

10-Year Capital Needs Forecast



FY2019 - 2028













2019

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Key Metro Assets

 <p>234 miles of revenue track</p>	 <p>9 major rail yards</p>	 <p>1,583 buses</p>
 <p>19 miles of bridges</p>	 <p>1,300 rail cars</p>	 <p>11 bus garages</p>
 <p>100 miles of tunnels</p>	 <p>91 rail stations</p>	 <p>750 paratransit vehicles</p>
 <p>109 traction power substations</p>		

1. Overview

The Washington Metropolitan Area Transit Authority (Metro) owns and operates more than \$42 billion in physical assets (see [Figure 1-1](#)), which provide public transit services for the region. Metro's 10-year Capital Needs Forecast (CNF) totals \$22.5 billion¹, \$15.7 billion for SGR reinvestments to rehabilitate and replace aging assets and address deferred capital needs, and \$6.8 billion for system modernization needs. The forecasted level of SGR need is about \$2 billion lower than Metro forecasted in 2016, representing significant investments and progress during the past two years. Metro is maturing a capital planning and programming process that develops capital needs into projects for implementation. Dedicated funding and reauthorization of Passenger Rail Investment and Improvement Act (PRIIA) funding are important to enable the level of investment to address these needs. Metro is working towards a capital program that makes proactive investments, informed business decisions, and looks towards the future.

Since the publication of the last Capital Needs Inventory (CNI) (2016) and as noted in Metro's Transit Asset Management Plan (2018), Metro has made considerable progress on critical safety and state of good repair (SGR) investments and significantly improved its asset condition data. Improved asset data provides Metro with more accurate assessments to plan for maintaining systems and assets in SGR, which is essential for providing safe, reliable, and affordable transit services.

The 2019 Capital Needs Forecast updates and refines Metro's capital needs over a 10-year horizon with a methodology that improves on the approach used in 2016. The CNF quantifies the existing and anticipated costs to achieve and then maintain assets in SGR, improve safety, and meet compliance requirements. This CNF estimates Metro's unconstrained capital needs to be approximately \$2.25 billion annually in year of expenditure (YOE) dollars from FY2019 to FY2028. The total for these 10 years includes more than \$15 billion in SGR needs and more than \$7 billion in modernization needs (see [Figure 1-2](#)).

Compared to the 2016 CNI, the current level of Metro's forecasted capital needs has declined due to the implementation of the largest capital reinvestment program in Metro's history. During the past two years, Metro has invested more than \$1 billion annually and prioritized deferred capital needs in the capital program. This focus has significantly decreased the SGR backlog in just two years from just over \$7 billion in inflation adjusted dollars in FY2017 to \$5 billion in FY2019. As shown in [Figure 1-3](#), 12 percent of Metro's asset base is still in the SGR backlog. The 2019 CNF improves key elements of prioritization for alignment with Metro's

¹ *In addition to the 10-year estimated needs, there are some potentially significant investment needs beyond the 10-year period that have yet to be included.

strategic goals (see [Figure 1-4](#)). One key goal of forecasting capital needs is to support the development of transit asset management (TAM) processes to align with Federal Transit Administration (FTA) requirements.

Summary of Existing Value by Asset Type

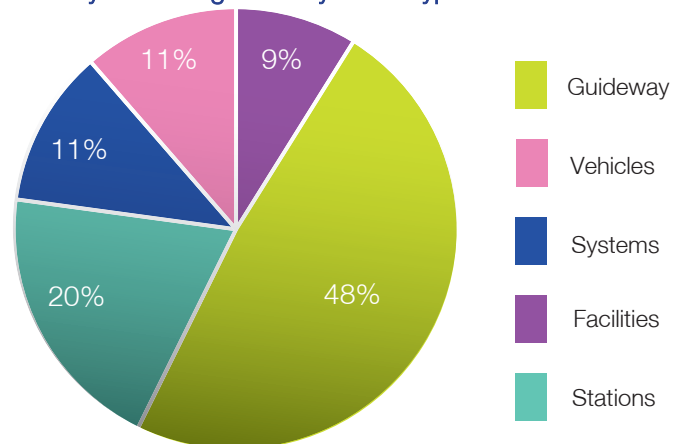


Figure 1-1: Distribution of Metro's Existing Assets by Asset Type

Unconstrained 10-Year Combined Needs (\$22.51 billion)

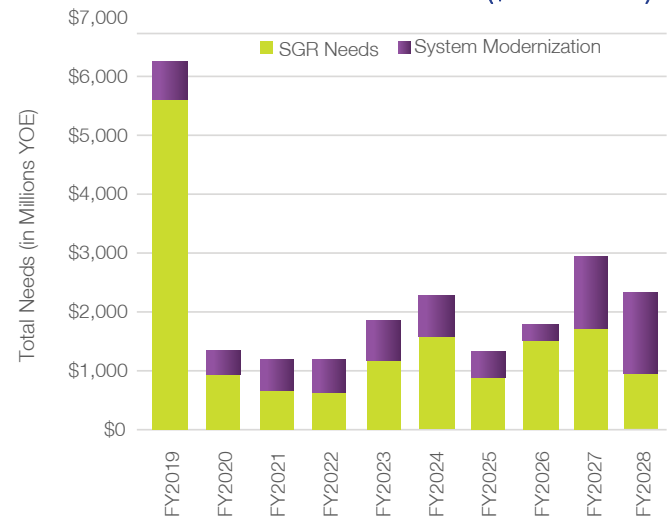


Figure 1-2: Total Combined Needs Over 10 Years (\$22.51 billion)

Improvements resulting from Metro’s TAM efforts during the past two years include:

- More asset condition data has been made available through the Transit Asset Inventory and Condition Assessment (TAICA) initiative, which helps to improve both the estimate of SGR needs and helps the prioritization of those needs.
- More detailed, condition-based track inventory by operable segment, which allows for improved SGR reinvestment planning based on component-level inspections and Metro's actual maintenance outage costs.

- More component-level records also are available for Metro's stations and facilities, supporting rehabilitation planning during the life of those buildings.
- More granular location data is available for assets, which allows for more refined approaches to applying ridership to assets.

The analysis for the CNF is unconstrained in terms of both time and cost. This means that the CNF assumes all capital needs will be addressed in the year they occur, regardless of Metro's actual capacity in terms of labor, procurement timing, access to right-of-way (ROW) or budget. All needs are reported in YOE dollars, which includes a three percent cost inflation rate.

The resulting forecast of 10-year needs provides information about the scale and scope of Metro's unconstrained SGR investment needs and also provides information for Metro to use in planning and prioritizing the capital program.

Metro's capital program process has evolved since 2016 to incorporate CNF data into the initiation and development of capital projects. Metro is continuing to coordinate ongoing improvements in the CNF with the development of the capital program.

SGR Backlog

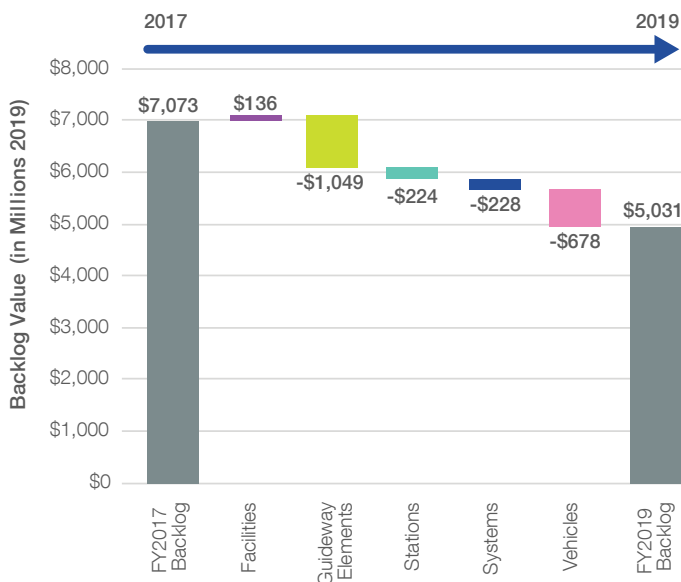


Figure 1-3: SGR Backlog Reduction by Asset Type

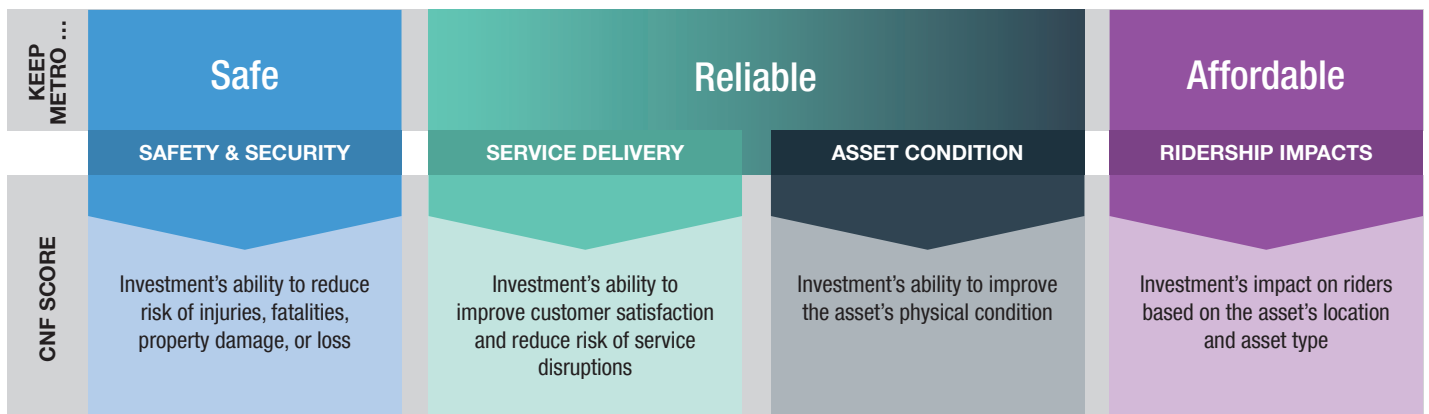


Figure 1-4: CNF Criteria Alignment With Metro's Strategic Goals

1.1 Overall Needs

The total estimated capital needs, based on TAM best practices and modernization needs total \$22.51 billion. SGR needs are 70 percent of the total need, with modernization needs at 30 percent (see Figure 1-5).

The capital needs in the 2019 CNF that average \$2.25 billion annually are unconstrained. As Metro does not have the financial and operational capacity to execute a capital program of this size, it is critical to prioritize these needs to inform the development of the financially-constrained capital program. Since 2016, the CNF prioritization has been used to inform Metro's capital program development to ensure that investments are planned in high-criticality areas.

Summary of 10-Year Combined Needs

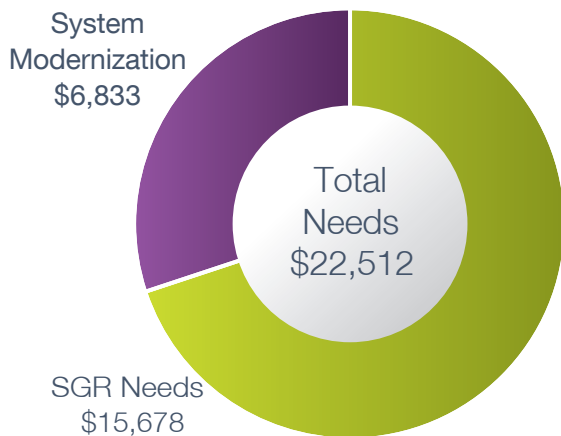


Figure 1-5: 10-year Total Needs (in millions YOY)

1.2 SGR Needs

SGR needs include the replacement, rehabilitation, or annual capital maintenance necessary to preserve existing capital assets. From FY2019 to FY2028, Metro's forecasted SGR needs total \$15.68 billion as seen in Figure 1-6. This includes \$5.03 billion in SGR backlog as of FY2019, which is \$2 billion less than the backlog reported in 2016 in real terms. Assets in backlog are either beyond their useful life, require replacement due to compliance requirements, are in poor condition, or did not meet their cyclical replacement schedule. Metro's SafeTrack program, funded by jurisdictions and federal grants, significantly improved the condition of track since 2016, resulting in a decline in the trackwork-related backlog. In addition, Metro has addressed many of the compliance-related needs reported in 2016, including replacement of the 1000-series rail cars.

While the backlog represents past-due needs, Metro still faces the normal, ongoing reinvestment in assets required to maintain SGR.

While the SGR backlog has decreased since 2016, the level of normal system preservation needs has not. Those needs will continue to accrue over time as the existing inventory of Metro's assets age and asset conditions deteriorate. An average of \$1.1 billion per year is needed for normal reinvestment.

