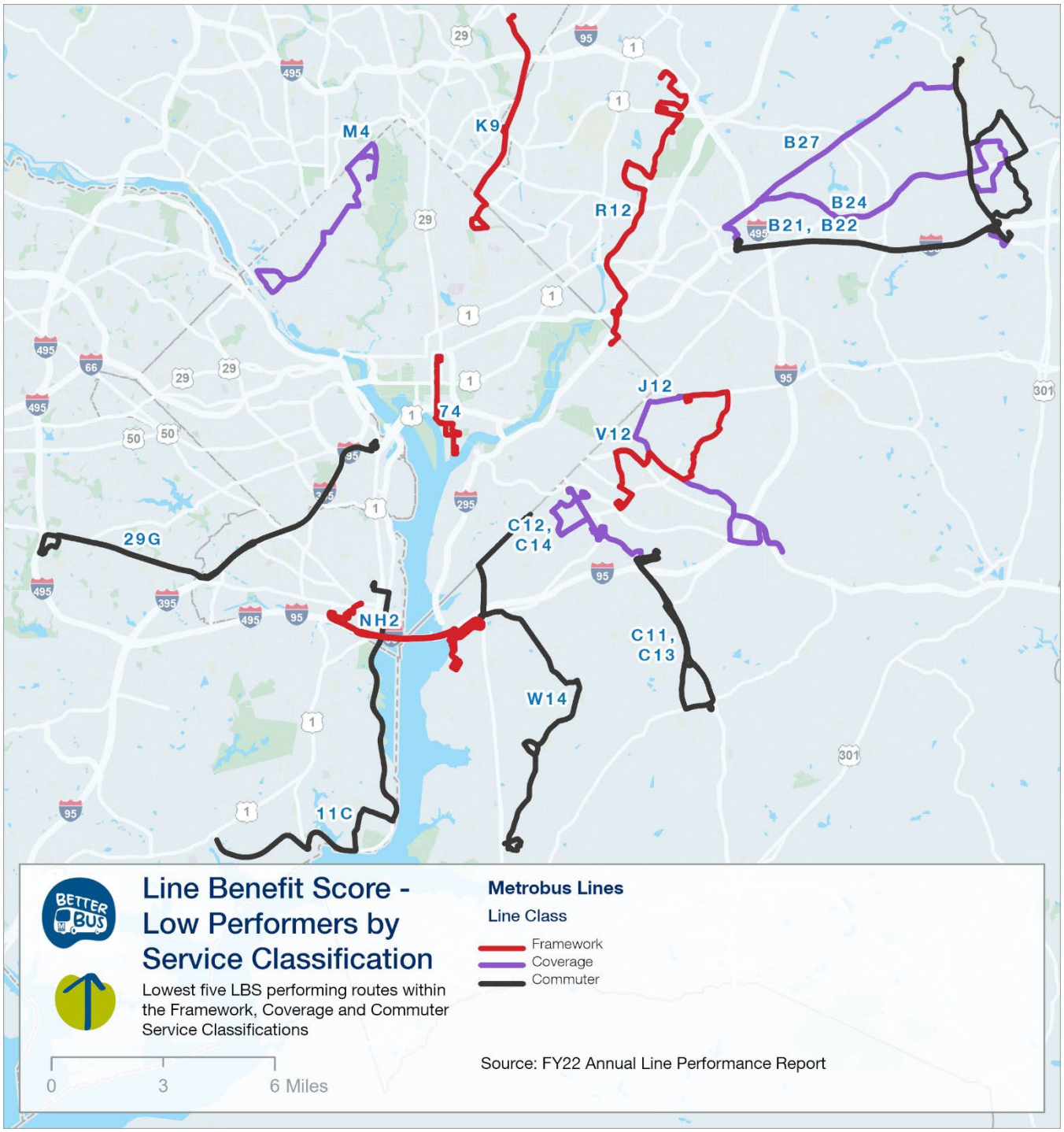


Figure 4: Line Benefit Score – Low LBS by Service Classification



How has bus travel changed post-pandemic?

Ridership recovery on Metrobus—comparing FY 2019 to FY 2022 ridership—has been strongest in Maryland post-pandemic, recovering by almost 71 percent. DC still carries the majority of ridership and has recovered almost 67 percent of its ridership, and Virginia follows with a 58 percent recovery rate.

Ridership has recovered differently across service classifications and time of day (**Table 2**). Understanding recovery trends is an important component to designing a bus network that meets the needs of post-pandemic travel patterns, whether by time of day of travel or changing locations. Weekday off-peak recovery has been stronger for all service classifications and has been strongest in Maryland. In general, Framework lines have recovered the most ridership post-pandemic, while commuter services are still struggling to return to normal.

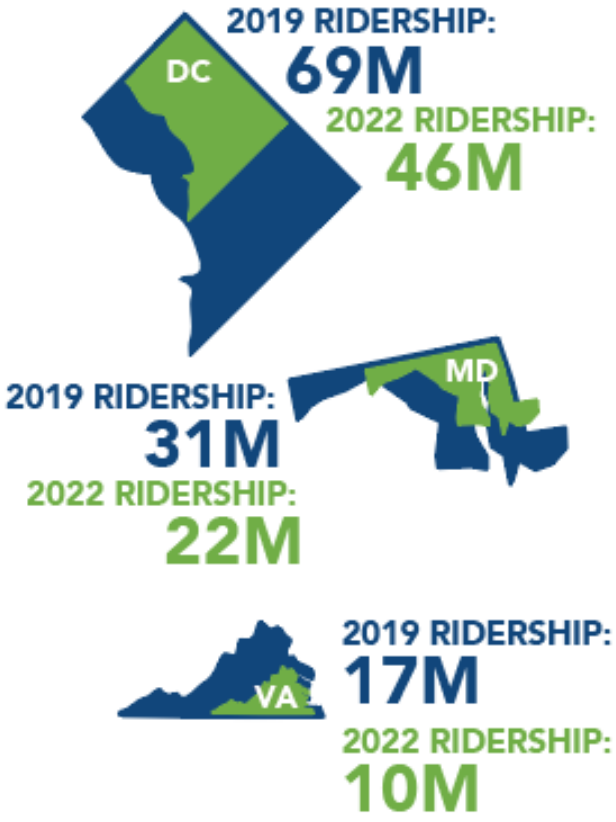
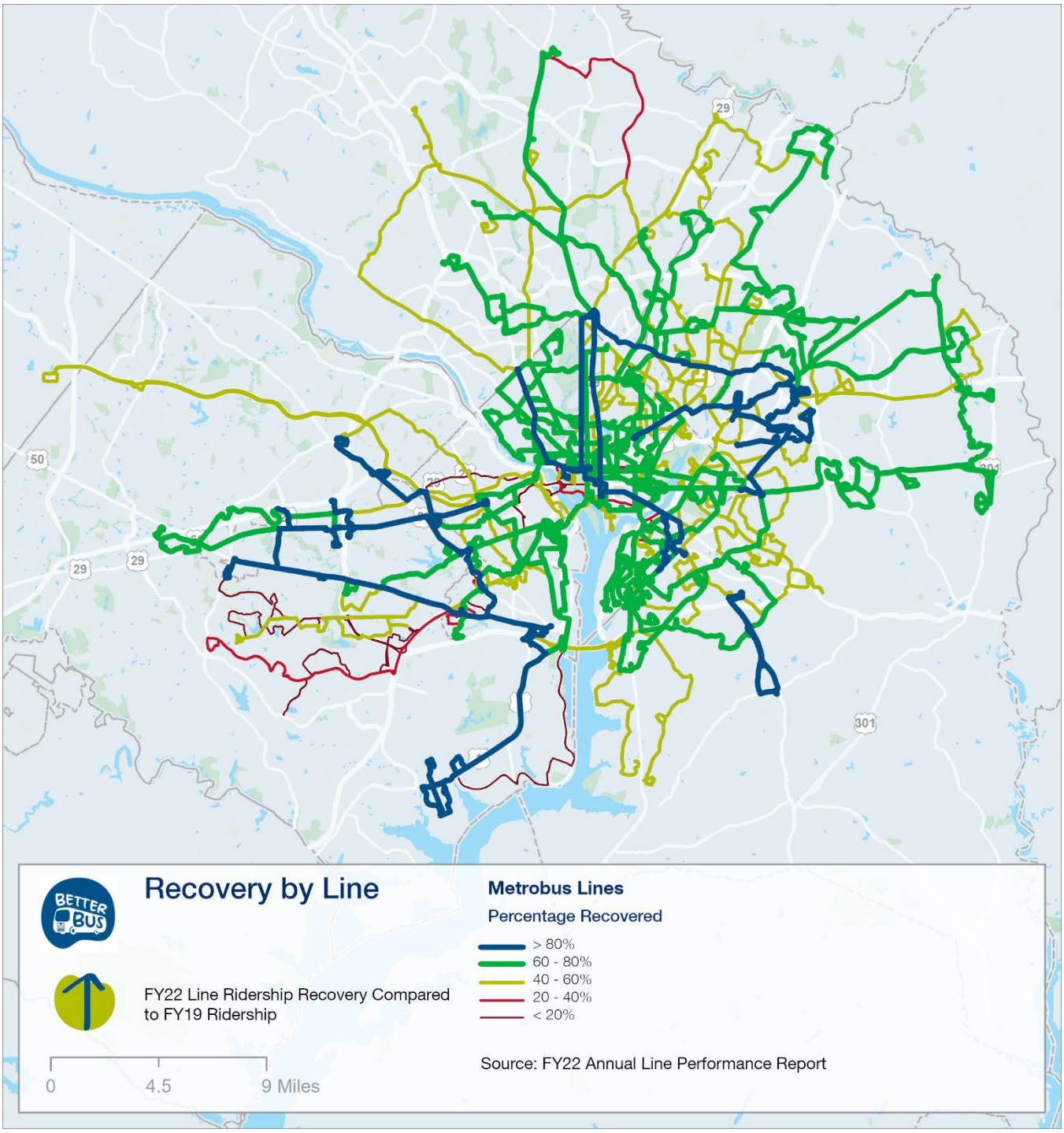


Table 2: Weekday Ridership Recovery

Service Classification	Weekday		Weekend
	Peak	Off-Peak	
BRT	30%	55%	71%
Framework	62%	71%	75%
Coverage	55%	61%	63%
Commuter	11%	23%	55%

Over 50 percent of lines have recovered at least 60 percent of their pre-pandemic ridership, and 14 percent have recovered more than 80 percent of their pre-pandemic ridership. **Figure 5** illustrates ridership recovery by Metrobus line across the region. Lines with higher ridership recovery tend to be oriented around Downtown DC. The Frequent Service Network, composed of buses scheduled every 12 or 20 minutes, outperforms other services with a ridership recovery of 74 percent compared to 54 percent of other services. Weekend ridership has also recovered at a faster rate than weekday, at 74 percent and 63 percent, respectively.

Figure 5: Ridership Recovery by Line



How does the bus system interact with the Metrorail system?

Metrorail is an important part of the region's transit network and works hand-in-hand with the bus network. Understanding how customers interact with these elements of the transit system can help identify places where bus-to-rail transfers need to be examined and/or new connections between bus and rail need to be made. Transfers between Metrobus and Metrorail happen most often on Framework services, which are typically comprised of higher-frequency services on major corridors.