Total 10-Year SGR Needs

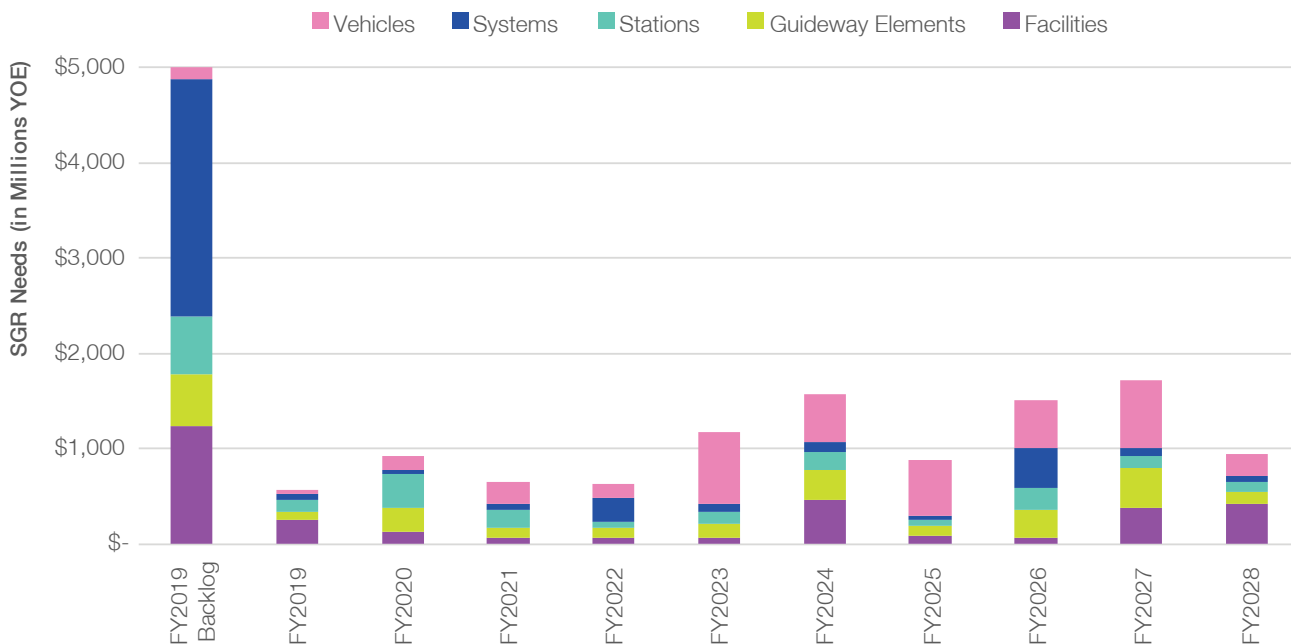


Figure 1-6: Unconstrained 10-year Total SGR Needs by Asset Type

Summary of 10-Year SGR Needs

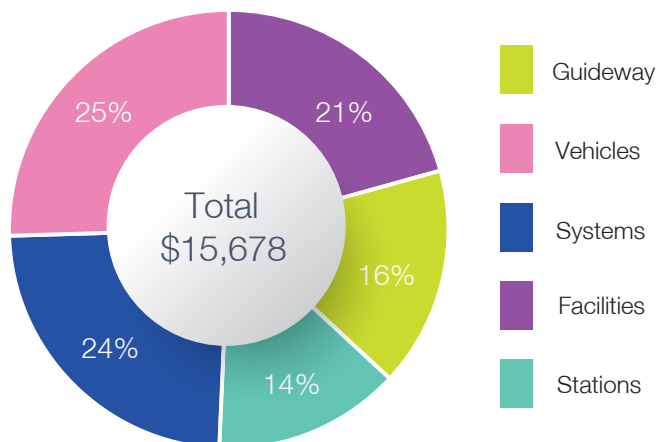


Figure 1-7 : Total 10-year SGR Needs by Asset Category (in Millions YOE)

Due to the replacement of 1000, 4000, and 5000 series rail cars with the new 7000 series fleet, the dollar value of Metro’s vehicles needs have declined since 2016. Vehicles used to make up a third of all SGR needs, and now make up only a quarter of all SGR needs (see Figure 1-7). Metro’s capital program is now focusing on developing programming to ensure that traction power and train control SGR needs are scoped to address the relatively large backlog of needs in these vital systems.

In addition, from FY2019 to FY2028, there are high-priority SGR needs that support ongoing system preservation, including:

- **Guideway** - Mitigating tunnel leaks and replacing worn tunnel liners to extend the useful life of assets operating in the tunnels, such as power cable insulators, which can fail and cause service disruptions and costly repairs when constantly exposed to water.
- **Vehicles** - Continuing to rehabilitate and replace Metrobuses on schedule to reduce potential failures and the need for costly corrective maintenance.
- **Vehicles** - Replacing the aging 2000 and 3000 series rail cars with modern 8000 series rail cars over the next decade.
- **Systems** - Upgrading Metrorail’s traction power equipment, including traction power substations, power cabling, and third rail, necessary for reliable, on-time performance.

Summary of 10-Year System Modernization (\$6.83 billion)

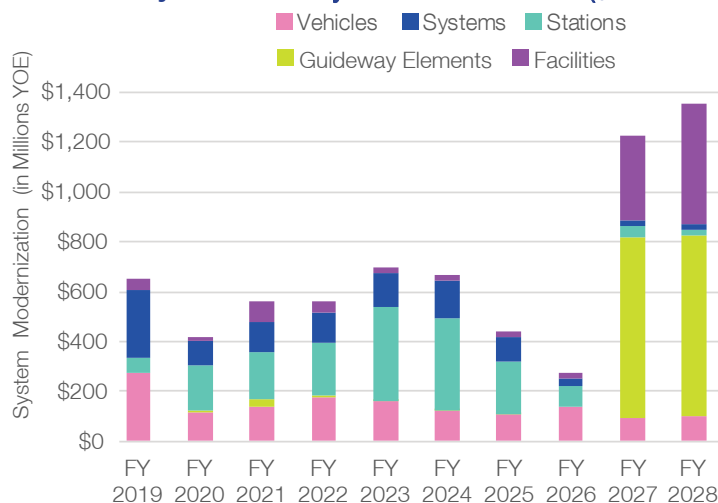


Figure 1-8: Total 10-year System Modernization by Asset Category

- **Systems** - Upgrading Metro’s train control system, including track circuits and signals, necessary for the safe and efficient operations of trains, including bus garages.
- **Facilities** - Updating facilities for operations, maintenance, and administration to support services and business operations.
- **Stations** - Rehabilitating and repairing outdoor station platforms for SGR.

1.3 System Modernization

Modernization needs improve existing services through capital investment in new technology, address compliance needs with new assets, increase functionality, or improve passenger circulation. The unconstrained modernization needs reported through the 2016 CNI have been updated and supplemented with new information. The unconstrained modernization needs from FY2019 to FY2028 total \$6.83 billion (see Figure 1-8 and Table 1-1).

More than \$985 million of these modernization needs address compliance-related issues that impact safety, security, and environmental concerns. Compliance-related modernization needs specifically address the outcomes of an audit or investigation, or help Metro meet current codes or standards. Many SGR needs are interdependent with these high-priority modernization needs as they will improve the maintenance and operation of Metro’s existing assets.

Overview

For example, many of the modernization needs address remediation of known hazards at Metro’s support facilities or capacity constraints at Metro’s core stations. Since 2016, two core station capacity projects have been progressed to design solutions that will improve passenger safety and the efficient operation of the stations.

In addition, about \$5.8 billion of modernization needs address improved passenger circulation in stations, such as relieving major bottlenecks to operating the Metrorail system, which drive up maintenance and operating costs, at Rosslyn and between Stadium Armory and Benning Road/Minnesota Avenue stations.

Asset Categories	Total Cost of System Modernization (\$M YOE)	Percentage of Total
Facilities	\$1,402.62	21%
Guideway Elements	\$1,493.47	22%
Stations	\$1,756.97	26%
Systems	\$1,077.31	16%
Vehicles	\$1,102.93	16%
Grand Total	\$6,833.30	100%

Table 1-1: 10-year System Modernization by Asset Category

1.4 Impact of Metro’s Investments

Metro’s SGR backlog has decreased by more than \$2 billion since 2016 based on Metro’s prioritization of SGR needs in the capital program. The impact of Metro’s investments is also apparent in the performance of the Metrorail system. Rail car reliability has improved by 224 percent in terms of the distance rail cars travel between failures and has improved 141 percent in terms of the distance rail cars travel before causing delays. This improvement in reliability of service is directly correlated with the arrival of the new 7000 series cars that replaced the older 1000, 4000, and 5000 series rail cars.

Metro’s infrastructure investments also have significantly reduced the number of disruptions on the rail system and decreased the need for unplanned single tracking. Infrastructure incidents were cut in half between FY2017 and FY2018, with further declines seen in FY2019 (see Figure 1-9). Unplanned single-tracking events also decreased by 28 percent from FY2017 to FY2018. Most of the reductions in disruptions to the system were seen after the SafeTrack program completed its accelerated renewal of track assets.

Improved rail car reliability and fewer system disruptions have resulted in the highest on-time performance for the Metrorail system in seven years. These improvements help to protect Metro’s core ridership, as service reliability is a key factor in customers deciding to ride the system.

Safety and reliability of the Metrorail system has also increased through infrastructure investments combined with improved procedures, trainings, safety programs, and engineering solutions. Since fiscal year 2017, Metro has seen:

- Track infrastructure incidents (such as speed restrictions and derailments) decrease by 87%;
- Track electrical fires (arcing insulators or cable fires) decrease by 35%;
- Red signal infractions decrease by 33%; and
- Customer offloads, for any reason, decrease by 50%.

While many other factors impact transit ridership in the region, Metro is focusing the Capital Improvement Program (CIP) on continuing the positive performance trends. The FY2020 capital budget includes increased reinvestment in the system as dedicated funding becomes available to Metro. This dedicated funding will allow Metro to continue to address the SGR backlog, keep up with ongoing system preservation needs, meet compliance requirements, and improve the overall customer experience. Dedicated funding and reauthorization of PRIIA are important to enable the level of investment to address these needs.

Track Infrastructure Incidents

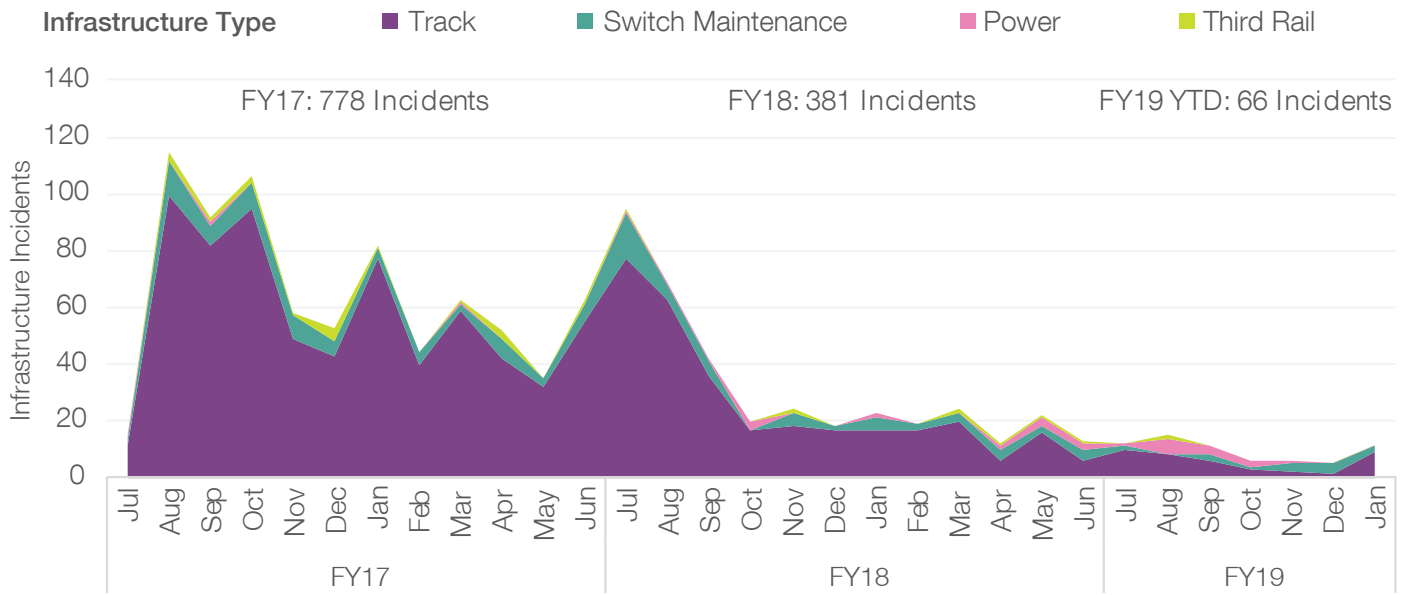


Figure 1-9: Track infrastructure incidents by capital improvement type, July 2016 to January 2019

2. Capital Needs Forecast

Metro's 10-year Capital Needs Forecast totals \$22.5 billion, \$15.7 billion for SGR reinvestments to rehabilitate and replace aging assets and address deferred capital needs, and \$6.8 billion for modernization needs. The forecasted level of SGR need is about \$2 billion lower than Metro forecasted in 2016, representing significant investments and progress during the past two years.

2.1. State of Good Repair Needs

The basis of Metro's SGR needs is a comprehensive inventory of existing assets. Each record in this inventory documents each asset's type, age, expected life, replacement cost, and other attributes required to assess that asset's 10-year reinvestment requirements. Reinvestment types include:

- Rehabilitations that require capital renewal (including major overhauls, renovations, or rebuilds)
- Replacement
- Annual Capital Maintenance (ACM) —generally occurs for larger assets such as tunnels or bridges, which require periodic infusions of capital to maintain SGR

The FTA Capital Needs Analysis Requirements Model (TERM Lite) forecasts these needs based on each individual asset's age, useful life, replacement cost, and lifecycle plans regarding the timing and cost of rehabilitations or application of ACM. Cost inflation also is applied at 3 percent per year, so all values are in year of expenditure (YOE) dollars.

2.1.1. 10-Year SGR Needs Estimate

From FY2019 to FY2028, Metro's total unconstrained SGR needs are estimated to be \$15.68 billion, or \$1.57 billion on average per year. Within the 10-year SGR needs, Vehicles and Systems are the asset categories with the largest SGR needs with \$3.99 billion and \$3.74 billion in needs, respectively (see [Figure 2-1](#)).

Metro's total SGR needs includes \$5.03 billion in deferred capital needs or backlog as of 2019 (see [Figure 2-2](#)). SGR backlog includes assets that require prompt reinvestment as they are already past their useful lives or require rehabilitation or replacement due to regulatory requirements or compliance obligations. Backlog needs

may also include a variety of compliance-related needs, which must be completed as a priority to meet FTA, Washington Metrorail Safety Commission (WMSC), National Transportation Safety Board (NTSB), or Metro requirements, recommendations, or standards. The 2019 backlog value is approximately \$2 billion (in 2019 dollars) less than the backlog value estimated in 2017.

In total, the FY2019 to FY2028 backlog includes 12 percent of Metro's total asset base, which is an improvement from the 17 percent of assets in backlog in 2017. The largest proportion of deferred capital needs continues to be in major Systems, which makes up about half of the backlog at \$2.5 billion. Within Systems, train control and electrification (i.e., traction power) assets make up the largest asset types with \$984 million and \$706 million in deferred needs, respectively. Due to Metro's major investment in track during the past two years, Guideway assets are no longer the second largest portion of the backlog. Facilities is now the second-largest portion at \$1.24 billion (see [Figure 2-3](#)).

Summary of 10-Year SGR Needs

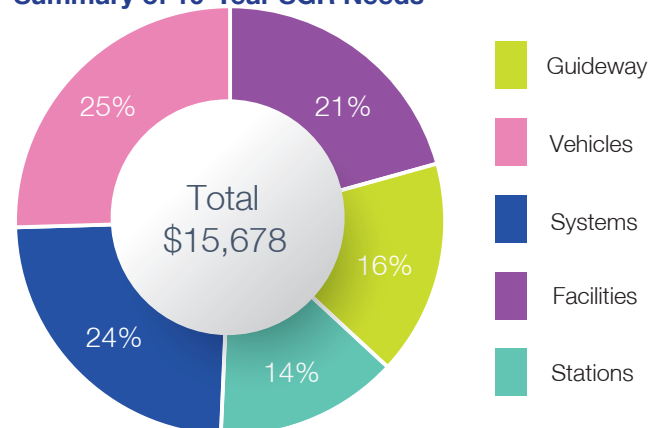


Figure 2-1: Total 10-Year SGR Needs by Asset Type (in Millions YOE)

Summary of 10-Year SGR Needs

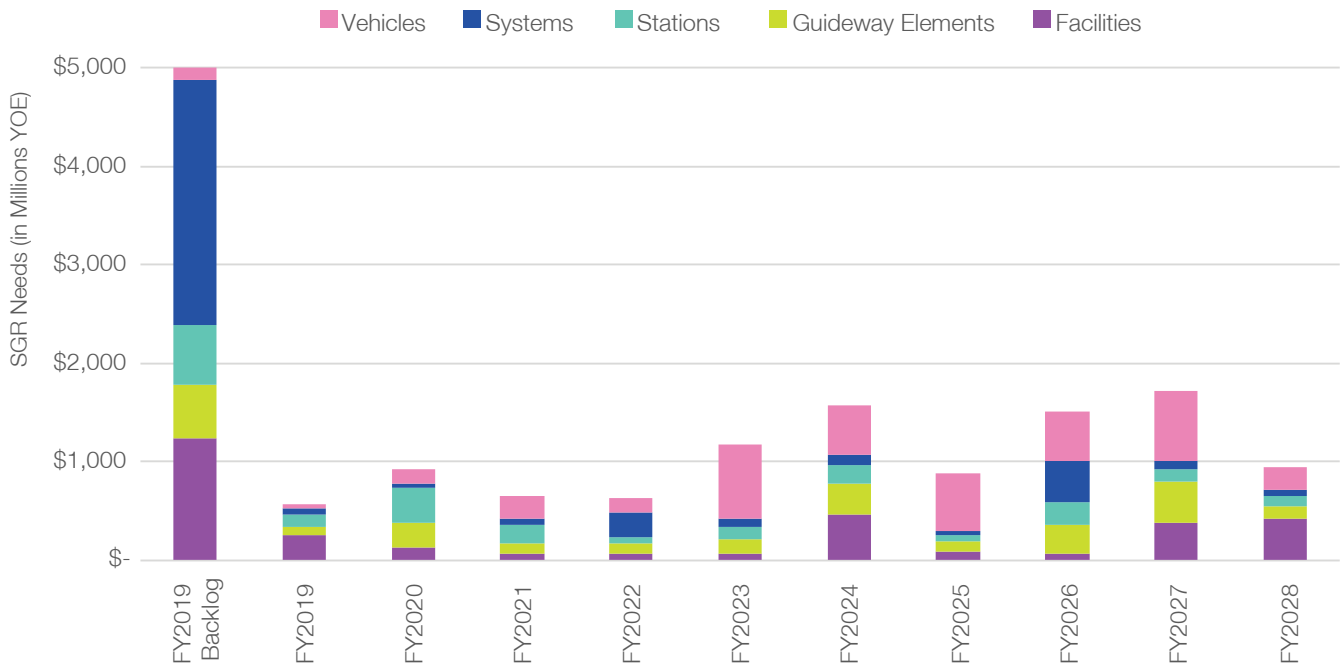


Figure 2-2: Unconstrained 10-Year Total SGR Needs by Asset Type

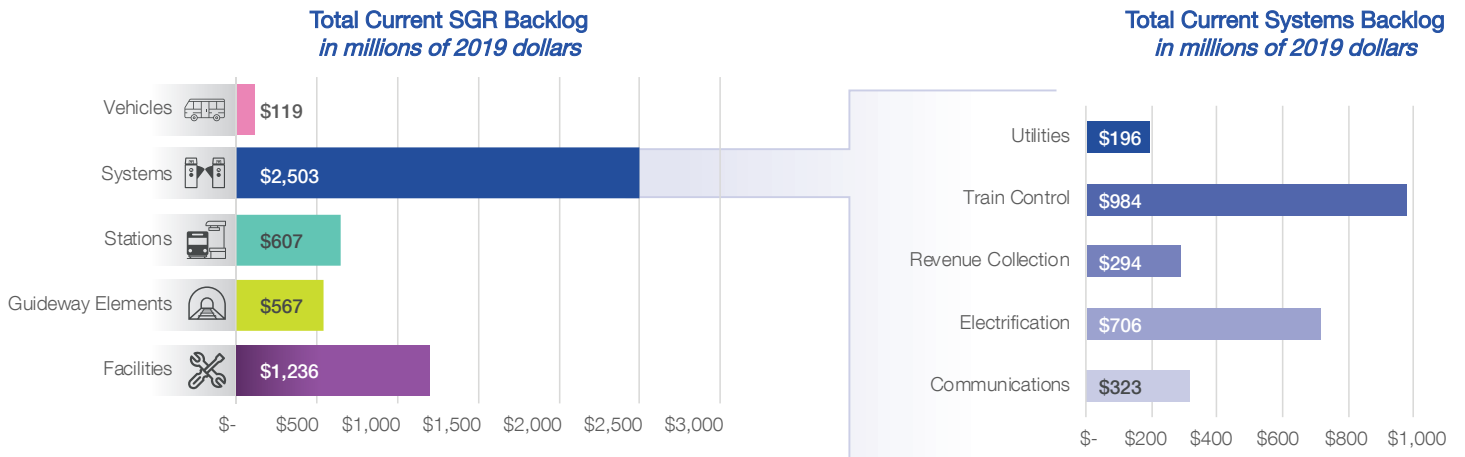


Figure 2-3: Total Cost of Current SGR Backlog in Millions 2019

Note: Individual items have been rounded to the nearest \$10 million; therefore, totals may not sum due to rounding.

21.2. 10-Year SGR Needs Prioritization

The prioritization criteria and risk-based weighting approach described in Appendix 1 is applied to SGR needs, with TERM Lite providing the engine to score and organize individual assets into grouped SGR needs. These grouped SGR needs are not equivalent to scoped projects but rather represent bundles of coincident needs occurring in the same location and/or across the same asset type. The needs are then refined and grouped through input from operations and project managers. The Strategy, Planning and Program Management (SPPM) department works across all Metro departments to use these needs in initiation and development of projects aligned with Metro’s strategic priorities. These projects are then prioritized and used to inform the proposed 10-year capital plan.

Figure 2-4 displays SGR needs sorted by priority score. A majority of SGR needs score over 50 points (out of 100). The highest-scoring assets are in poor condition, which increases their risk of failure, and are critical to safety, service, and ridership. The highest-ranked SGR need is scored as 90 for Metrorail systemwide track circuits.

Track circuits are a critical part of the train control system. The lowest-ranked SGR need is scored as 19 for rehabilitation scheduled for the newest stations on the Silver Line.

The risk profile of SGR needs is presented in Figure 2-5 where the consequence of failure is on the Y-axis, the probability of failure on the X-axis, and the size of the bubbles or circles represent the 10-year cost of the need. The risk profile illustrates that train control (track circuits and signals), tunnels (leak mitigation), and electrification remain the highest-risk elements (upper right corner), which also translates into the highest-priority needs in the CNF.