Framework services account for over 80 percent of all Metrobus to Metrorail transfers in the region. Coverage services also provide a significant number of transfers to Metrorail, accounting for just over 15 percent. Coverage services often act as neighborhood "feeder" services to both Framework services and Metrorail and therefore are an important component of the regional transit network.

The 14th Street Line (52, 54) sees the most daily transfers to the stations it serves, which include stations on all Metrorail lines (**Figure 6**). It is followed by the Wisconsin Avenue Line (31, 33), whose station connections enable passengers to transfer to and from the Metrorail Red, Blue, Orange, and Silver Lines. They are followed by the New Hampshire Ave-Maryland Line (K6) which has the highest number of weekday transfers for a single route in the entire Metrobus system, all of which occur at Fort Totten station. Only Route 33, in the aforementioned Wisconsin Avenue Line, and the Leesburg Pike Line (28A) outperform it in weekend transfers.

Some Metrobus lines provide similar connections to Metrorail while others operate services that are independent of Metrorail. To investigate the relationship between each line and the Metrorail system, the overlap of each Metrobus line's service area was compared with Metrorail stations[3]. The average overlap for a Metrobus line is 25 percent. **Figure 7** visualizes Metrobus lines with more than 70 percent overlap with Metrorail service. The Ballston Farragut Square Line (38B), which parallels the Orange and Silver Lines and provides a crucial connection to Georgetown, has the highest overlap at 86 percent. It is followed by the Anacostia-Eckington Line (P6) at 85 percent, which partially parallels the Green Line, while also making crucial connections to all other Metrorail Lines, especially the Red Line. The Convention Center-Southwest Waterfront Line (74) similarly parallels the Green Line and has an 84 percent overlap with the Metrorail service area.

[3] Metrobus service area is calculated as 1/4-mile from any bus stop. Metrorail service area is calculated as ½-mile from any station.

Figure 6: Top Lines with Transfers to Metrorail (Weekdays)

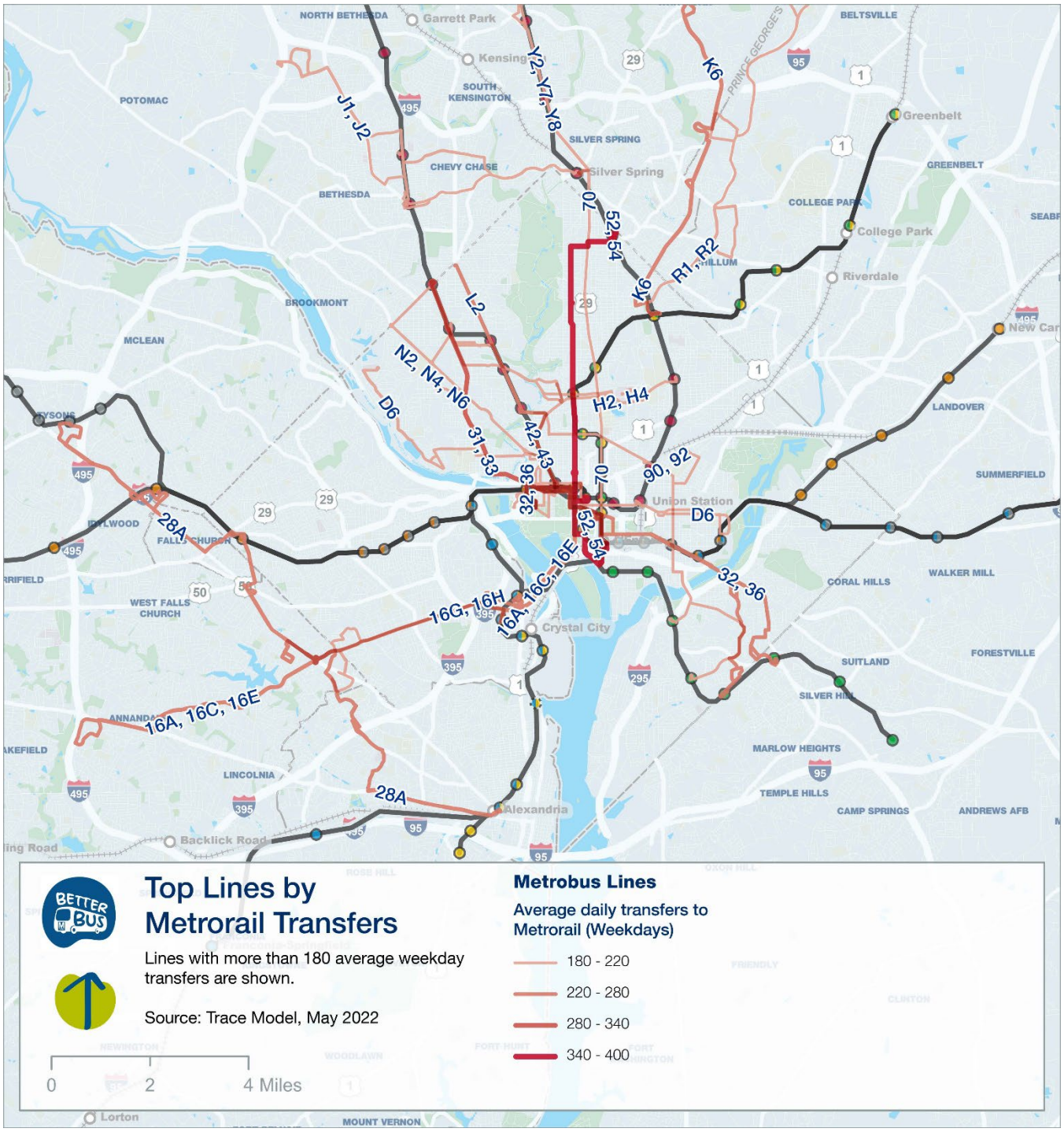
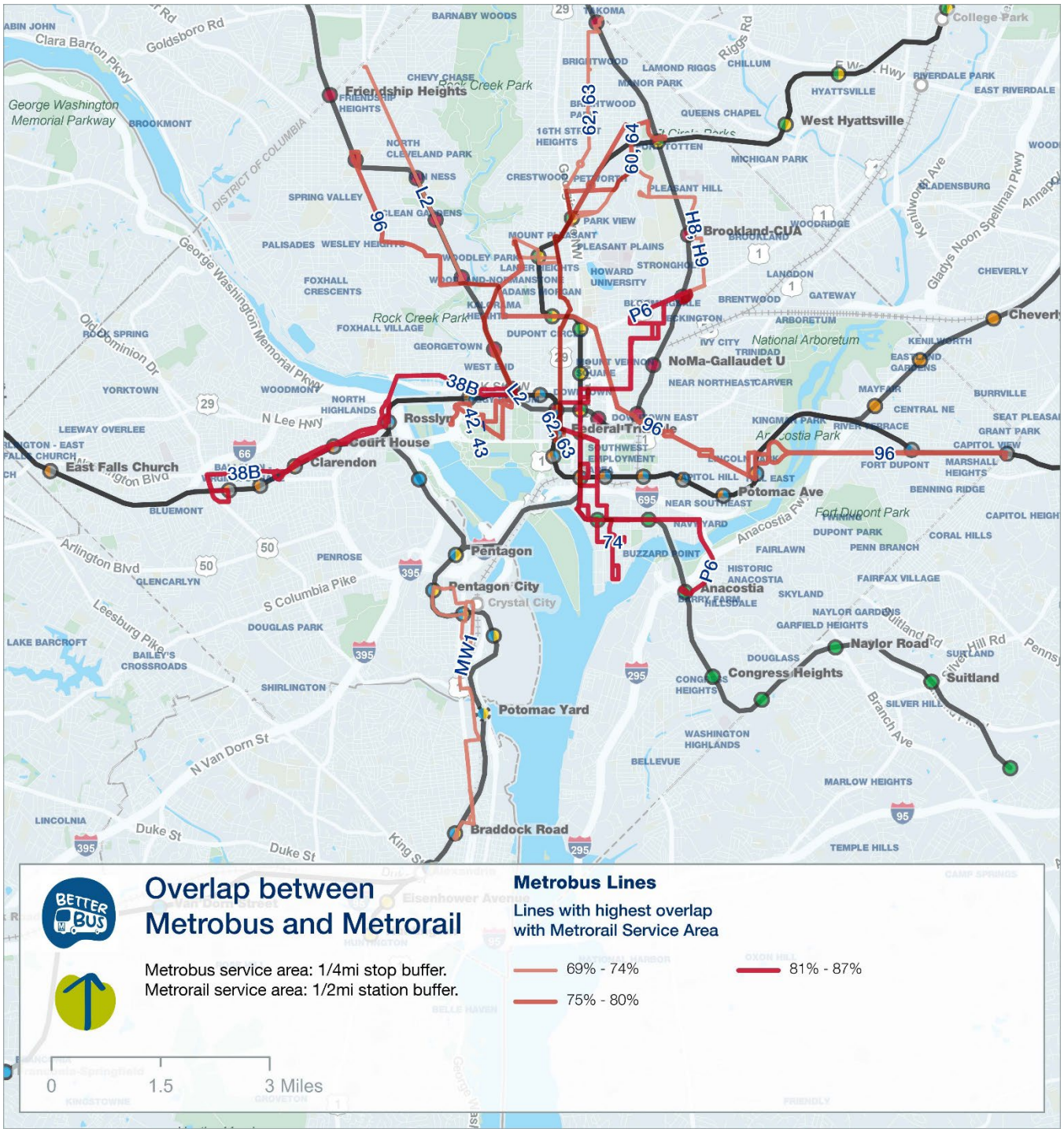


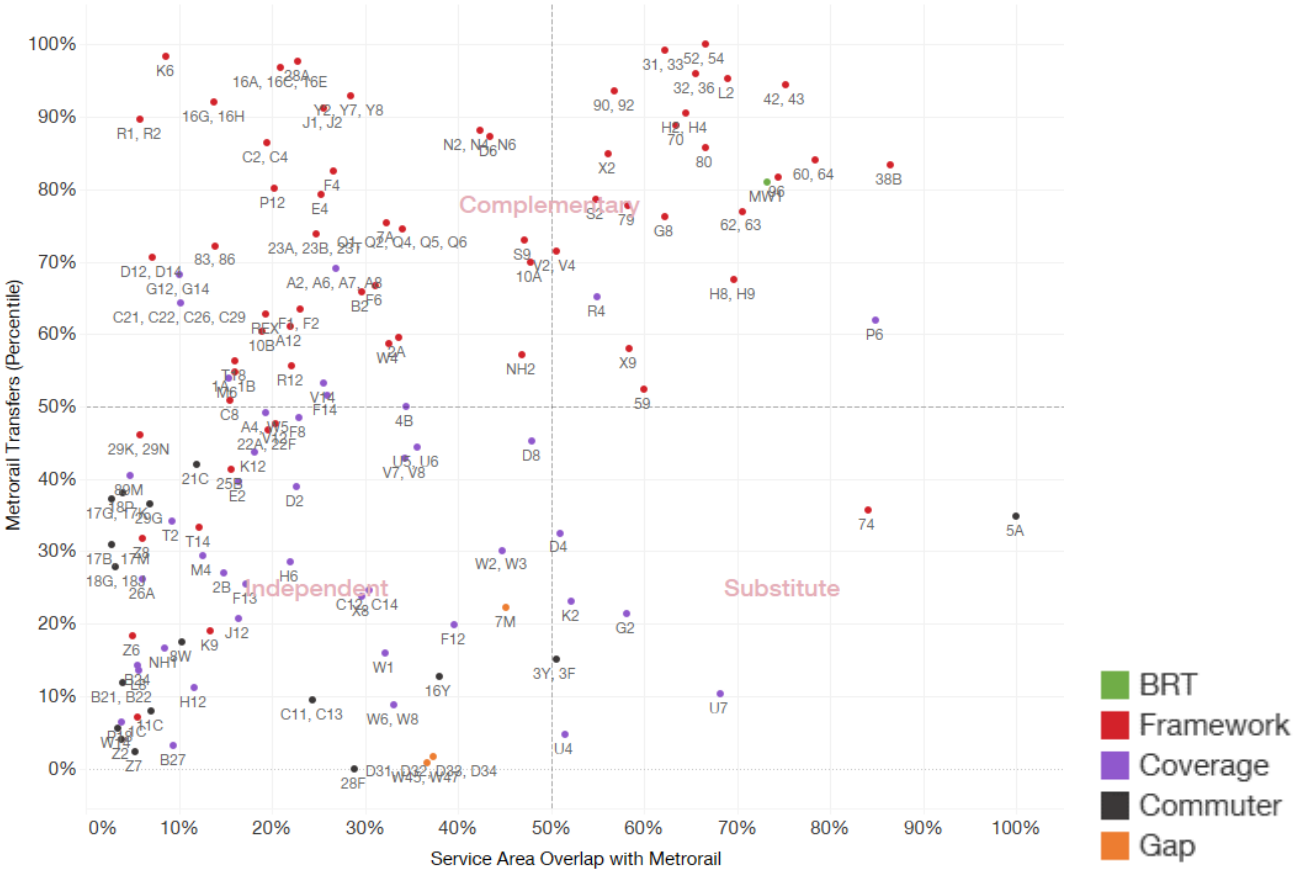
Figure 7: Metrobus Lines with More than 70 Percent Overlap with Metrorail Service



Comparing each line's volume of transfers to Metrorail with the overlap of the same line's service area with Metrorail's yields noteworthy results. **Figure 8** visualizes the two metrics (with transfers shown by overall percentile, for example the 14th Street Line (52, 54) has the highest number of transfers to Metrorail overall),

with the quadrants roughly identifying where lines are complementary, substitutive, or independent of Metrorail service. The two measures are largely independent of each other, and high transfer volumes are more likely to occur on Framework services, regardless of how much they overlap with the Metrorail system. Framework services, with the addition of the Metroway BRT, have the highest transfer volumes but are relatively spread out in terms of their percent overlap with Metrorail service area. Lines that substitute Metrorail are few, as seen in the relative sparsity of the bottom-right quadrant.

Figure 8: Metrobus Lines Classified by Relationship to Metrorail



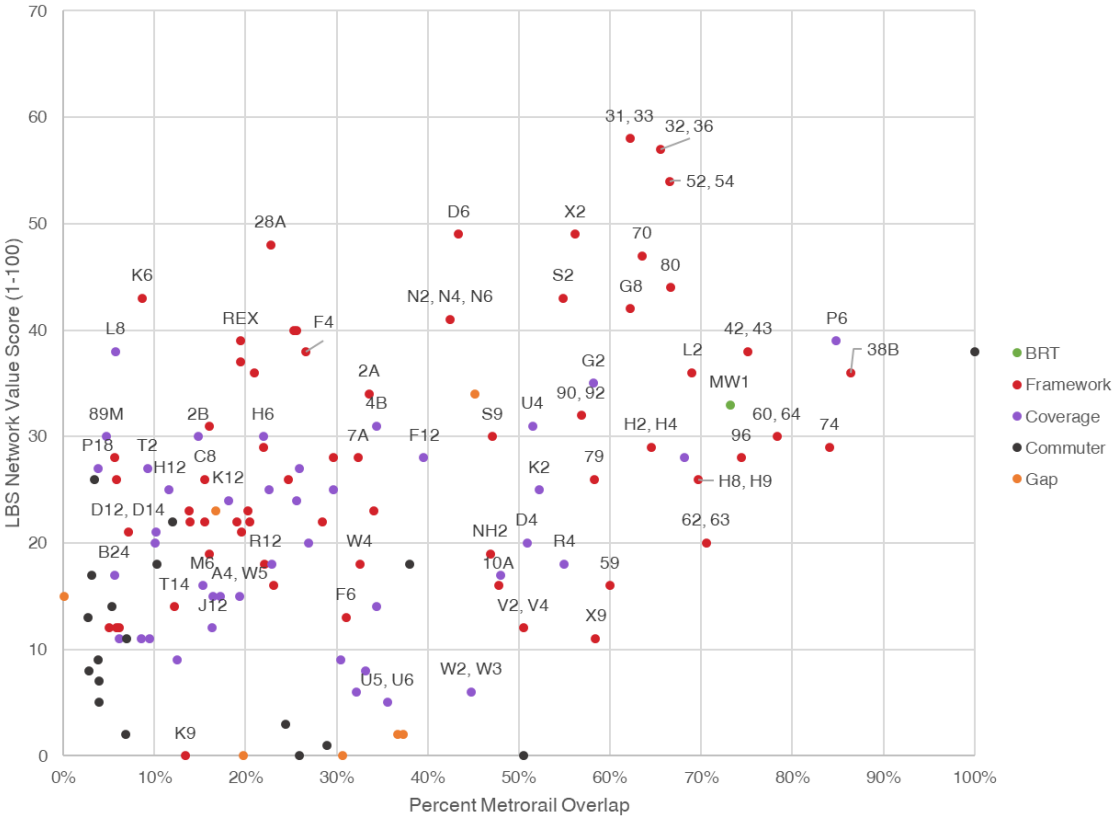
Comparing each line's Network Value score (a component of the Line Benefit Score) with the overlap of the same line's service area with Metrorail's yields noteworthy results (**Figure 9**). Lines with higher percentages of overlap with Metrorail tend to have higher Network Value scores meaning that they have a higher transfer rate, access to more jobs, and more unique ridership segments that benefit the network overall. This analysis demonstrates that the Metrobus network does a good job of complementing the Metrorail network and serving customers' needs in addition to Metrorail instead of in competition with Metrorail. On many lines, the Metrobus network provides valuable feeder service to Metrorail despite having significant overlap. This is particularly evident on Framework lines such as 14th Street (52, 54), Wisconsin Avenue (31, 33), Pennsylvania Avenue (32, 36), and H Street/Benning Road (X2).

Lines with high Network Value scores and low overlap with Metrorail are also noteworthy as these lines are beneficial to the network as either feeders to Metrorail or direct connectors to major employment sites. This

includes important crosstown lines like Leesburg Pike (28A) and suburban routes like Richmond Highway Express (REX) and New Hampshire Avenue - Maryland (K6) that feed Metrorail from outlying suburban corridors. Additionally, lines with low Network Value scores and high overlap with Metrorail could be identified as candidates for service realignments, particularly if they are not Coverage routes that are feeding Metrorail or Framework routes from equity-focused communities.

The insights of this analysis into the relationships that Metrobus lines have to Metrorail will inform the redesign effort. The redesign will maintain and strengthen the Framework connections to Metrorail, which not only provides riders with frequent bus service on major urban corridors but also increases access by connecting people to Metrorail stations. The redesign will also identify new connections to Metrorail and consider ways in which Metrobus service can be complementary to Metrorail temporally, providing late night connections outside of Metrorail's operating hours.

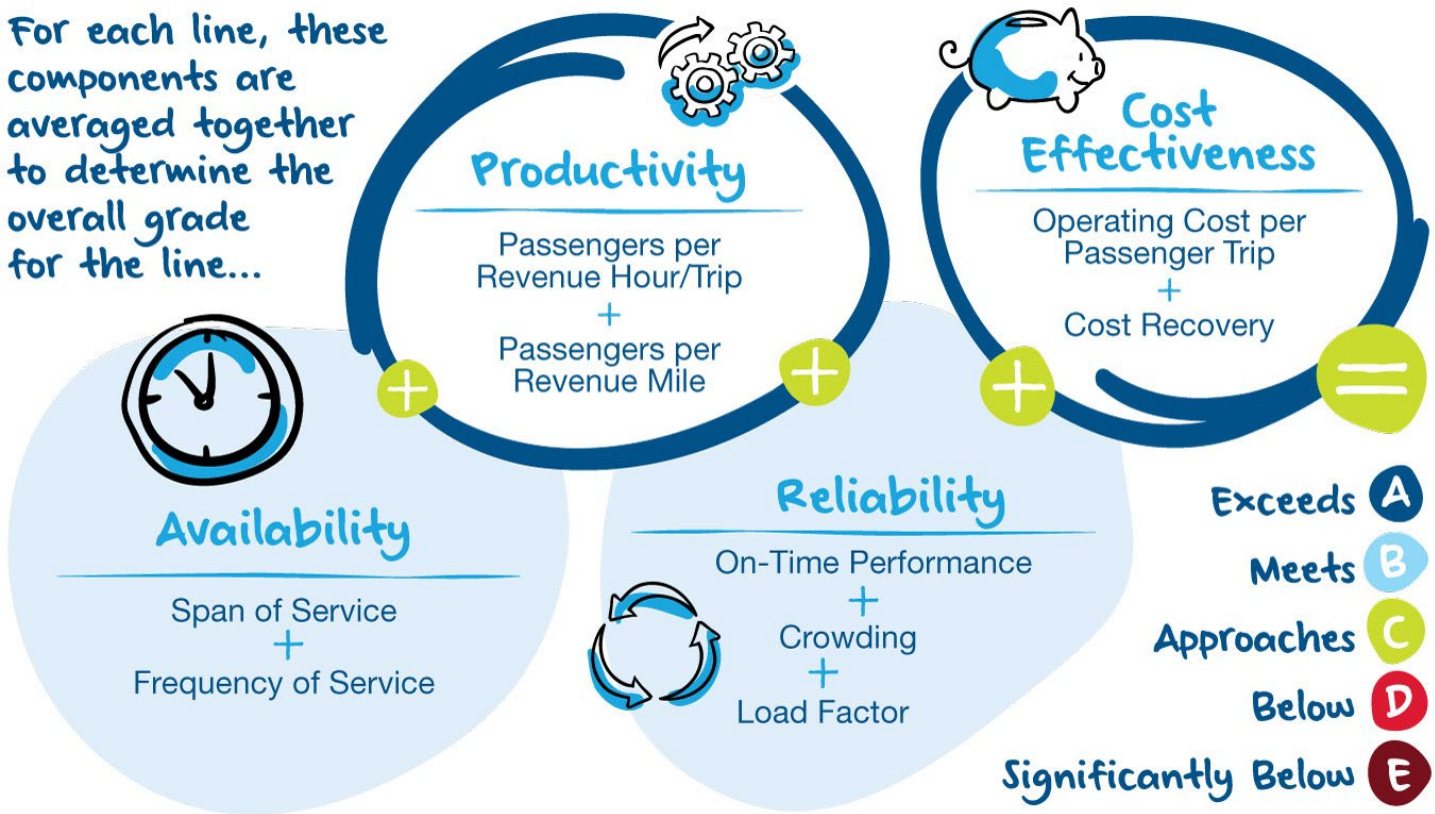
Figure 9: Line Benefit Score – Comparison between Network Value and Metrorail Overlap



What service is working well, and where does it need to improve?