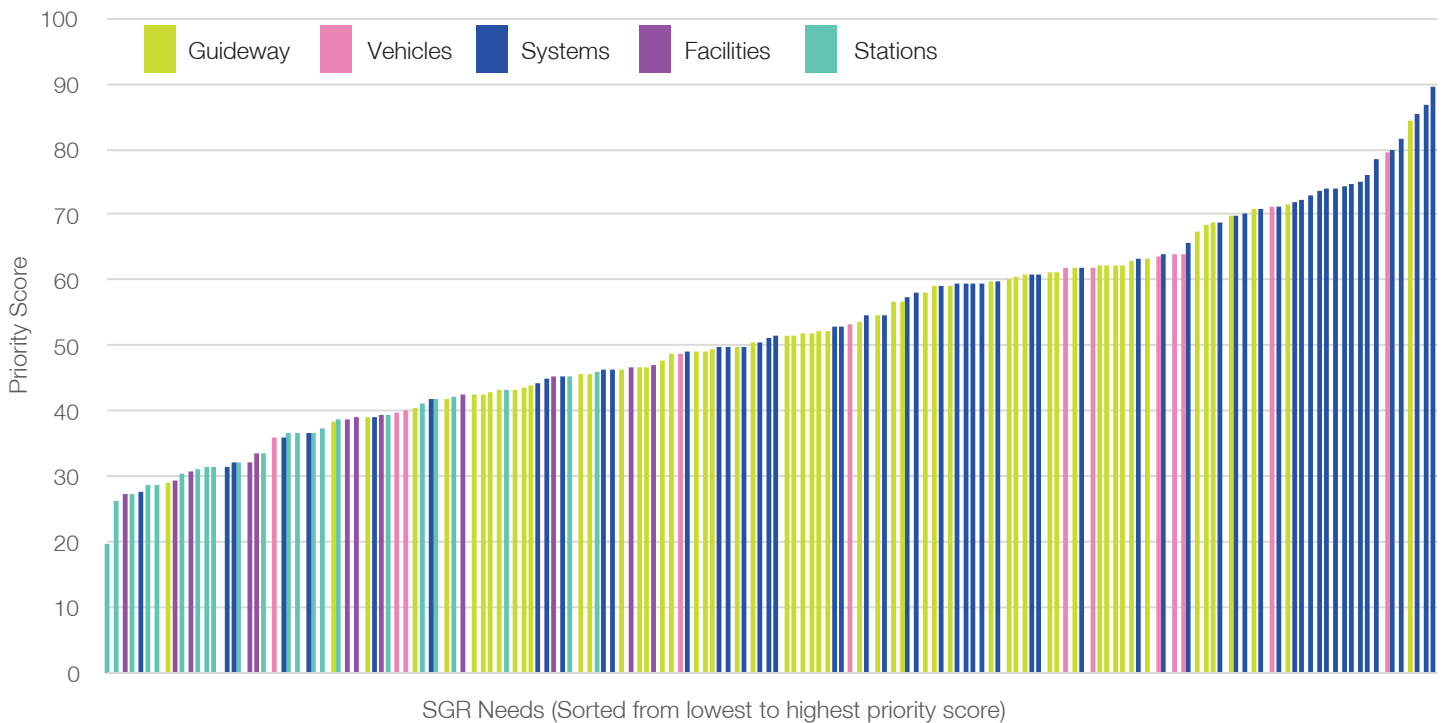


Figure 2-4: All SGR Needs Sorted by Priority Score

Risk Profile of 10-Year SGR Needs

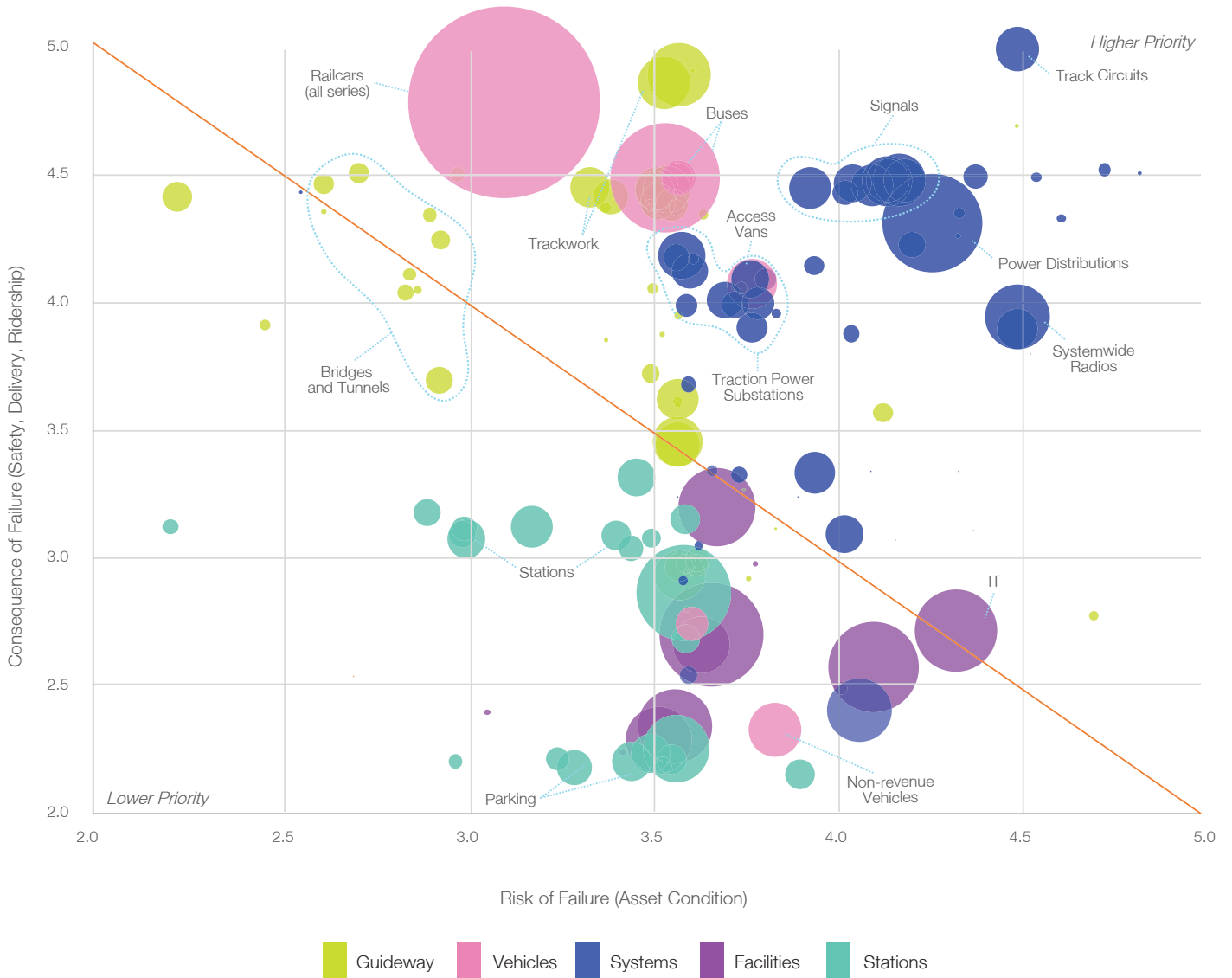


Figure 2-5: 10-Year SGR Needs

2.2019 CNF –System Modernization

Modernization needs improve existing services with new technology, address compliance needs with new assets, increase functionality, or improve passenger circulation. The unconstrained modernization needs reported through the 2016 CNI have been updated and supplemented with new information. The unconstrained modernization needs from FY2019 to FY2028 total \$6.83 billion (see [Figure 2-6](#)).

More than \$985 million of these modernization needs address compliance-related issues that impact safety, security, and environmental concerns. Compliance-related modernization needs specifically address the outcomes of an audit or investigation, or help Metro meet current codes or standards. Many SGR needs are interdependent with these high-priority modernization needs as they will improve the maintenance and operation of Metro's existing assets. For CNF purposes, in 2019 new (non-SGR) investment needs are categorized as system modernization needs.

As shown in [Figure 2-6](#), total system modernization needs over the 10-year period are estimated to be \$6.8 billion.

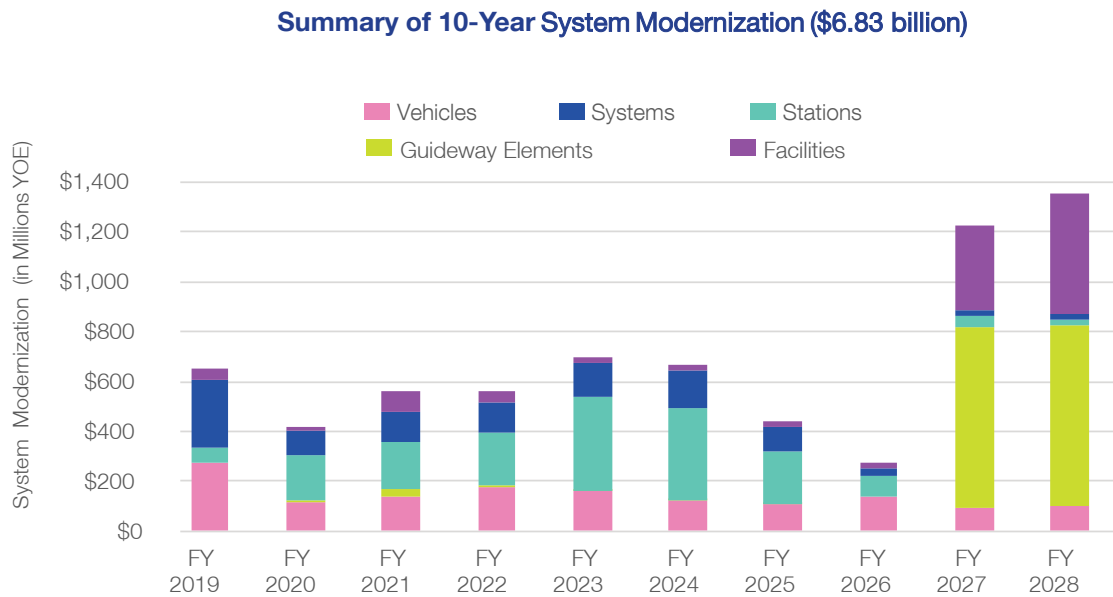


Figure 2-6: Total 10-year System Modernization by Asset Category

3. Metro's Capital Program

Since FY2015, Metro's pace of capital investments has increased significantly to meet critical needs. The FY2020 capital budget includes \$1.74 billion in capital program investment and is grounded in the principles set forth in Metro's strategic plan, *Keeping Metro Safe, Reliable and Affordable*.

Metro is currently transitioning from a reactive capital program - where the focus was on quickly repairing failing assets - towards a program that identifies and targets assets before they fail. Metro is now in the process of focusing investments on assets and systems which directly impact the ability to provide timely and consistent service now and in the future. There is still more work to be done, but the transformation is in progress. This document summarizes forecasted capital needs analysis as of December 2018. Subsequent to development of this document Metro has continued to retool our efforts to maintain, modernize, and upgrade our infrastructure with a view towards the long-term.

This *Capital Needs Forecast* (CNF) includes existing and anticipated needs to improve safety and achieve and then maintain assets in SGR, modernize and upgrade infrastructure, and meet regulatory compliance. The estimates contained in this document do not represent individual projects. They are based on asset status as of December 2018 and are a component in identifying repair and replacement needs in creation of the capital plan.

In addition to the CNF, Metro will be publishing this fall:

- **Capital Program Strategy** – this publication will establish the vision, high-level strategy and goals for capital investments. It will outline Metro's priorities and outcomes of what we expect the capital program to achieve.
- **10-Year Capital Plan** – this publication will detail how Metro will achieve the Capital Program Strategy. It will identify and explore initiatives and projects aligning to the strategy including project-level detail, estimates, and schedules for capital initiatives. It will be a list of capital investment plans and will include concepts and future projects resulting from current or planned studies.
- **6-Year Capital Improvement Program** – this publication will be a specific list of priority projects and programs both for the FY2021-2026 Capital Improvement Program and the Capital Budget proposed for FY2021.



A. Appendices

A.1. Methodology

Metro is committed to continually improving the data-driven methodology established in 2016 to identify and prioritize capital needs. The 2016 CNI represented a significant improvement in Metro's approach to quantifying capital needs. The 2019 CNF builds on that methodology to provide greater accuracy and granularity. The CNF is founded on Metro's inventory of existing assets and asset conditions, along with identification of modernization needs that address compliance requirements and improve passenger circulation. The criteria used to prioritize needs were applied across SGR and modernization needs and are designed to support progress toward Metro's strategic objectives.

A.1.1 Methodology Overview

The methodology used in the 2019 CNF was based principally on the methodology used for SGR in the 2016 CNI (see 2016 CNI Final Report for more details²). Multiple improvements were made for this iteration using improved data sources and more accurate processes. Key to the methodology behind the 2019 CNF is the concept of Unconstrained SGR Needs. SGR needs include any replacement or rehabilitation (including rebuild or overhaul) of an existing asset that will provide the same or similar function, even if the replacement includes improved functionality or capacity. SGR needs also include annual capital maintenance (ACM) of large infrastructure assets, such as bridges and tunnels, which require periodic maintenance to sustain SGR.

A.1.1.1 Guiding Principles

The 2019 CNF continues to use industry best practices and support Metro's commitment to *Keeping Metro Safe, Reliable and Affordable*.

The CNF's needs identification and investment prioritization approaches continue to align with Federal Transit Administration (FTA) guidance under MAP-21 legislation and review of approaches used by peer agencies, which include:

- Data-driven approaches that provide support for informed funding discussions
- Simple prioritization criteria with defined measures for continuous use and communication, ideally with no more than five or six criteria
- Asset condition information to provide priority for near-term needs

Metro Strategic Plan Alignment

In the 2019 CNF, Metro maintains the prioritization criteria developed in 2016 as they align with the strategic goals of *Keeping Metro Safe, Reliable and Affordable* (see [Figure A-1](#)).

² <https://www.wmata.com/initiatives/plans/upload/CNI-full-report-and-appendices.pdf>

A.1.1.2 Prioritization

The prioritization process is designed to evaluate the extent to which each proposed investment contributes to the Metro strategic goals identified in [Figure A-1](#).

Following best practices of defining measurable and simple prioritization objectives, the following four criteria were selected as the foundation of the prioritization process:

- Asset Condition
- Safety and Security
- Service Delivery
- Ridership Impact

Each criterion was defined based on the impact of an investment on an asset to either improve its condition, which contributes to Metro’s SGR, or the impact of an investment to mitigate risks. Generally, the criteria are scored on a common scale of 1 (lowest) to 5 (highest) using a variety of data-driven measures to determine the scores for an asset. A sample for the asset condition criterion is shown in [Figure A-2](#).

A brief description of each priority criterion is provided in the following paragraphs and a summary of corresponding scoring approaches is provided in [Figure A-3](#). Additional information regarding the prioritization criteria, measures that support prioritization criteria, and scoring under each criterion is presented in [Appendix 2 Part 1](#) and [Appendix 4](#) of the 2016 CNI Final Report.

The **Asset Condition** criterion reflects Metro’s focus on renewing assets to improve existing services. The criterion is assessed using empirically based asset decay curves utilizing FTA’s 5-point TERM condition scale. Unlike other criteria used for prioritization, asset condition is recalculated during each year of the CNF analysis period based on the asset’s age and position along the decay curve, meaning as assets age their condition deteriorates and their priority increases (see [Figure A-3](#)). This dynamic scoring of condition follows FTA’s development of decay curves for the purposes of projecting future asset conditions.

The **Safety and Security** criterion reflects Metro’s commitment to investing in safety improvements. Asset investments are assessed based on the industry standard Military Standard (MIL-STD 882E), which provides a risk-based assessment of potential hazards by combining the severity and probability of an incident. A combined safety or security score for each type of asset in Metro’s inventory is based on where it falls in the hazard assessment matrix. Unlike Asset Condition, scoring for Safety and Security is static by asset type, meaning that scores do not change based on the year of analysis.

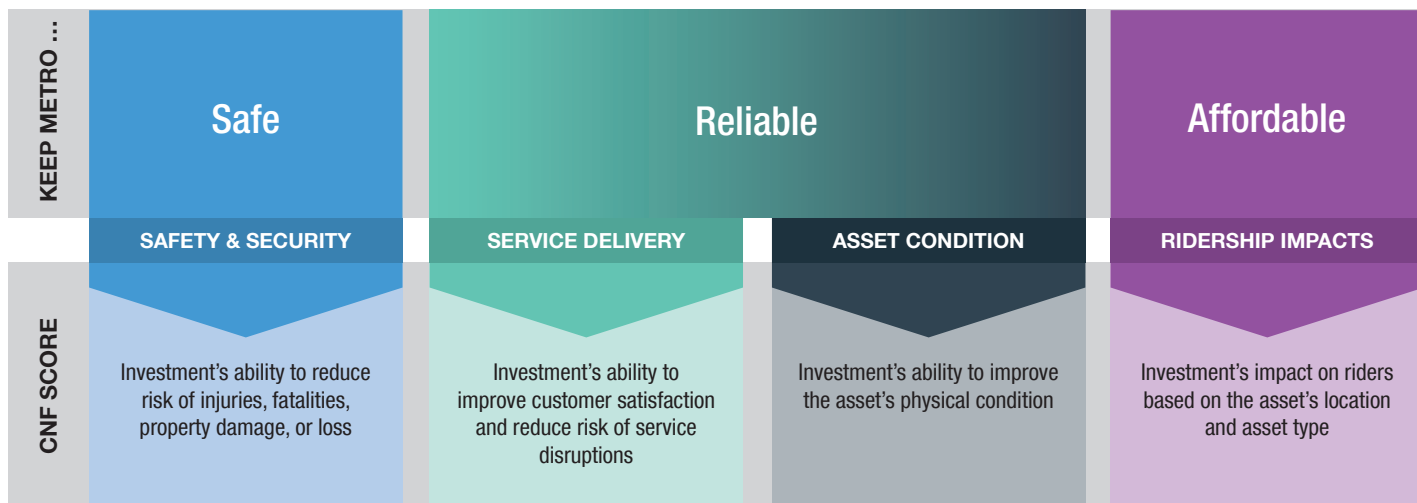


Figure A-1: CNF criteria alignment with Metro’s strategic goals.

Appendices

The **Service Delivery** criterion prioritizes investments that improve reliability and customer experience. It is assessed based on an asset's percentage impact on customer satisfaction as reported through Metro's quarterly customer survey, where service reliability or on-time performance has been shown to provide the greatest benefit to customers. The age of the asset also is incorporated into this measure to reflect the increased priority of reinvesting in older assets, in poorer condition, to improve customer experience. This criterion aims to capture both an investment's ability to meet customer expectations for service and reduce the risk of service failures/disruptions. The Service Delivery criterion is a combined criterion with both static and dynamic scoring by asset type.

Finally, the **Ridership Impact** criterion is assessed based on the average number of weekday riders affected by an asset. Ridership levels are based on the mode an asset serves (paratransit, bus, or rail) and the location of the individual asset in the system. To ensure that areas with low levels of ridership receive priority, a logarithmic scale is used for this measure with the maximum set to about 640,000 riders—or, the average weekday ridership of Metrorail. In the current CNF, the ridership values corresponding to asset types was updated with 2018 data to better reflect current ridership trends.

While the scoring methodologies for Asset Condition, Safety and Security, and Service Delivery were maintained from the 2016 CNI, additional improvements were made to scoring for Ridership Impact in the 2019 CNF. These improvements reflect a more accurate application of ridership to linear assets and rail systems. Detailed information on the change in methodology can be found in [Section A.2](#).

Condition	Asset Condition	Priority Score	Description
Excellent	5	1	New Asset
Good	4	2	Minimal signs of wear
Adequate	3	3	Asset has reached its mid-life
Marginal	2	4	Asset reaching or just past its useful life
Poor	1	5	Asset past its useful life/in need of immediate repair or replacement

Figure A-2: Asset Condition Scoring and Priority

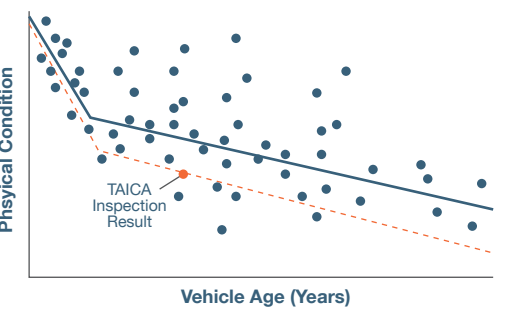
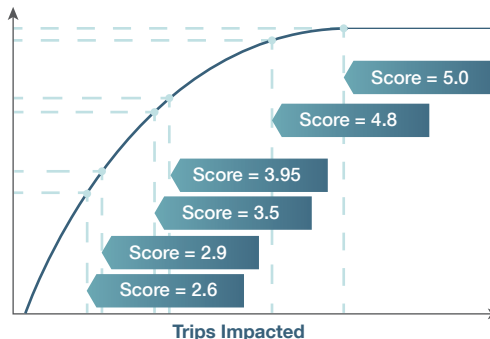
Criterion	Scoring Definition	Scoring Guidelines	Illustrated Scoring Approach																																									
<p>ASSET CONDITION</p>	<p>The physical condition of an asset.</p>	<p>Based on the inverse of FTA Condition Rating, where in a scale of 1 to 5: 1 = Best Asset Condition 5 = Worst Asset Condition Dynamic Scoring: Condition decays as asset ages</p>	<p>Asset Condition Decay Curve</p> 																																									
<p>SAFETY AND SECURITY</p>	<p>The degree to which asset reinvestment impacts the safety and security of passengers and employees.</p>	<p>Based on industry standard (MIL-STD-882E) risk assessment matrix, where in a scale of 1 to 5: 1 = Low Risk Assets 5 = High Risk Assets Static Scoring: Based on asset type</p>	<p>Safety and Security Hazard Risk Assessment Matrix</p> <table border="1" data-bbox="1055 714 1494 1071"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Severity</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> </thead> <tbody> <tr> <th rowspan="6">Probability</th> <th>A</th> <td>5</td> <td>5</td> <td>3</td> <td>2</td> </tr> <tr> <th>B</th> <td>5</td> <td>4</td> <td>3</td> <td>2</td> </tr> <tr> <th>C</th> <td>4</td> <td>3</td> <td>2</td> <td>1</td> </tr> <tr> <th>D</th> <td>3</td> <td>2</td> <td>2</td> <td>1</td> </tr> <tr> <th>E</th> <td>2</td> <td>2</td> <td>2</td> <td>1</td> </tr> <tr> <th>F</th> <td colspan="4">0</td> </tr> </tbody> </table>			Severity				1	2	3	4	Probability	A	5	5	3	2	B	5	4	3	2	C	4	3	2	1	D	3	2	2	1	E	2	2	2	1	F	0			
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	E	2	2	2	1																																							
	F	0																																										
<p>SERVICE DELIVERY</p>	<p>The degree to which reinvestment improves customer satisfaction and service reliability or reduces risk of service failures.</p>	<p>Based on the age and the relative effect of the asset on service reliability, where in a scale of 1 to 5: 1 = Low Service Delivery Impact 5 = High Service Delivery Impact Combined Scoring: Based on asset type (fixed) and condition (dynamic)</p>	<p>Service Delivery Combined Scoring</p> 																																									
<p>RIDERSHIP IMPACT</p>	<p>The relative number of riders impacted by asset reinvestment.</p>	<p>Based on a logarithmic evaluation of the relative effect of the asset on ridership, where in a scale of 1 to 5: 1 = Low Ridership Impact 5 = High Ridership Impact Static Scoring: Remains fixed throughout years of analysis based on asset type and location</p>	<p>Logarithmic Metro Ridership Curve</p> 																																									

Figure A-3: Prioritization Criteria Summary

Special Circumstances

One result of the 2016 CNI effort was to refine Metro’s definition of compliance needs to focus resources where they are needed most urgently. Metro identifies individual assets or bundles of assets that have a higher priority due to compliance reasons in the current CNF. Unlike the 2016 CNI, the reasons to be identified as a compliance need have been narrowed to include only:

- Assets that have been damaged in accidents or have been identified through investigation or audit as requiring replacement
- Assets that no longer meet code, standard, or regulation (this includes legal and industry requirements only)

Compliance actions include responses to National Transportation Safety Board (NTSB) recommendations, FTA and WMSC findings, or Metro internal investigations. They also include assets that no longer meet standards or codes for safety or environmental compliance. If an individual asset, asset type, or project submission is identified as a “Compliance” need, it automatically receives the highest-possible score for the Asset Condition criterion.

A.1.1.3. Prioritization Weights

Metro uses a risk-based weighting approach to combine the four individual prioritization criteria into a single, overall prioritization score.

The objective of the risk-based approach is to assign the highest prioritization scores to those investments that are most likely to yield a significant reduction in the probability of safety or service incidents (see [Figure A-4](#)). This allows

Metro to concentrate investments on safety and service critical needs, while also allowing for innovations that may improve ridership and customer experience.

Under the risk-based approach, Asset Condition is used as a proxy for the probability of asset failure. Therefore, it receives 100 percent of the weight for probability. The three remaining criteria—Safety and Security, Service Delivery, and Ridership Impact—all represent the consequences to Metro and its riders of asset failure. Metro puts the highest weight on Safety and Security.

A.1.2. Evolution of the Needs Forecasting

The 2019 CNF is the third and current edition of a 10-year needs forecast produced by Metro. Over the years, the forecast has evolved to better align, represent, and report Metro’s capital needs by continuously adopting refinements toward a more data-driven process. The 2019 CNF includes changes to the grouping of assets to accommodate larger volumes of SGR data from TAICA, improved ridership scoring for track and rail systems, and more accurate track inventory records.

A.1.2.1. 2010 CNI: 2011 to 2020

In 2010, Metro produced a 10-year CNI through a Call for Needs process where project managers submitted capital projects. Prioritization was done by Metro staff who voted on projects across multiple criteria during facilitated workshops. The 2010 CNI outlined more than \$11 billion in total needs over 10 years (FY2011 to FY2020).

Risk-Based Weighting of Criteria



Figure A-4: Risk Based and Compliance Scoring

Some of the key limitations identified by Metro of the 2010 CNI included:

- Lack of asset condition data: At the time, Metro lacked a comprehensive asset database with an inventory of asset conditions or useful lives as a basis for the development of the 2010 CNI. Without a consolidated database of Metro's asset inventory and condition ratings, only needs identified by managers were raised and included in the process.
- Qualitative prioritization approach: The evaluation and prioritization of asset needs was based on qualitative assessment by management. While the professional judgment for major asset categories reflected asset conditions at high levels, it yielded a product that was largely based on trade-off analyses.
- Mix of assets and projects: The 2010 CNI attempted to propose individual projects rather than articulate asset-based investment needs. This resulted in an itemized list of projects without adequate consideration paid to the overall asset needs and readiness of individual projects to enter the Capital Improvement Program (CIP).

A.1.2.2. 2016 CNI: 2017 to 2026

In the spring of 2016, Metro began to develop the second iteration of the CNI. Metro considered best practices for asset management and focused on developing processes founded on quantifiable prioritization criteria and asset inventory data. The 2016 CNI aimed to improve Metro's 10-year capital needs estimates by setting the following goals:

- Construct an objective, data-driven, and risk-based approach to estimate Metro's major rehabilitation and capital asset replacement/acquisition needs.
- Build a prioritization methodology aligned with Metro's strategic goals and grounded in asset inventory and conditions assessments (see [Figure A-3](#)).
- Ensure that safety, service delivery, ridership, and asset conditions will drive need prioritization in a quantifiable and data-driven manner (see [Figure A-4](#)).

- Construct a process that will support the construction and ongoing stewardship of a TAM plan required by the FTA.
- Coordinate the CNI with ongoing improvements in Metro's capital program development process.