Each line has been assigned an overall grade as a way of evaluating and measuring its level of service and performance against the service standards established by the 2020 Metrobus Bus Service Guidelines. A grade is assigned based on the extent to which the line meets the standards set forth in the Service Guidelines across various metrics, specifically availability of service, productivity, reliability, and cost efficiency (**Figure 10**). The lines receive a "B" if they are meeting the appropriate standards, an "A" if they exceed them, and if they fall short, they will receive a "C", "D", or "E" based on how far they are from reaching the standard.

Figure 10: Line Grade Components



Across the region, most of the lines meeting or exceeding the standards operate primarily in DC or Maryland (**Figure 11**), while a significant portion of lines scoring "D" or "E"—well below their standards—operate primarily in Virginia. **Figure 12** provides an overview by state of the total number of lines with each grade.

Over 60 percent of the coverage lines meet or exceed service standards (**Figure 13**). However, only 40 percent of the Framework lines meet or exceed service standards, despite having higher overall value to the network by LBS, 40 percent of Framework lines with an LBS greater than 50 fail to meet service standard. These lines in particular can be a focus for optimization during the redesign. This information will assist in determining which types of services continue to make sense throughout the region, what levels of service continue to be successful and if new service types need to be considered to meet the demands of the community.

Figure 11: Line Grades

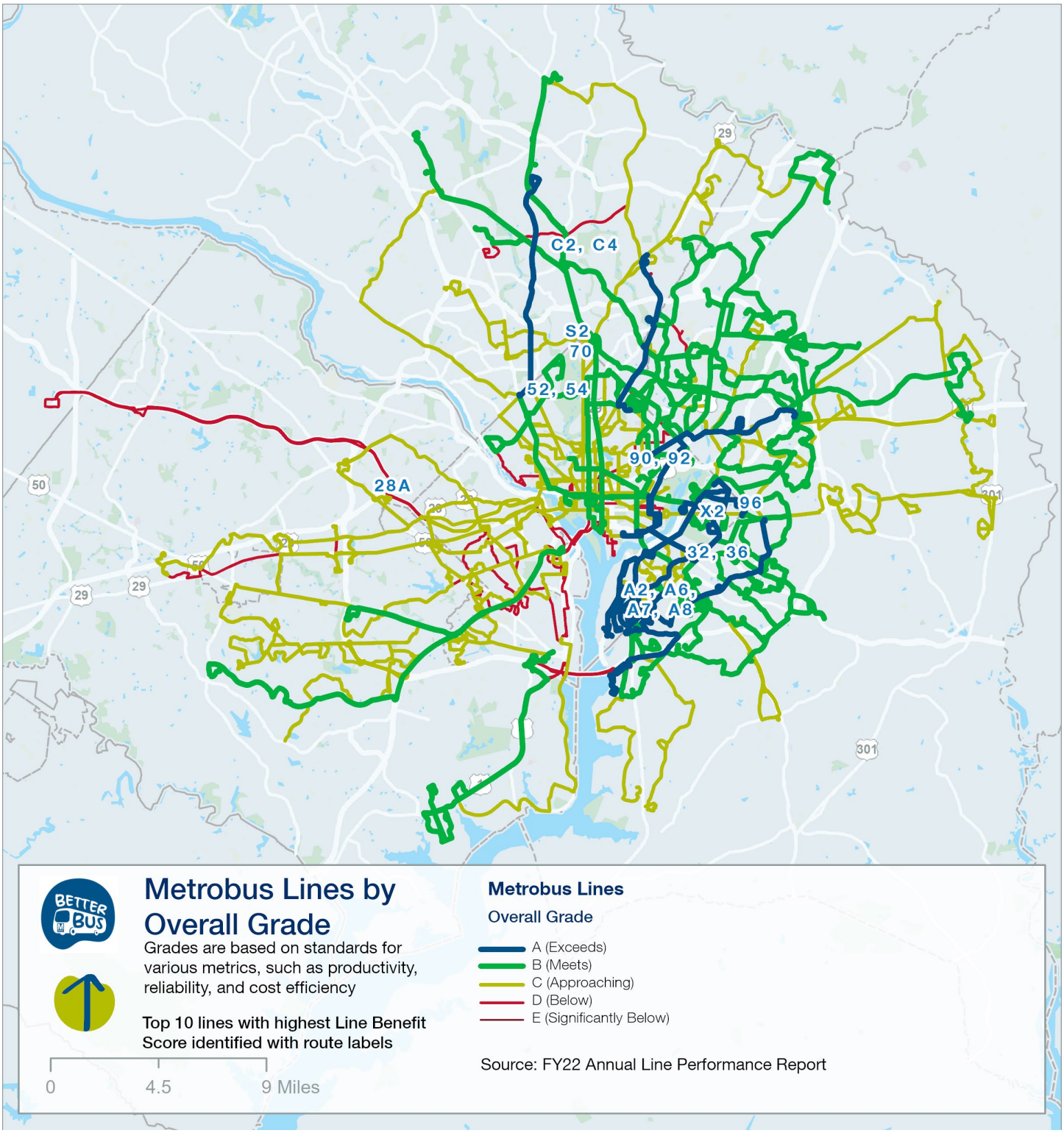


Figure 12: Line Grades - Grades by State

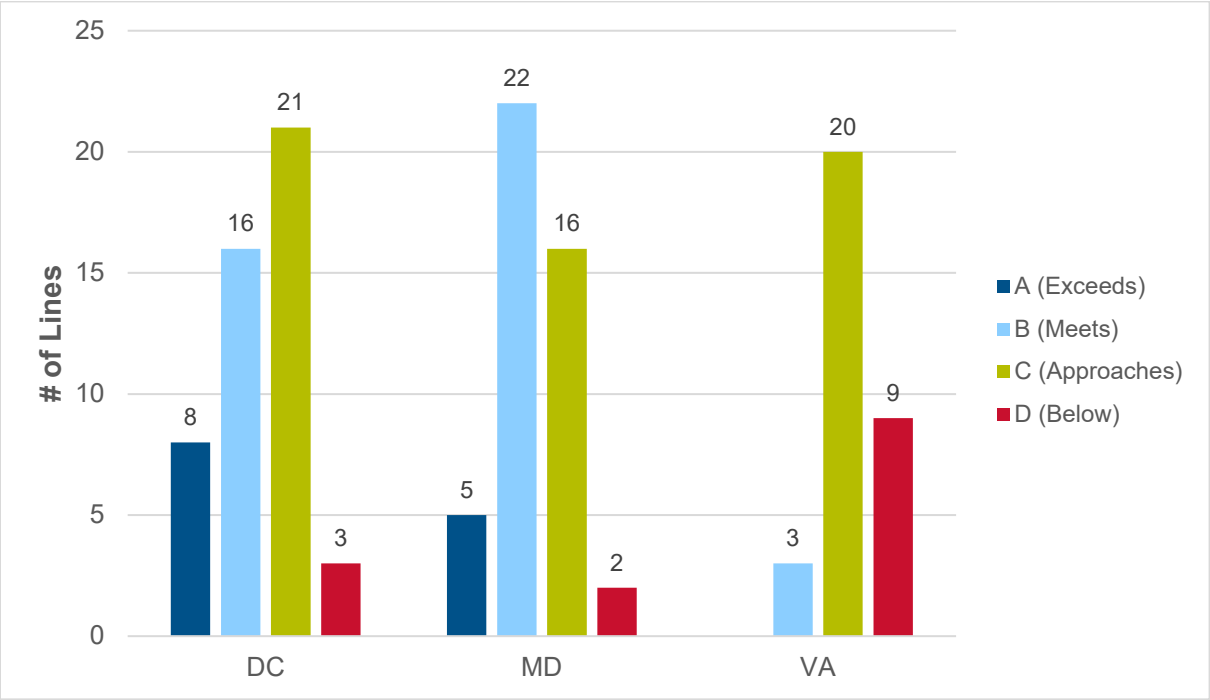
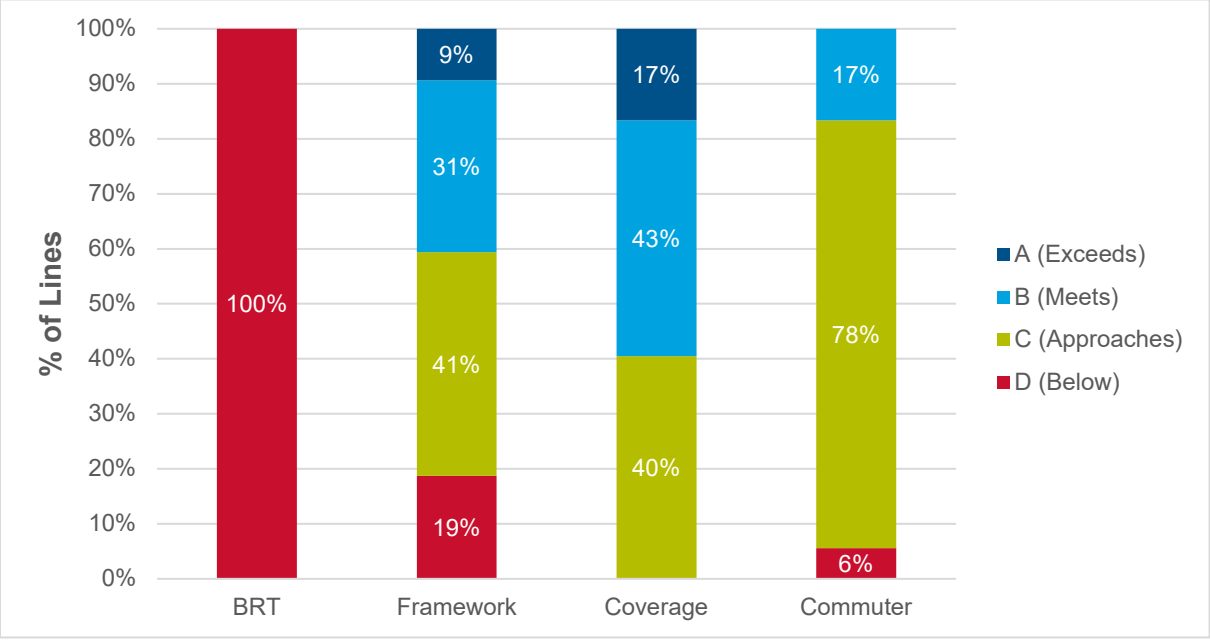