Using these goals as guidelines, improvements in the 2016 CNI included:

1. Constructed a consolidated capital asset inventory based on existing or previous asset management inventories and the initial phase of the TAICA program. This inventory provided a basis for understanding Metro's needs that did not rely on project managers to anticipate capital investments beyond the reach of the current CIP.
2. Incorporated a risk-based and data-driven asset evaluation framework built on the FTA's TERM Lite. This step developed the 2016 CNI into a product driven by data on condition estimates, safety and security, service delivery, and ridership to determine the priority ranking of investment needs rather than depend largely on professional judgment.
3. Accounted for and reported both anticipated needs as well as compliance requirements (see [Appendix 1 Part 2](#)), allowing decision makers to understand the magnitude and resources demanded of critical safety or compliance-driven directives.
4. Shifted the focus to SGR needs by emphasizing the prioritization of safety and service delivery improvements.
5. Clarified the role and purpose of the 2016 CNI by restructuring it as a needs inventory rather than a list of projects. The 2016 CNI articulated and prioritized the investment levels needed by groups of assets, allowing the development or identification of scoped projects to follow a separate step through the development of Metro's Capital Program (i.e., project development and readiness evaluation).

While the 2016 CNI utilized condition scoring for some asset types to determine the effective age or effective

useful life of assets—including major structures like bridges and tunnels—overall, condition data was not complete or available for most asset types during the development of the 2016 CNI. Other drawbacks of the 2016 process also were based on the timing of its completion compared to ongoing work at the Authority and included:

1. Trackwork inventory did not capture SafeTrack improvements that were happening concurrently with development of the asset inventory records.
 - SafeTrack was an accelerated track work plan put in place to address safety recommendations and rehabilitate the Metrorail system to improve safety and reliability.
 - SafeTrack started on June 4, 2016, and the \$163 million program was completed in 16 safety surges during the period of a year.
2. Facilities and stations did not have reinvestments planned based on the condition of major components or subsystems. Reinvestments in facilities and stations were based on either the submission of a project to the capital program that identified a specific SGR need or generalized rehabilitation plans at the mid-life of a station or facility.
3. Metro’s location hierarchy was incomplete in the 2016 asset inventory, which limited the usefulness of grouping individual SGR needs into geographic groups. For example, the location hierarchy is meant to map rail assets to a construction section, station or yard, and individual building (i.e., Section C, Alexandria Yard, Building A Service and Inspection).

2016 CNI – New Investment Needs

In the 2016 CNI, Metro conducted a Call for New Needs (CFN) process to solicit information on new needs from Metro managers. New needs had not previously been documented alongside the reinvestment needs of existing assets. In the CFN process of the 2016 CNI, a total of 152 new needs were identified. At the time of the 2016 CNI, the definition of new needs included needs that replace an existing asset with a new asset that provides a new function or improves the existing asset by demonstrably impacting safety, security, ridership, and/

or service delivery. This group of 35 identified needs was later determined to be SGR and subsequently removed from the list of enhancement needs in the 2016 CNI database, leaving 117 new investment needs that originated through the CFN process. A summary of the improvements in methodology for each iteration of capital needs is shown below in [Table A-1](#).

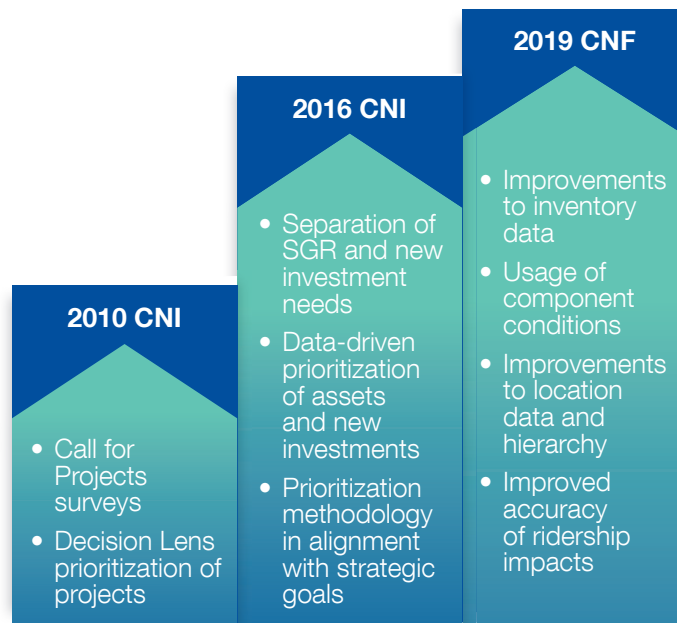


Table A-1: Evolution of Metro’s Needs Forecasting

A.1.2.3. 2019 CNF: 2019 to 2028

The 2019 CNF was developed as an evolution or refinement of the 2016 CNI SGR methodology. The same data-driven, quantifiable approach to SGR needs and prioritization was applied in this iteration. Metro’s primary focus for the 2019 CNF was on improving data quality and addressing the limitations of the previous outputs. As such, most of the modifications to the 2019 CNF added or refined elements that improved the 2016 CNI SGR needs forecasts, including:

1. Use of operable segments as the basis for track assets to better coordinate with the way Metro operates and maintains Metrorail. The change in inventory structure also included the use of total risk on service scoring developed by Metro’s Maintenance of Way Engineering (MOWE) as the basis of ridership prioritization scoring for track assets (see details below).

- Integration of actual inspection data to determine the “effective age” of operable segments for the updated track inventory. Defective components, including running rail, fasteners, ties and grout pads, are aggregated across a segment to determine if each segment is in SGR or requires immediate reinvestment. This approach captures the current condition of track to determine the level of near-term reinvestment needs, which also quantifies the improvements brought on by the SafeTrack program.

A further improvement to track needs is based on Metro’s emerging preventative maintenance program, which will continuously reinvest in track maintenance at low levels to maintain track in SGR following the current maintenance required to address the backlog of needs. With this approach, track assets receive annual capital maintenance (ACM).

- Inclusion of a greater number of facilities based on the results of Metro’s asset management efforts to develop a comprehensive listing of all buildings at every site.

- Components with shorter replacement cycles, from 10–20 years, were accounted for in multiple rehabs using this methodology. For example, air compressors and water heaters are renewed every 15 years, so are included both the 15– and 30–year rehabs.
- Incorporation of condition data from the TAICA program to more realistically reflect the condition of Metro’s assets and the needs associated with them. Specifically, the inclusion of TAICA data for facilities, stations, traction power substations, chiller plants, train control rooms, and tie breaker stations increased the accuracy of renewal plans for those asset types, as shown below in [Figure A-5](#). TAICA building inspection data provides detailed records of components and subsystems, including in-service dates, renewal dates, and condition scores. This information was used to determine the pattern of rehabilitations required by facility or station type, based on when specific components of the building required replacement and how much components cost. Rehabilitation needs are now based on the total value of actual component replacements needed in each time period.

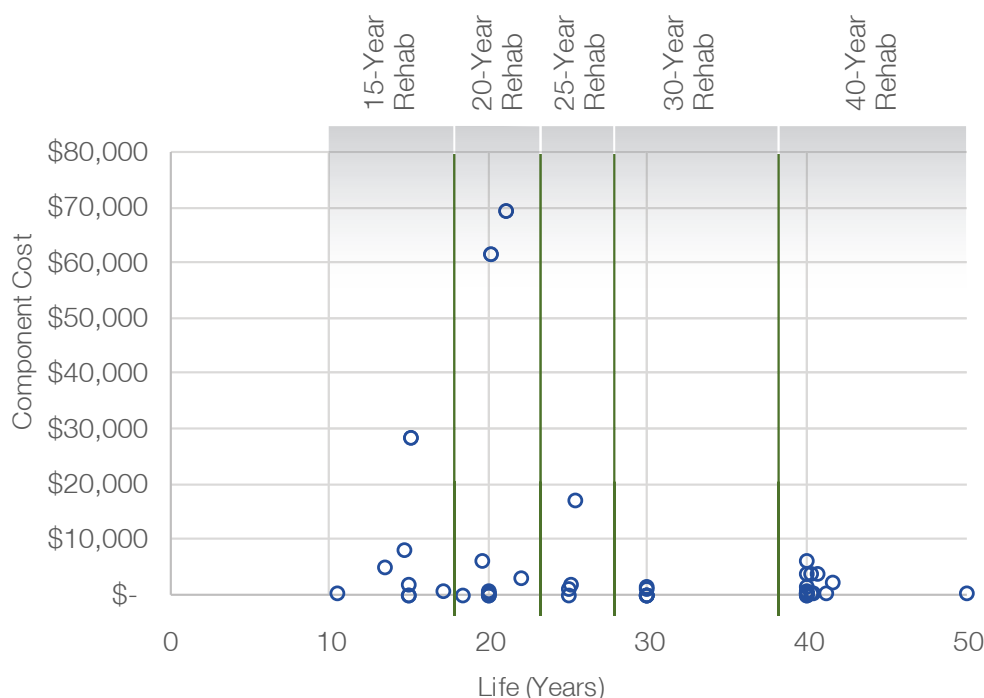


Figure A-5: Building Component Replacement Example: TPSS Components

6. Grouping of asset records to accommodate the larger volumes of asset data from TAICA. The 2019 CNF groups asset records at a different level than in the 2016 CNF to allow for more granular asset types to be represented.
7. Completion of location hierarchy data for all assets in the existing inventory to allow needs grouping at any geographic level. The 2019 CNF allows for the grouping of needs at individual buildings and operable segments. This data is being used to support the new capital program development process.

Advances in Ridership Approach

In addition to the changes noted above regarding needs identification and groupings, Metro also improved the use of ridership data for prioritization in the 2019 CNF.

Update to 2018 Ridership Values

Ridership Impact is one of the four criteria used to prioritize Metro's capital needs. To more accurately reflect current ridership impacts, Metro updated the table of ridership by location to match 2018 levels. This update captures changes in ridership trends that could impact Metro's priorities for reinvestment. Compared to the previous year, 2018 saw a decrease in average weekday ridership across portions of the Metro system, which includes declines in Metrorail and Metrobus ridership. While overall ridership has decreased due to several factors, ridership has increased since 2016 in some locations and services.

Mode	2016 Average Weekday Trips	2018 Average Weekday Trips	Change
Systemwide	1,155,918	1,035,054	-10.5%
Metrorail	712,843	640,649	-10.1%
Metrobus	436,801	385,795	-11.7%
MetroAccess	6,274	8,610	37.2%

Table A-2: Ridership Changes by Mode from 2016 to 2018

As seen below, average weekday ridership decreased across all modes except for MetroAccess, which saw an increase of about 2,300 daily riders in 2018 (see [Table A-2](#)).

Despite this systemwide ridership decrease, many Metrorail stations saw increases in average weekday ridership including Eisenhower Avenue, Federal Center SW, and NoMa-Gallaudet U. Additionally, several new Silver Line stations saw increases in weekday ridership including Greensboro, McLean, and Tysons Corner.

Finally, ridership impacts were updated to account for new locations in the Metrobus system. The Silver Spring Transit Center, which opened in 2015, did not have a full year of ridership available in 2016 and has since been added as a new ridership location. The opening of the new Cinder Bed Road bus facility, which supports Metrobus fleet maintenance and operations activities in Fairfax County and Alexandria, VA, also has been added.

Change to Ridership Methodology for Track

To prioritize future investments to track, each operable segment in the Metrorail system was assigned a Total Impact score on a scale of 0 to 11. The Total Impact score for each operable segment not only takes into account the potential ridership impacts to customers on that individual segment but also the total impact to the wider Metrorail system if any one segment were to be taken out of operation or single-tracked, as such actions have rippling effects across the network. In other words, Total Impact calculates the potential impact of a single operable segment to systemwide ridership based on the operating impacts to the whole network.

The highest-risk rail segments in the Metrorail system are most commonly found in the core of the system, where ridership is highest and multiple lines converge and overlap. This includes interlockings at Farragut North station as well as tracks and switches at Judiciary Square station and Dupont Circle station, which carry passengers through the core of Washington, DC, along the Red Line, the oldest and busiest line in the Metrorail system.

To associate the concept of Total Impact with ridership impacts, a simple linear scale was applied where the highest-possible Metrorail ridership corresponds to the highest Total Impact and the lowest Metrorail ridership (associated with an individual segment) corresponds to

the lowest Total Impact (see Table A-3). While more complex relationships could be drawn, Metro chose to maintain a simple, easier to communicate approach to prioritization scoring.

Refinement to Ridership Impact of Rail Systems

In the 2016 CNI, critical rail systems were assigned the ridership of an entire construction section. This was done for two reasons: 1) when rail systems fail they tend to have systemic impacts beyond their individual location, and 2) the location hierarchy at the time did not support assignment of rail systems to more granular locations than construction sections. For the 2019 CNF, ridership assignments to rail systems—including train control and traction power—were calculated based on the specific location of the asset and the criticality of that location to network operations. This refinement of ridership impact allows for the exact location of an asset to be associated with the level of systemic impact it will have.

The first step in the new methodology was to determine the number of lines served by a system asset and then consider the service criticality of additional locations, which would increase the impact of assets due to Metro’s operational flexibility. Assets serving “core lines”—those that include three or more Metrorail lines—were assigned a high ridership criticality of 640,649, the average weekday ridership of the entire Metrorail system. If these assets fail, services will be disrupted across the entire system. Ridership assignments were then scaled down evenly for assets on two lines, which are assigned medium criticality, and those on single lines are assigned low criticality as shown in Table A-4.

Total Impact	Ridership Level
11	640,649
10	582,601
9	524,553
8	466,505
7	408,457
6	350,409
5	292,361
4	234,313
3	176,265
2	118,217
1	60,169
0	2,121

Table A-3: Relationship between Total Impact and Track Ridership

Ridership Criticality	Rail System Ridership Impact
Low Criticality	213,550
Medium Criticality	427,099
High Criticality	640,649

Table A-4: Rail System Ridership Impacts by Line

Tysons Corner traction power substation, for example, serves only the Silver Line and received a ridership impact of 213,550 riders. However, Crystal City traction power substation serves two lines (Yellow Line and Blue Line) and therefore received a ridership impact of 427,099 riders.

Traction power substations that serve three or more lines received ridership impacts equivalent to entire system ridership given their prominent roles as key hubs and transfer stations in the overall system. Core lines include assets surrounding the following locations:

- Gallery Place-Chinatown (Red Line, Green Line, and Yellow Line)
- Metro Center (Red Line, Blue Line, Orange Line, and Silver Line)
- L’Enfant Plaza (Green Line, Yellow Line, Blue Line, Orange Line, and Silver Line)
- Rosslyn (Yellow Line, Blue Line, and Silver Line)

Additional systems located along the following segments are considered medium or high criticality due to the service criticality of the area or the ability to perform short service operations:

- Farragut North to NoMa-Gallaudet U (Red Line) is considered Core Line
- Dupont Circle to Grosvenor (Red Line) is considered Double Line
- Rhode Island Avenue to Silver Spring (Red Line) is considered Double Line
- Mt Vernon Square to L’Enfant Plaza (Green Line and Yellow Line) is considered Core Line

Figure A-6 illustrates the assignment of system ridership for rail systems across the network.

Washington Metro
Schematic Track Map



Figure A-6: Metrorail Schematic Map for Rail Systems Ridership

* While G carries two lines, it is considered Low Criticality due to the operational flexibility of rerouting trains to New Carrollton in the event of a failure and overall lower ridership on the outer line.

A.2 Useful Life and Lifecycle Policies by Asset Type

Table A-5 summarizes the range of useful lives and rehabilitation (rehab) plans for Metro’s asset types. The rehab costs provided in Table A-5 are as a percent of the total replacement cost of the assets. Some assets have annual capital maintenance (ACM) instead of a defined rehab. These are expenses that Metro incurs each year to maintain assets in SGR. The following asset types are assigned an annual expenditure of 0.25 percent:

- Aerials (heavy rail bridges)
- Facility components (drainage, built-in equipment, employee parking, and safety systems only)

- Elevators and escalators
- Wayside train control and switch machines

Underground tubes and tunnels differ from the asset types listed above and have an ACM of 0.11 percent based on historical levels of capital reinvestment in Metro’s underground structures.

A major change from the 2016 CNI is the application of 4.5 percent ACM to all trackwork records. The annual capital investments made in trackwork are aligned with Metro’s preventative maintenance approach to maintaining track assets following the major investments needed to address the backlog of track needs.

Table A-5: Useful Life by Asset Type

Category	Sub-Category	Element	Sub-Element	Useful Life Range	# of Rehabs	Rehab Cost(s)
Guideway Elements	Guideway	At Grade Ballast	Heavy Rail	50 years	0	N/A
Guideway Elements	Guideway	Elevated Structure	-	36 years	0	(0.25% ACM)
Guideway Elements	Guideway	Elevated Structure	Heavy Rail	4 - 50 years	0	(0.25% ACM)
Guideway Elements	Guideway	Elevated Structure	Bridge	27 - 50 years	0	(0.25% ACM)
Guideway Elements	Guideway	Elevated Structure	Foot Walk	4 - 50 years	0	N/A
Guideway Elements	Guideway	Underground	Tunnel Heavy Rail	80 years	0	(0.11% ACM)
Guideway Elements	Guideway	Underground	Cut & Cover Heavy Rail	80 years	0	(0.11% ACM)
Guideway Elements	Guideway	Underground	Tube	80 years	0	(0.11% ACM)
Guideway Elements	Guideway	Underground	Steel Liner	25 - 55 years	0	N/A
Guideway Elements	Trackwork	Direct Fixation	-	40 years	0	(4.5% ACM)
Guideway Elements	Trackwork	Ballasted	-	40 years	0	(4.5% ACM)
Guideway Elements	Trackwork	Special	Direct Fixation Double Crossover	40 years	0	(4.5% ACM)
Guideway Elements	Trackwork	Special	Ballasted Double Crossover	40 years	0	(4.5% ACM)
Guideway Elements	Trackwork	Special	Direct Fixation Single Crossover	40 years	0	(4.5% ACM)
Guideway Elements	Trackwork	Special	Ballasted Single Crossover	40 years	0	(4.5% ACM)
Guideway Elements	Trackwork	Special	Direct Fixation Turnout	40 years	0	(4.5% ACM)
Guideway Elements	Trackwork	Special	Ballasted Turnout	40 years	0	(4.5% ACM)
Guideway Elements	Trackwork	Special	Turntable	14 - 46 years	0	N/A

Appendices

Category	Sub-Category	Element	Sub-Element	Useful Life Range	# of Rehabs	Rehab Cost(s)
Guideway Elements	Trackwork	Yard	-	70 years	0	(4.5% ACM)
Guideway Elements	Special Structures	Fencing	-	15 - 48 years	0	N/A
Guideway Elements	Special Structures	Retaining Walls	-	2 - 48 years	0	N/A
Guideway Elements	Bus Guideway	Turnaround	-	20 years	0	N/A
Facilities	Buildings	Administration	-	35 - 50 years	4	3.5%-4%-8.7%-7.5%
Facilities	Buildings	Administration	Police	3 - 60 years	4	10%-10%-25%-22%
Facilities	Buildings	Maintenance	-	35 - 60 years	4	2%-5%-8%-7%
Facilities	Buildings	Maintenance	Bus	35 - 60 years	4	9%-16%-34%-25%
Facilities	Buildings	Maintenance	Rail Heavy Rail	35 years	1	0.5 (0.25% ACM)
Facilities	Buildings	Building Components	Plumbing	15 - 42 years	0	(0.25% ACM)
Facilities	Buildings	Building Components	Drainage	25 years	0	(0.25% ACM)
Facilities	Buildings	Building Components	Access and Parking	29 years	0	(0.25% ACM)
Facilities	Buildings	Building Components	Built-in Equipment and Specialties	15 - 40 years	0	(0.25% ACM)
Facilities	Buildings	Building Components	Fall Protection	25 - 30 years	0	(0.25% ACM)
Facilities	Storage Yard	-	-	50 years	1	50%
Facilities	Storage Yard	Bus	Bus Parking	20 years	1	50%
Facilities	Buildings	Bus Turnaround Facility	-	30 - 40 years	1	50%
Facilities	Equipment	-	-	15 years	0	N/A
Facilities	Equipment	MIS/IT/Network Systems	Software	4 - 10 years	0	N/A
Facilities	Equipment	MIS/IT/Network Systems	Computers/Hardware	2 - 8 years	0	N/A
Facilities	Equipment	MIS/IT/Network Systems	Mission Critical Software	5 years	0	N/A
Facilities	Equipment	MIS/IT/Network Systems	Mission Critical Computers/Hardware	5 years	0	N/A
Facilities	Equipment	MIS/IT/Network Systems	SmarTrip Software	7 years	0	N/A
Facilities	Equipment	Maintenance	-	10 years	0	N/A
Facilities	Equipment	Maintenance	Bus	10 - 40 years	0	N/A
Facilities	Equipment	Maintenance	Rail Heavy Rail	10 - 40 years	0	N/A
Facilities	Equipment	Maintenance	Pollution Treatment	30 years	0	N/A

Category	Sub-Category	Element	Sub-Element	Useful Life Range	# of Rehabs	Rehab Cost(s)
Facilities	Equipment	Maintenance	Bus Washer	15 - 42 years	0	N/A
Facilities	Equipment	Maintenance	Train Washer	15 - 41 years	0	N/A
Facilities	Equipment	Maintenance	Vehicle Paintbooth	20 - 30 years	0	N/A
Facilities	Equipment	Maintenance	Fuel Island	15 - 40 years	0	N/A
Facilities	Equipment	Maintenance	Dynamometers	15 - 15 years	0	N/A
Facilities	Equipment	Maintenance	Lifts - Portable	10 - 20 years	0	N/A
Facilities	Equipment	Maintenance	Lifts - Fixed	15 - 30 years	0	N/A
Facilities	Equipment	Maintenance	Brake Lathe	15 - 30 years	0	N/A
Facilities	Equipment	Maintenance	Fuel Tank	15 - 30 years	0	N/A
Facilities	Equipment	Maintenance	Lifts - Fixed: In Floor	15 - 40 years	0	N/A
Facilities	Equipment	Maintenance	Lifts - Fixed: Parallelogram	20 - 40 years	0	N/A
Facilities	Equipment	Maintenance	Wheel Presses	15 - 30 years	0	N/A
Facilities	Equipment	Maintenance	Turntables, Truck	15 - 30 years	0	N/A
Facilities	Equipment	Maintenance	Air Compressor	15 years	0	N/A
Facilities	Equipment	Maintenance	Hoist	15 - 30 years	0	N/A
Facilities	Equipment	Maintenance	Scrubber, Sprayer	10 - 25 years	0	N/A
Facilities	Equipment	Maintenance	Misc Equip	15 - 30 years	0	N/A
Facilities	Equipment	Maintenance	Crane	1 - 30 years	0	N/A
Facilities	Equipment	Maintenance	CNG Refueling Station	30 - 41 years	0	N/A
Facilities	Major Shops	Rail	Heavy Rail	15 - 50 years	4	3%-11%-73%-13%
Facilities	Major Shops	Bus	-	50 years	1	50%
Facilities	Central Control	-	-	35 years	1	50%
Systems	Train Control	Wayside Train Control	Heavy Rail	25 - 40 years	0	(0.25% ACM)
Systems	Train Control	Train Control Room	-	60 years	5	25%-3%-30%-41%-29%
Systems	Train Control	Wayside Train Control	RTU	40 years	0	(0.25% ACM)
Systems	Train Control	Wayside Train Control	Track Circuit	40 years	0	(0.25% ACM)
Systems	Train Control	Wayside Train Control	Train Control Cable	40 years	0	(0.25% ACM)
Systems	Train Control	Interlockings	Switch Machine - Motorized Ballasted	25 - 40 years	0	(0.25% ACM)
Systems	Electrification	-	Heavy Rail	35 years	0	N/A
Systems	Electrification	Substations	AC Switchgear	20 - 30 years	0	N/A

Appendices

Category	Sub-Category	Element	Sub-Element	Useful Life Range	# of Rehabs	Rehab Cost(s)
Systems	Electrification	Substations	DC Switchgear	30 years	0	N/A
Systems	Electrification	Substations	Rectifier	30 years	0	N/A
Systems	Electrification	Substations	Building	60 years	5	19%-61%-9%- 20%-71%
Systems	Electrification	Substations	Battery	10 - 30 years	0	N/A
Systems	Electrification	Substations	Charger	30 years	0	N/A
Systems	Electrification	Substations	SCADA RTUs	25 - 30 years	0	N/A
Systems	Electrification	Substations	Transformer	30 years	0	N/A
Systems	Electrification	Substations	Building Electrical	30 years	0	N/A
Systems	Electrification	Substations	Built-in Equipment and Specialties	30 years	0	N/A
Systems	Electrification	Substations	Conduit	30 years	0	N/A
Systems	Electrification	Substations	Corrosion Control	30 years	0	N/A
Systems	Electrification	Substations	Grounding	30 years	0	N/A
Systems	Electrification	Breaker House	Heavy Rail	60 years	5	23%-45%-11%- 24%-58%
Systems	Electrification	Contact Rail	Contact Rail, composite	35 - 50 years	0	N/A
Systems	Electrification	Contact Rail	Contact Rail, steel	35 - 50 years	0	N/A
Systems	Electrification	Contact Rail	Heaters	7 - 25 years	0	N/A
Systems	Electrification	Power Cable	-	2 - 30 years	0	N/A
Systems	Electrification	Power Cable	Substations	40 years	0	N/A
Systems	Electrification	Power Cable	Contact Rail	40 years	0	N/A
Systems	Communications	-	-	10 years	0	N/A
Systems	Communications	-	Heavy Rail	12 years	0	N/A
Systems	Communications	Cable Transmission System (CTS)	MIS/IT/Network Systems	15 years	0	N/A
Systems	Communications	Passenger Communications Systems	Public Address (PA)	10 years	0	N/A
Systems	Communications	Passenger Communications Systems	Transit Passenger Information Systems (TPIS)	10 years	0	N/A
Systems	Communications	Safety and Security	Emergency Management Panel (EMP)	20 - 25 years	0	N/A
Systems	Communications	Safety and Security	Fire and Intrusion Detection System (IDS)	20 years	0	N/A
Systems	Communications	Safety and Security	CCTV	10 - 20 years	0	N/A