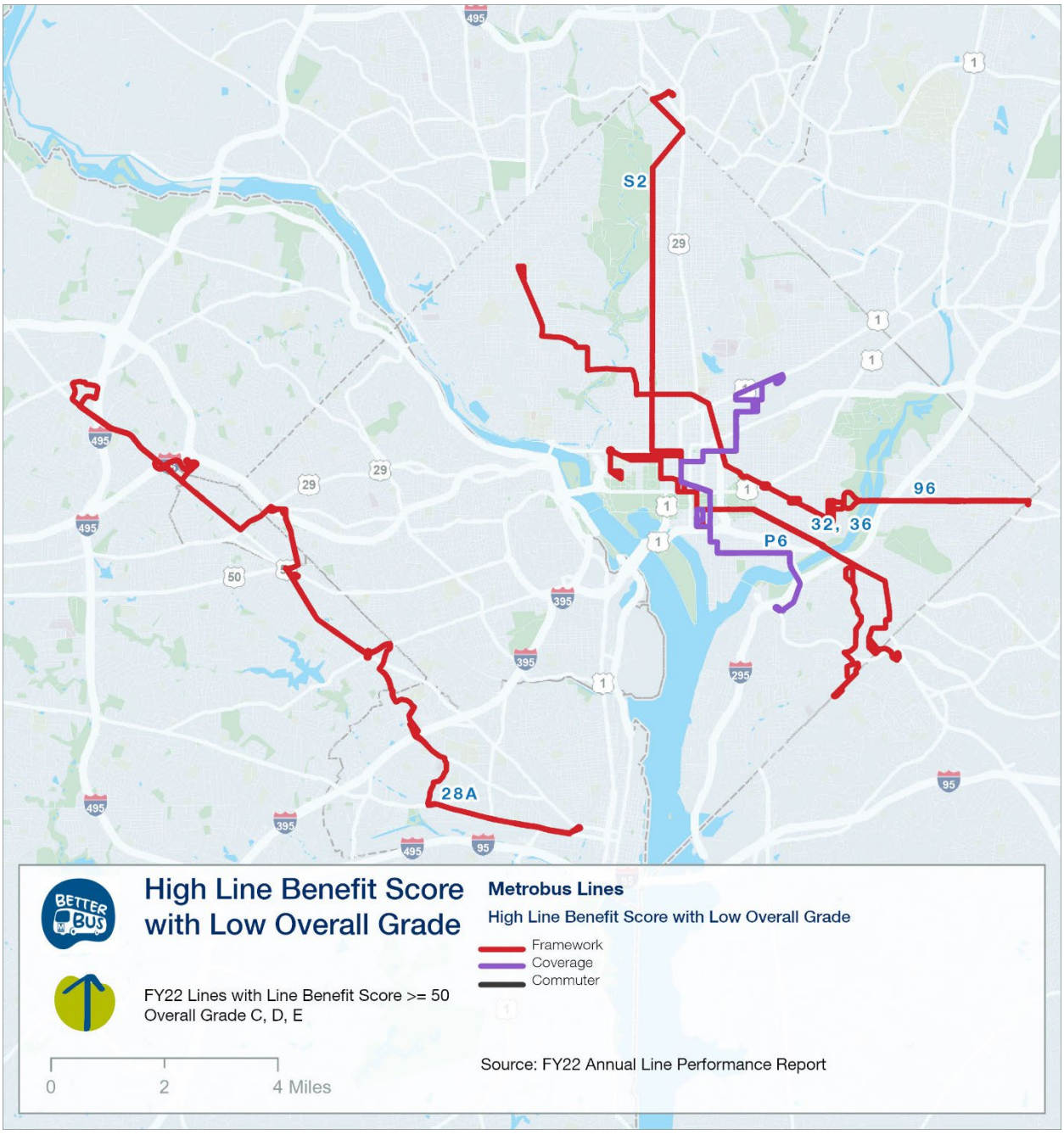
Figure 13: Lines Grades - Percentage of Grades by Service Classification



Comparing the LBS to a line's overall grade identifies areas for improvement, or even the need to completely redesign a line. Lines may have poor overall grades due to factors such as the availability of service (span or frequency), productivity, reliability, or cost effectiveness, but might still provide a high value to the network

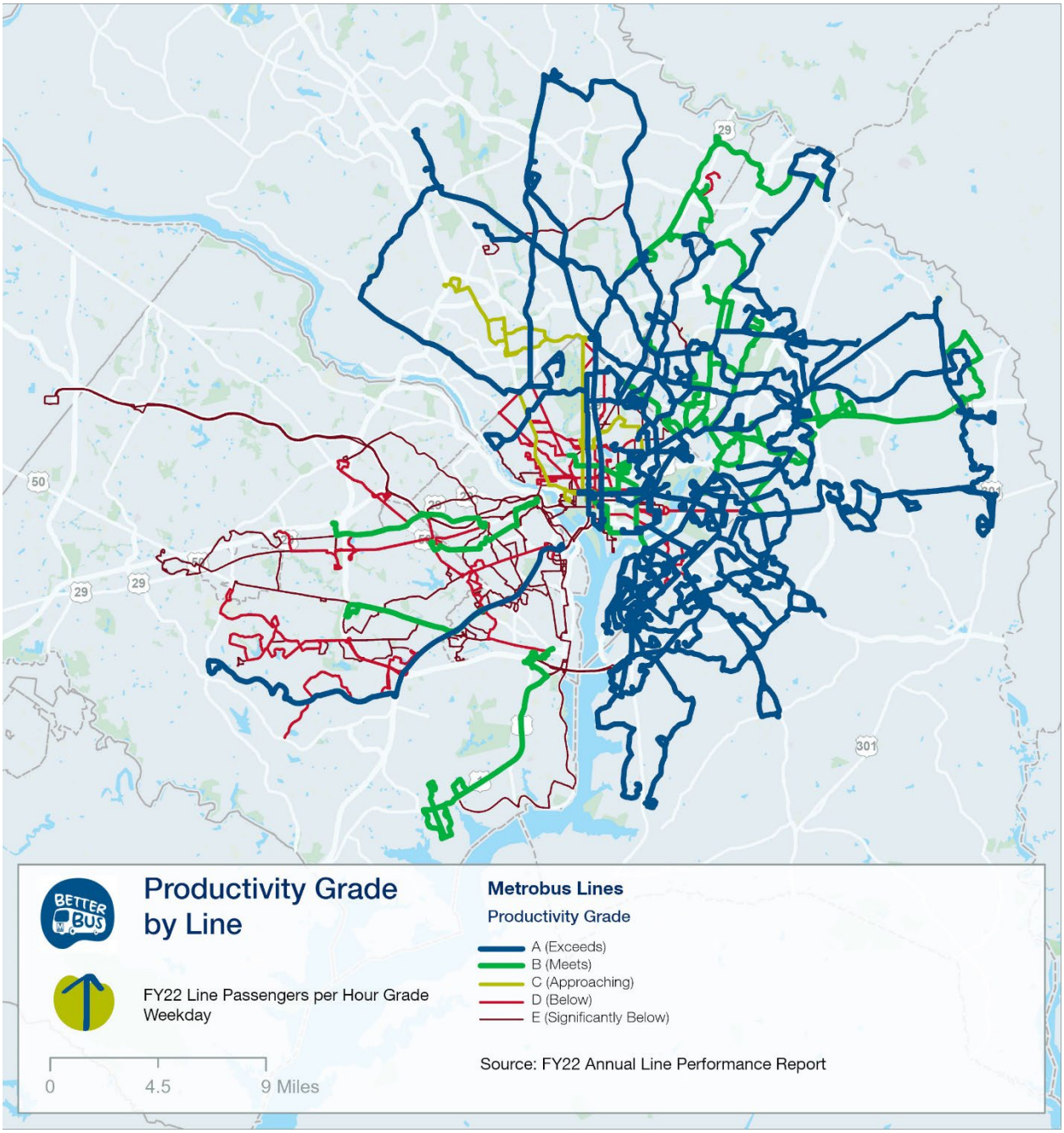
through connectivity and access. Poorly performing lines that are essential to the overall network will be evaluated to identify potential performance improvements to ensure they meet service guidelines and the targets for their classification and tier. Lines that have a high LBS but low overall line grade include 16th Street (S2), Leesburg Pike (28A), Pennsylvania Avenue (32, 36), Anacostia-Eckington (P6), and East Capitol Street-Cardozo (96), as shown in **Figure 14**. These lines are important to the overall network because of the size of the population they serve and the connections they provide but perform below the service standards based on their productivity and cost effectiveness.

Figure 14: Metrobus Lines with High LBS Scores and Low Performance Grades



Lines where passengers per hour or mile exceed the established standard indicate where additional capacity is needed, while lines with productivity significantly below the standard might indicate areas where resources could be reallocated and used more efficiently elsewhere. Through the BBNR a variety of tactics can be applied to improve productivity, ranging from reducing the frequency of a service to incorporating short turns or other design adjustments to make a more useful line. The most productive lines in the Metrobus service area are concentrated east of the Potomac (**Figure 15**).

Figure 15: Line Grade - Productivity



Is Metrobus delivering a service that provides equitable access to opportunity?

Through the BBNR, Metro will develop a bus network that continues to address racial and social inequities that exist in the region and that increases access to opportunity for historically disadvantaged communities. Looking at how the current service provides for these needs will help determine where and how to redesign the bus service to meet this goal. Metro identifies Equity-Focus Communities (EFCs) in the region where the highest concentrations of low-income residents, people of color, and people with disabilities live[4], as shown in **Figure 16**. By looking at which bus lines serve EFCs and their level of quality and performance, Metro can prioritize improvements that address the needs of these communities.

Figure 17 visualizes Metrobus lines according to the percent overlap of their service areas with equity-focus communities, their overall line grade, and their classification. EFCs in the service region are disproportionately served by Coverage services, which are designed to target transit-dependent populations, many of which are also designated equity-focus communities. Coverage routes connect less dense neighborhood areas to local destinations, provide transfers to other transit services, and operate at lower frequencies than Framework services. This finding has implications for the BBNR, which will closely examine opportunities for the introduction or expansion of Framework services along the major corridors through different equity-focus communities.

Using overall line grade—which rates the line on availability, productivity, reliability, and cost-effectiveness of service— as a measure of service quality, lines that serve more equity-focus communities tend to perform better overall. The vast majority of lines whose service areas are 50 percent or more in equity-focus communities have overall line grades of “B” (Meets) or “A” (Exceeds). In fact, out of 13 lines which have achieved overall “A” grades, all but one has over 70 percent of their service area overlaps with equity-focus communities. However, since EFCs are disproportionately served by coverage lines, they are subject to lower service standards which could explain the overall better performance.

Despite higher overall grades among EFC lines, the New Hampshire Ave.-Maryland Limited Line (K9) stands out as the only EFC-majority line with an overall grade worse than “C”. It underperforms in availability, productivity, and cost effectiveness categories. Several other lines, notably the Kenilworth Avenue (R12) and Martin Luther King Jr. Highway (A12) Framework lines which operate 93 percent and 97 percent through EFCs, respectively, are not meeting service standards, with grades of “C”. The Kenilworth Avenue line underperforms in frequency of service, cost effectiveness, and weekend productivity, while the Martin Luther King Jr. Highway line underperforms in cost effectiveness, on-time performance, and weekend productivity. Focusing on these lines to further identify how their performance can be improved will ensure that EFCs are better served in the redesigned network.

While EFCs are served by some mid- and high-frequency Framework and Coverage services, an analysis of scheduled weekday peak frequencies found that the highest-frequency Framework services do not significantly serve EFCs (**Figure 18**). This is also the case when examining weekend service and weekday service during off-peak periods.

This analysis then identifies opportunities for improvement. The redesign will consider candidate corridors in EFCs that need and can support the highest-frequency framework service.

[4] The census block groups that are home to 30 percent of the region’s population and that rank the highest for these three-population metrics are designated as EFCs.

Figure 16: Equity-Focus Communities

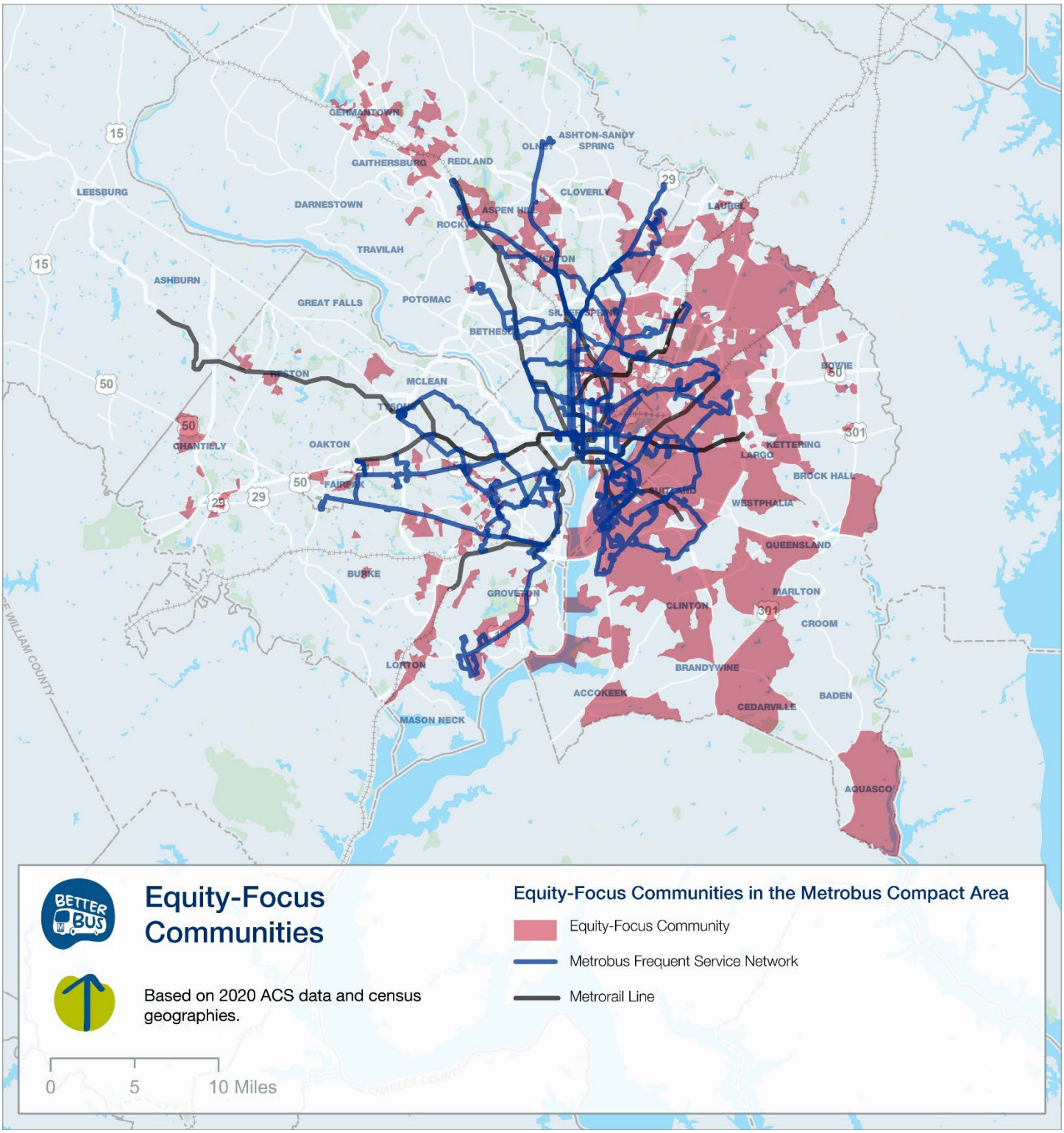
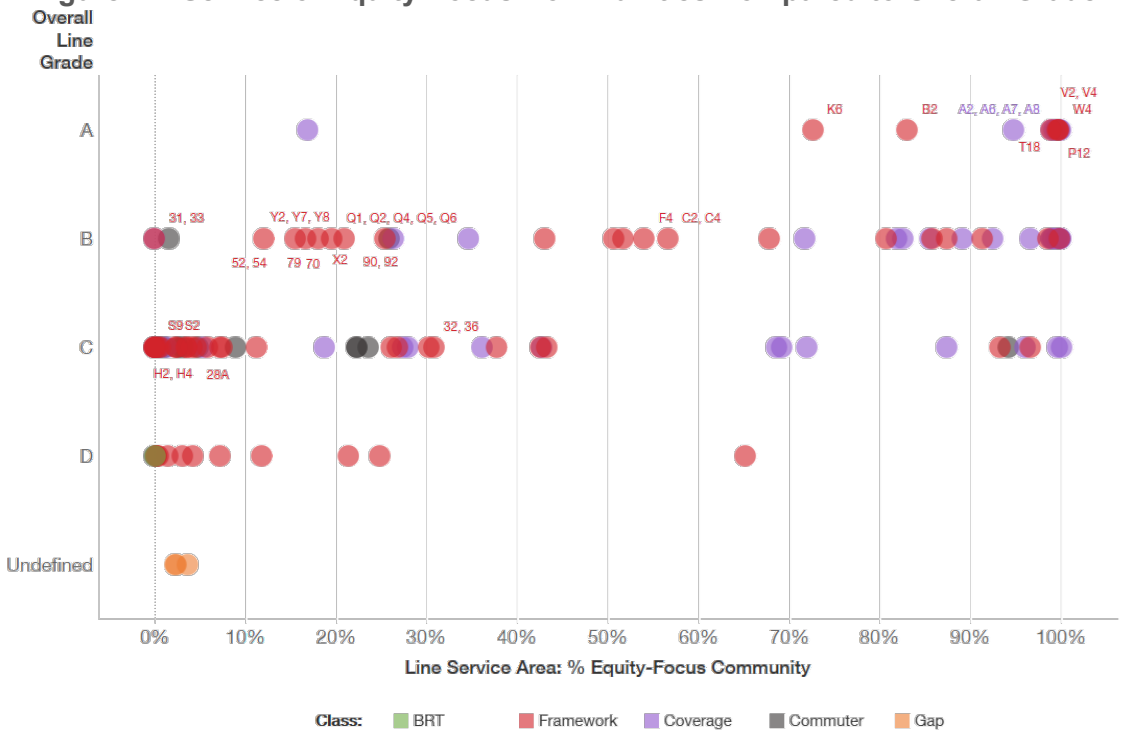
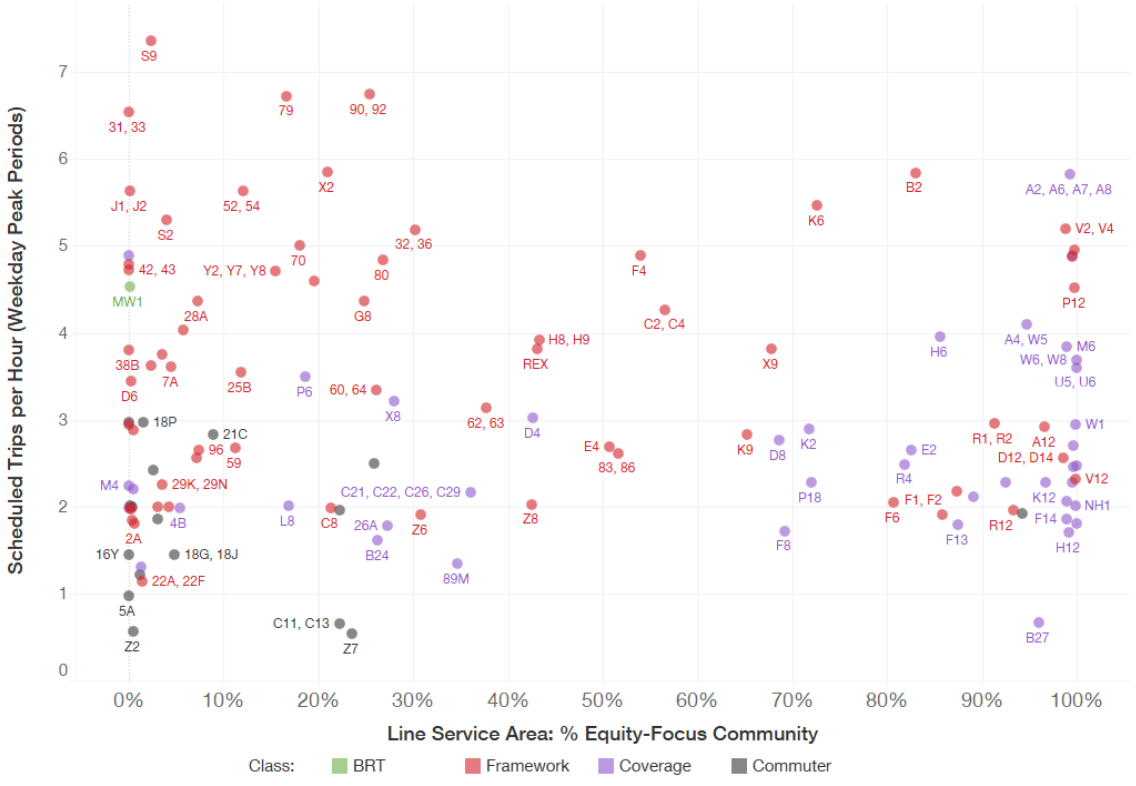


Figure 17: Service of Equity-Focus Communities Compared to Overall Grade



Note: the top 20 highest ridership lines are labelled.

Figure 18: Weekday Peak Period Frequencies of Equity-Focus Community Service



Coverage lines in particular are assigned their Population Served component of the LBS based on the transit-dependent populations they serve, specifically the low-income population and number of zero-car households residing within 1/4 mi of the line bus stops. Coverage lines in Prince George's County and Northeast DC (**Figure 19**) tend to have lower Population Served scores. In addition, the River Road Line (T2) in Montgomery County and the Nebraska Avenue Line (M4) in Northwest DC have similarly low Population Served scores. Northeast DC and much of Prince George's County are disproportionately designated as EFCs. The redesign will pay close attention to these coverage lines that do not serve a large transit-dependent population and consider specific ways they can be made more beneficial, with adjusted route design or bus stop placement.

Figure 19: Line Benefit Score - Low Population Served Score (Coverage Lines)

Is service available and frequent?

To make transit a reasonable travel option, the bus service must be frequent and available at all times of day. Minimum levels of span (**Table 3)** and frequency (**Table 4)** were established in the Metrobus Service Guidelines. The guidelines are based on a line's defined service classification and activity tier. The activity tier was developed to reflect the diverse land use characteristics around the WMATA Compact Area and various levels of transit demand. Transit serving these areas requires the appropriate level of service and design elements to serve these areas effectively. The activity tiers are defined as follows:

- Tier 1 (the densest): Over 50 percent of bus stops along a line have population plus employment of 25 or more per acre.
- Tier 2: Between 15 percent and 50 percent of bus stops along a line have population plus employment of 25 or more per acre.
- Tier 3: Less than 15 percent of bus stops along a line have population plus employment of 25 or more per acre.

Table 3: Metrobus Service Guidelines – Minimum Span

Zone	BRT	Framework	Coverage	Commuter
Tier 1	5:30 a.m.– Midnight	6:00 a.m.– Midnight	6:00 a.m.– 9:00 p.m.	Minimum of one trip that arrives by 7:00 a.m., and one trip that leaves at or after 6:30 p.m.
Tier 2	5:30 a.m.– 10:00 p.m.	6:00 a.m.– 10:00 p.m.	6:00 a.m.– 8:00 p.m.	
Tier 3	5:30 a.m.– 10:00 p.m.	6:00 a.m.– 10:00 p.m.	6:00 a.m.– 8:00 p.m.	

Table 4: Metrobus Service Guidelines – Minimum Frequency

Zone	BRT		Framework		Coverage		Commuter
	Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak	
Tier 1	10	15	15	15	12	30	Varies
Tier 2	15	20	20	20	30	60	
Tier 3	30	30	30	60	30	60	

Across the region, 92 percent of lines meet the minimum span of service standard set for their service classification (**Figure 20**), while only 66 percent are meeting the minimum frequency standard (**Figure 21**). Lines that meet their service standards create a network of services that are useful and available to customers by reducing wait times and eliminating reliance on schedules, making the bus more appealing.

Figure 20: Line Grade – Span of Service

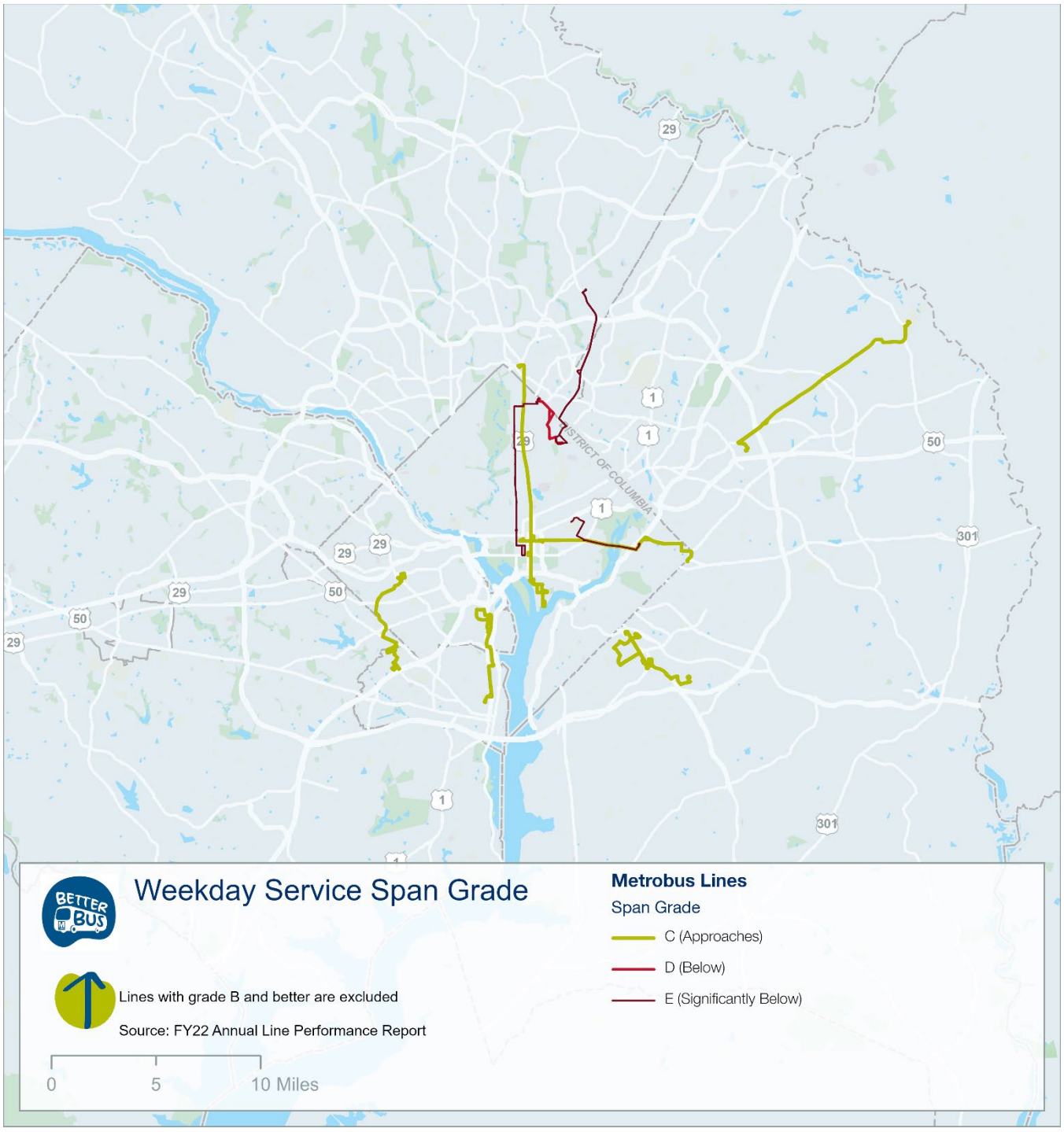
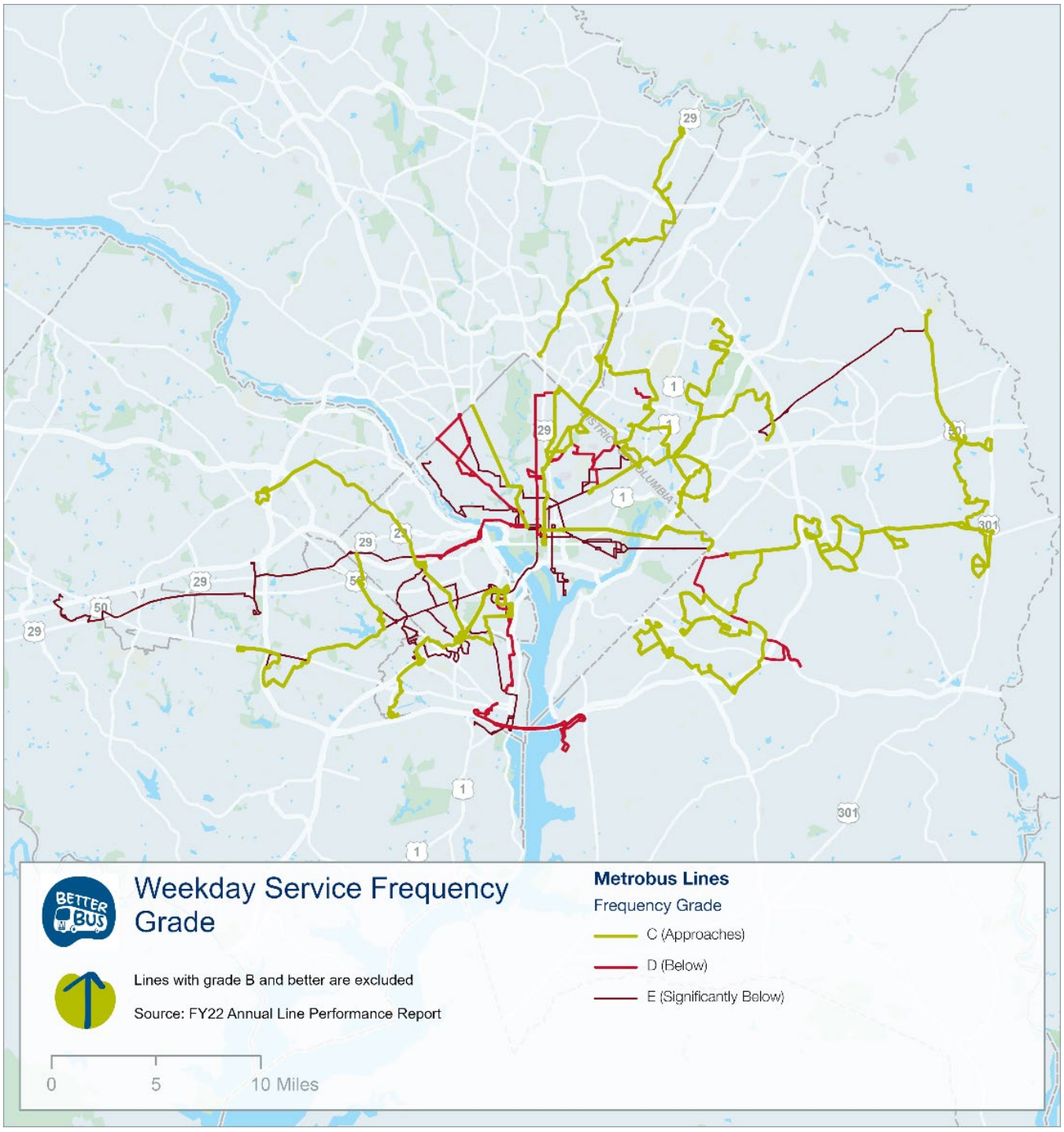
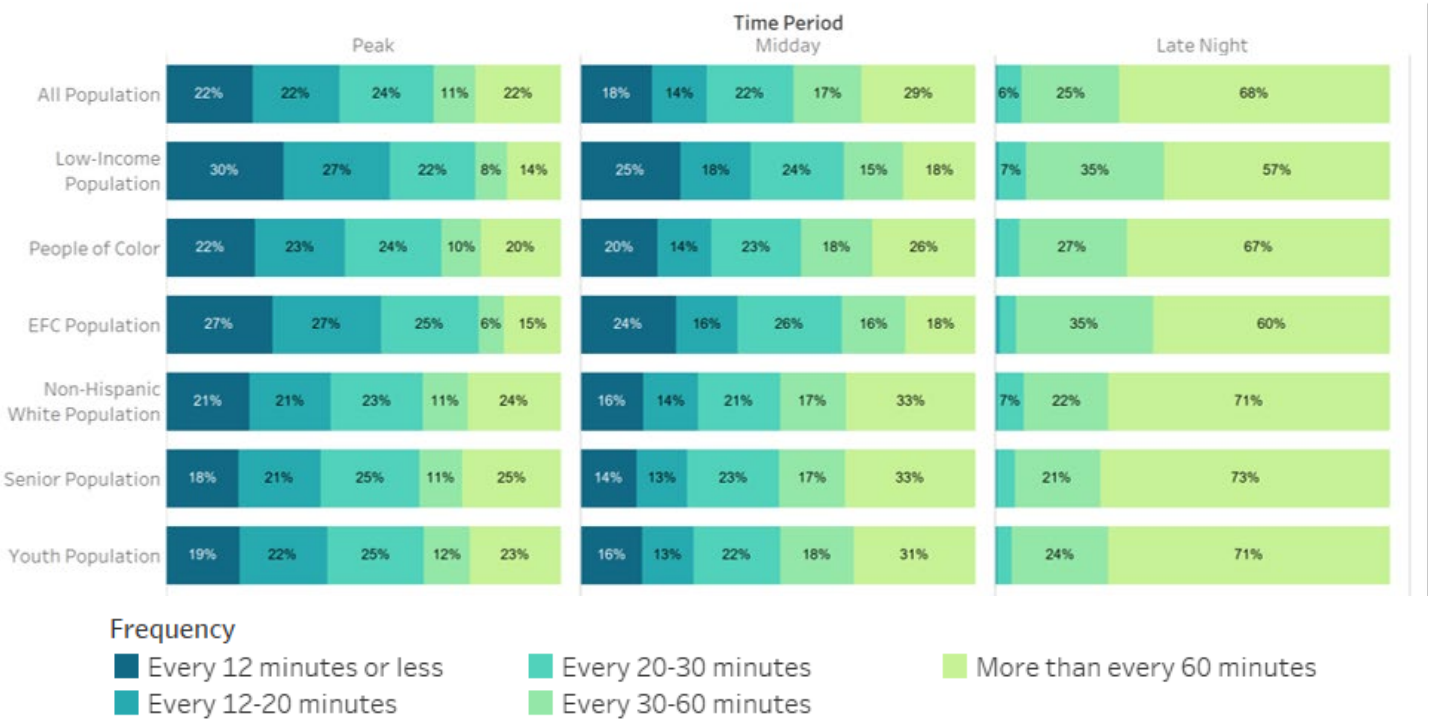


Figure 21: Line Grade – Frequency



Access to frequent bus service is similar across most population groups but highest for low-income residents and residents of Equity Focus Communities (**Figure 22**). This information will be used as part of the BBNR design process to ensure that vulnerable populations not only have access to transit, but they have access to frequent and quality service.

Figure 22: Frequency of Service by Population Group



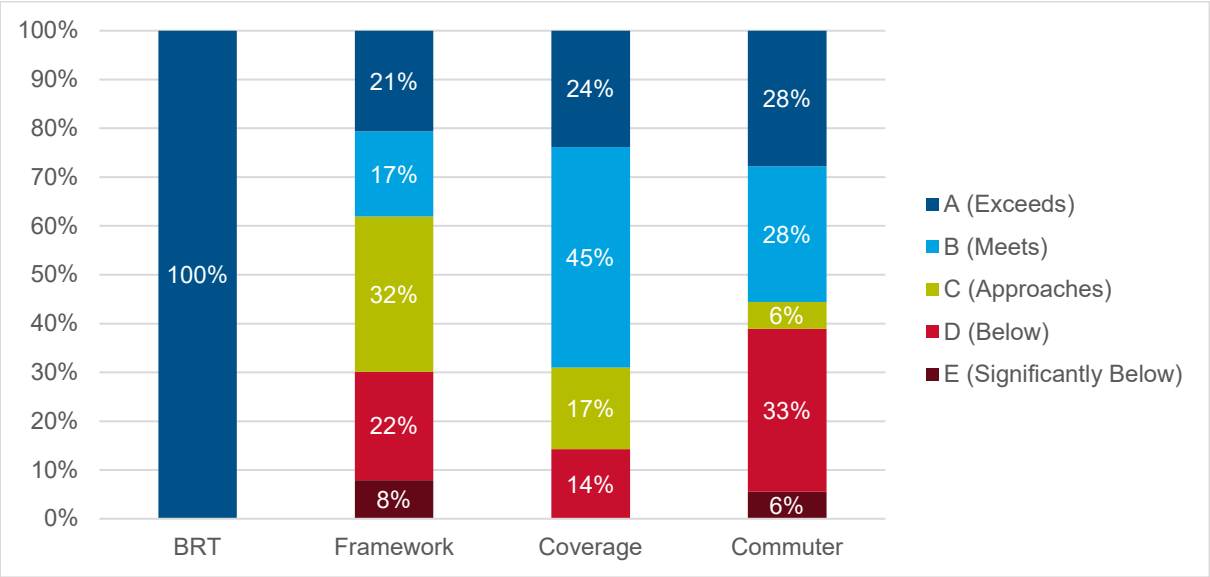
Source: 2022 GTFS feeds, 2020 ACS 5-Year Estimates.

Where and when is the bus not reliable?

Service reliability is an important factor in riders' mode choice and satisfaction with bus service. **Improvements to reliability were one of the most desired requests made by riders during the Phase 1 public engagement process.** Not surprisingly, due to higher levels of traffic congestion and ridership, many lines in Downtown DC have poor reliability, particularly Wisconsin Avenue (31,33), 14th St NW (52, 54), 16th St NW (S2), and Georgia Avenue NW (70). In Maryland, most lines east of MD-355 and west of I-95 have poor reliability, along with most radial lines in Prince George's County. Overall, Virginia has more reliable lines compared to Maryland and the District, with the exception of several commuter lines in Fairfax County that serve the mid-county area.

As value of time and reliability differs for different trip purposes, it is important to evaluate the reliability of lines with different classifications. **Figure 23** illustrates the distribution of on-time performance grades by classification, indicating that most commuter and coverage lines are meeting or exceeding on-time performance standards. Nearly 60 percent of framework lines, however, do not meet on-time performance standards. Given that framework lines are the most prevalent and highest ridership lines in the region, improving their reliability would have the largest impact on the overall performance of the network.

Figure 23: On-Time Performance Grade by Service Classification



Where is the bus not providing a sufficiently direct travel option?

Lines that are more direct between major origins and destinations provide faster, more reliable service than those with numerous deviations. In the Metrobus network, lines that are more direct, or less circuitous, tend to be more reliable and have higher ridership as they provide quicker trips with fewer turns. The concept of circuity measures the directness of a line using the ratio of a line's total length over the direct driving distance between its end points. Generally higher circuity is undesirable, with Metrobus Service guidelines suggesting a maximum circuity ratio of 1.75 for BRT and Framework services. However, some lines (i.e., Coverage services) are intentionally circuitous to reach more people and services in places that do not necessarily have gridded street networks. In general BRT and Framework services have a circuity ratio of 1.27 and 1.51, respectively. While circuitous lines provide good coverage and access to bus service, they do not generally provide direct service to the places people want to go, which is the intent of these two service types.

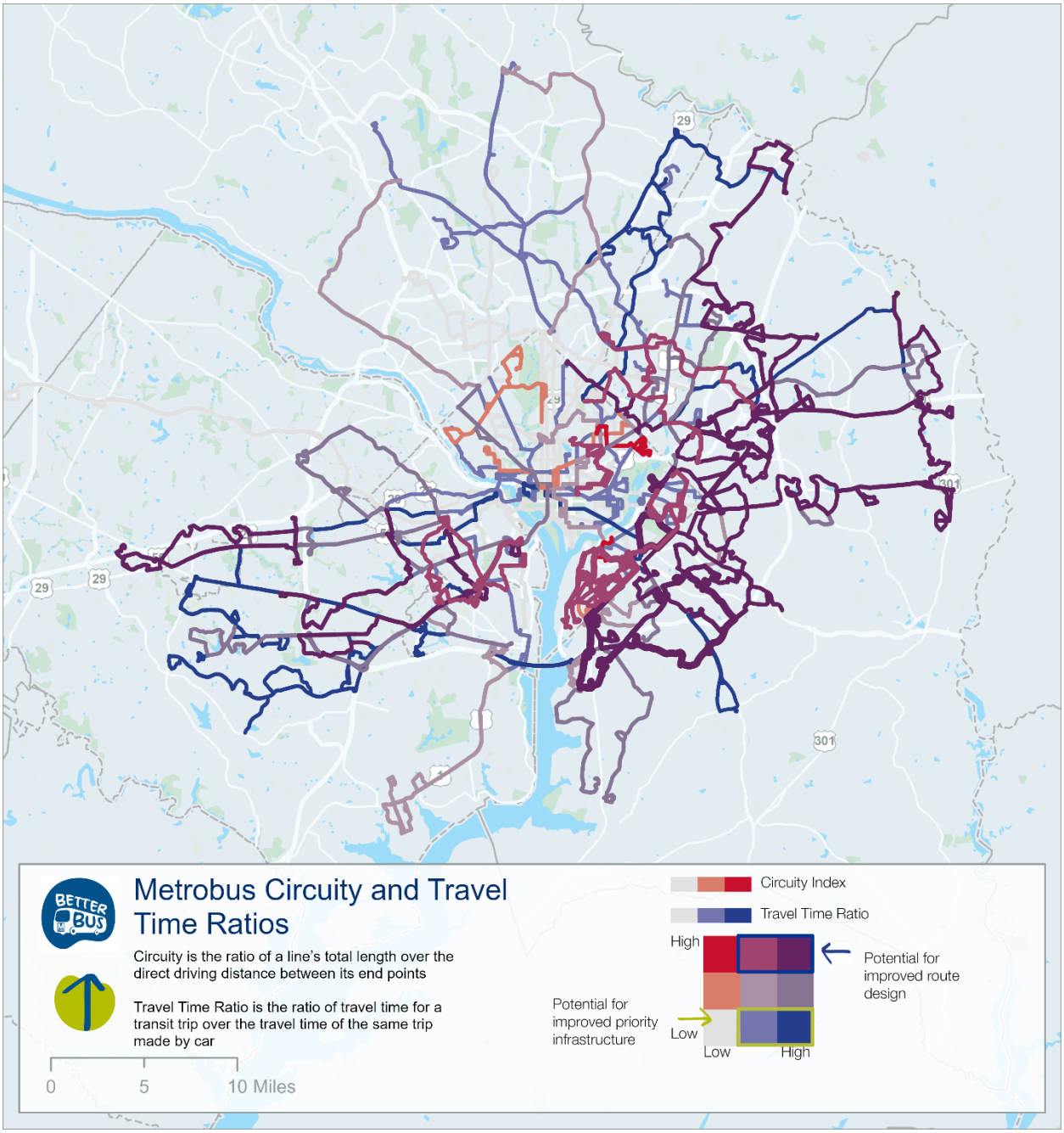
Because travel time is such an important consideration in travel choices, a travel time ratio analysis was also conducted to compare the average travel time for bus trips on a line to the average travel time of the same trips made by car. The market assessment provides a more detailed analysis of where the bus system provides convenient travel options for the trips customers actually take.

Figure 24 shows the circuity index and travel time ratio of all Metrobus lines in the region, highlighting areas with potential for improved route design or enhanced infrastructure. The creation of more direct alignments is one way to improve circuity and travel time ratios. Lines that serve areas without gridded street networks tend to fall into the highest tiers of circuity and travel time ratio, including many lines in Southeast DC and Prince George's County. Some examples include the Oxon Hill-Suitland Line (P18) in Prince George's County and Martin Luther King Jr. Highway (A12) and Deanwood-Minnesota Avenue (U7) in the District. In Virginia, lines including Annandale-East Falls Church (26A), Fair Oaks-Jermantown Road (2B), and Kings Park-North Springfield (17B, 17M) also have high circuity and high travel time ratios.

Additionally, travel time ratios and overall convenience can be impacted by changes in bus speed, wait times, transfers, and walk times. Examples of Metrobus lines that are not circuitous but have a high travel time ratio,

include King Park Express (17G, 17H), Alexandria-Fairfax (29K, 29N), and Fair Oaks-Fairfax Boulevard (1C). The redesign will investigate the potential for modifications in stop spacing, implementation of transit priority treatments, or increases in frequency to improve travel times along these lines.

Figure 24: Circuity and Travel Time Ratio



What does all of this information mean for the Better Bus Network Redesign?

The BBNR will propose new bus networks that help address the many types of needs and areas of improvement found across the region through the market assessment as well as those that have been identified through the detailed evaluation of existing conditions. The proposed service will consider how to address the shortcomings of the existing service either through changes to current lines or replacement with a completely new network of lines. Some areas of the region, times of day, and/or types of services may have a greater need of being addressed and may be prioritized. Ways that service could be changed to address these needs are illustrated in **Figure 25**.

Figure 25: Service Interventions