Category	Sub-Category	Element	Sub-Element	Useful Life Range	# of Rehabs	Rehab Cost(s)
Systems	Communications	Safety and Security	CCTV -- Fixed	20 years	0	N/A
Systems	Communications	Safety and Security	Chem/Bio Detection System	20 years	5	18%-19%-20%-21%-22%
Systems	Communications	Phone System	Phone System	12 years	0	N/A
Systems	Communications	Phone System	Telephones	12 years	0	N/A
Systems	Communications	Radio	-	10 - 45 years	0	N/A
Systems	Communications	SCADA	Programmable Logic Controller (PLC)	25 years	0	N/A
Systems	Communications	SCADA	RTU	25 years	0	N/A
Systems	Communications	SCADA	AIM	25 years	0	N/A
Systems	Communications	SCADA	TRACS	20 - 30 years	0	N/A
Systems	Communications	SCADA	Other	25 - 30 years	0	N/A
Systems	Communications	Communications Huts	Hut	25 years	0	N/A
Systems	Communications	Safety and Security	-	20 years	0	N/A
Systems	Revenue Collection	In-Station	Heavy Rail	20 years	0	N/A
Systems	Revenue Collection	In-Station	Turnstiles	20 years	0	N/A
Systems	Revenue Collection	In-Station	TVMs	20 years	0	N/A
Systems	Revenue Collection	In-Station	Parking Meters	15 - 20 years	0	N/A
Systems	Revenue Collection	On-Vehicle	Fareboxes	15 years	0	N/A
Systems	Utilities	-	-	25 years	0	N/A
Systems	Utilities	Lighting	Subway	25 years	0	N/A
Systems	Utilities	Lighting	Station	25 years	0	N/A
Systems	Utilities	Pump Rooms	Subway	15 years	0	N/A
Systems	Utilities	Fire Protection Plumbing	Subway	20 - 30 years	0	N/A
Systems	Utilities	Ventilation	Subway	20 years	0	N/A
Systems	Utilities	Fan Plants	Subway	20 - 37 years	0	N/A
Systems	Utilities	Chiller Plant	Subway	19 - 43 years	1	50%
Systems	Utilities	Emergency Exits	Subway	25 years	0	N/A
Stations	Complete Station	Transfer Center	Bus	20 - 35 years	1	25%
Stations	Complete Station	Bus Stop Shelters	Bus	20 years	1	25%

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Category	Sub-Category	Element	Sub-Element	Useful Life Range	# of Rehabs	Rehab Cost(s)
Stations	Building	At-Grade / Center Platform	At-Grade / Center Platform Heavy Rail	100 years	5	0.3%-5%-11%-11%-27%
Stations	Building	At-Grade / Center Platform	At-Grade / Side Platform Heavy Rail	100 years	5	0.5%-6%-15%-8%-6%
Stations	Building	At-Grade / Center Platform	Elevated / Center Platform Heavy Rail	75 years	5	0.2%-3%-7%-4%-3%
Stations	Building	At-Grade / Center Platform	Elevated / Side Platform Heavy Rail	75 years	5	0.1%-2%-6%-3%-3%
Stations	Building	At-Grade / Center Platform	Subway / Center Platform Heavy Rail	100 years	5	0.2%-0.6%-2%-2%-0.6%
Stations	Building	At-Grade / Center Platform	Subway / Side Platform Heavy Rail	100 years	5	0.3%-0.8%-2%-2%-0.9%
Stations	Building	Building Components	Shelter	20 years	0	N/A
Stations	Building	Building Components	Interior	40 years	1	25%
Stations	Building	Building Components	Station Police Booth	40 years	5	20%-20%-20%-20%-20%
Stations	Building	Building Components	Drainage	42 years	1	25%
Stations	Building	Building Components	HVAC	41 years	1	25%
Stations	Building	Building Components	Exterior	42 years	1	25%
Stations	Building	Building Components	Other	18 - 41 years	1	25%
Stations	Access	Elevators	-	35 years	2	33%-33% (0.3% ACM)
Stations	Access	Escalators	-	35 years	2	33%-33% (0.3% ACM)
Stations	Access	Parking	Garage	37 - 60 years	5	4%-4%-4%-25%-4%
Stations	Access	Parking	Lot	30 years	5	6%-6%-6%-50%-6%
Stations	Platform	At-Grade	Center Platform	19 - 46 years	1	50%
Stations	Platform	At-Grade	Side Platform	40 - 44 years	1	50%
Stations	Platform	Elevated	Center Platform	38 - 40 years	1	50%
Stations	Platform	Elevated	Side Platform	30 - 40 years	1	50%
Stations	Platform	Subway	Center Platform	100 years	1	50%
Stations	Platform	Subway	Side Platform	100 years	1	50%
Stations	Platform	Canopy	Heavy Rail	25 - 41 years	0	N/A
Vehicles	Revenue Vehicles	Heavy Rail	2/3000 Series	40 years	6	24%-24%-24%-24%-24%-24%

Category	Sub-Category	Element	Sub-Element	Useful Life Range	# of Rehabs	Rehab Cost(s)
Vehicles	Revenue Vehicles	Heavy Rail	6000 Series	40 years	6	24%-24%-24%- 24%-24%-24%
Vehicles	Revenue Vehicles	Heavy Rail	7000 Series	40 years	6	24%-24%-24%- 24%-24%-24%
Vehicles	Revenue Vehicles	Bus	Bus (40 ft) - Diesel	15 years	1	39%
Vehicles	Revenue Vehicles	Bus	Articulated Bus (60 ft) - Hybrid	12 years	1	46%
Vehicles	Revenue Vehicles	Bus	Bus (40 ft) - Hybrid	15 years	1	49%
Vehicles	Revenue Vehicles	Bus	Bus (30 ft) - Hybrid	15 years	1	32%
Vehicles	Revenue Vehicles	Bus	Articulated Bus (60 ft) - CNG	12 years	1	34%
Vehicles	Revenue Vehicles	Bus	Bus (40 ft) - CNG	15 years	1	36%
Vehicles	Revenue Vehicles	Bus	Bus (30 ft) - CNG	15 years	1	25%
Vehicles	Revenue Vehicles	Bus	Bus (40 ft) - Electric	15 years	0	N/A
Vehicles	Revenue Vehicles	Vans, Cutaways and Autos	Raised Roof Van	4 years	0	N/A
Vehicles	Non-Revenue Vehicles	-	-		0	N/A
Vehicles	Non-Revenue Vehicles	Car	-	5 - 8 years	0	N/A
Vehicles	Non-Revenue Vehicles	Truck	-	5 - 12 years	0	N/A
Vehicles	Non-Revenue Vehicles	Special	-	6 - 75 years	0	N/A
Vehicles	Non-Revenue Vehicles	Locomotive, Switch	-	20 years	0	N/A
Vehicles	Non-Revenue Vehicles	Van	-	5 years	0	N/A
Vehicles	Non-Revenue Vehicles	Heavy Truck	-		0	N/A
Vehicles	Non-Revenue Vehicles	Van	-	5 years	0	N/A
Vehicles	Non-Revenue Vehicles	Heavy Truck	-	6 years	0	N/A

A.3 List of Assumptions

Table A-6 displays a list of SGR needs by asset group. Assumptions underlying the current CNF rely more heavily on internal Metro sources for information than the 2016 CNI, reflecting the improved quality of data in the current iteration. There also are fewer assumptions in use in the 2019 CNF as more data was available from TAICA. As an example, all assumed traction power substation data for Silver Line locations from 2016 were replaced with actual physical inventory records for the 2019 CNF. The following assumptions were made in compiling the asset inventory for the 2019 CNF, in addition to those listed in the body of the report:

- Facilities replacement values are taken from insurance documents for valuation of facilities, unless full facility values were available from TAICA.
- MetroAccess vehicles costs: Costs of \$93,000 per van (2018 dollars) and \$55,500 per sedan were used (confirmed by MetroAccess staff). Sedans will be used to replace 175 vans in upcoming years.
- Aerials (bridges and pedestrian walkways): TAICA records showed two different condition ratings, which were assigned to a percentage of the asset's length; therefore, two inventory records were created for the asset, with lengths corresponding to the percentage assigned to the condition score. The effective useful life of the lower-scoring asset was calculated based on the condition score to reflect accelerated decay and earlier replacement need.
- Dampers (guideway utilities/tunnel ventilation system): For those records with missing costs, a cost of \$102,000 per damper was used (TAICA PM, 9/21/16).
- Emergency egress hatches (guideway utilities/tunnel emergency exits):
 - o For records with missing quantities, a quantity of 1 was assumed, as quantity data was missing for all records (TAICA PM, 9/21/16).
 - o For those records with missing costs, a cost of \$31,000 per emergency egress hatch was used (TAICA PM, 9/21/16).
- Fan plants, pump rooms, and select ventilation assets (all guideway utilities): For assets with missing date built, median date in service of the same asset type in same tunnel section was used as assumed build date (TAICA PM, 9/21/16).
- Fan plants: For those records with missing costs, a cost of \$7,700 per fan plant was used (TAICA PM, 9/21/16).
- Fences:
 - o TAICA records showed two different condition ratings, which were assigned to a percentage of the asset's length; therefore, two inventory records were created for the asset, with lengths corresponding to the percentage assigned to the condition score. The effective useful life of the lower-scoring asset was calculated based on the condition score.
 - o Maryland Transit Administration Engineering estimate for 9-foot fences used for costs—\$31.17 per linear foot.
- Insulators (electrification/distribution):
 - o Set the useful life of insulators based on location in tunnels with varying degrees of water intrusion—highest level of intrusion is 2 years, moderate intrusion is 4 years, and a dry environment is 15 years (WMATA Engineering).
 - o Replacement cost of insulators assumed to be \$288 per unit (TAICA PM), which is a fully-loaded cost, including labor for installation (derived based on total past expenditures out of the CIP).
 - o Quantity of insulators assigned to a location, including yards, based on proportion of track feet and total of 170,340 insulators on the system.
- Maintenance equipment: Data provided by TAICA was missing install dates for two records and cost data for 17 records. Two core drill unit records were missing install dates and were assigned install dates in line with the 38 core drill units in existing inventory. Industry estimates were used in place of missing cost data for seventeen records ranging from locomotives to aerial lifts.
- MTPD radios: Costs of portable radio units was applied to assumed MTPD radio quantities—assumed total force of 645 and 20 percent spares for quantity.
- Phone systems: Assumed that all individual phones cost \$189 (2004 dollars) (equivalent to four-line Cortelco with auto-attendant).

- PIDs (passenger communications): PIDs costs provided as a total of \$15 million for upgrade and replacement (WMATA Planning).
- Retaining walls:
 - o TAICA records showed two different condition ratings, which were assigned to a percentage of the asset's length; therefore, two TERM Lite records were created for the asset, with lengths corresponding to the percentage assigned to the condition score. The effective useful life of the lower-scoring asset was calculated based on the condition score.
 - o Baltimore MTA Engineering estimate used for costs – \$1,022.67 per linear foot.
- Silver Line revenue collection: All assets were assigned a 2014 install date, except for TVMs, which were rehabbed. An install date of 1996 was used for all Silver Line TVMs to trigger scheduled replacement in 2021 (Automatic Fair Collection, Engineering).
- Silver Line stations: Cost assigned based on Full-Funding Grant Agreement figures. Total costs for at-grade and aerial stations were listed, so an average was calculated for each Silver Line station based on type of \$37.2 million (neat costs, without inclusion of soft costs).
- Soft costs: Soft costs are applied to purchase price or neat replacement costs to reflect the labor (planning, design/engineering, installation, etc.) related to replacement. See Table A-2 in the 2016 CNI report for soft cost applications; asset types not listed in this table are assumed to have fully loaded costs provided (i.e., a soft cost rate of 0 percent).
- Subway fan plants: For records with missing quantities, a quantity of four was assumed based on the median quantity of the other vent fans records (TAICA PM, 9/21/16).
- Subway pump rooms: for records with missing quantities, a quantity of three was assumed based on the median quantity of the other pumping rooms (TAICA PM, 9/21/16).
- Third rail: Tunnel records were used to determine if third rail segments were above or below ground. Belowground segments were assigned 35-year useful life, while aboveground segments were assigned 50-year useful life.
- Tunnels: TAICA records showed two different condition ratings, which were assigned to a percentage of the asset's length; therefore, two TERM Lite records were created for the asset, with lengths corresponding to the percentage assigned to the condition score. The effective useful life of the lower-scoring asset was calculated based on the condition score.
- Tunnel fire lines (guideway utilities/fire protection): For records missing quantities, a length of 1422.5 linear feet was assumed, based on the median fire line length (TAICA PM, 9/21/16).

Appendices

Table A-6: List of SGR Needs by Asset Group

Grouped Need Description	Risk Prob. Score	Risk Conseq. Score	Priority Score	FY19 Cost	FY20 Cost	FY21 Cost	FY22 Cost	FY23 Cost	FY24 Cost	FY25 Cost	FY26 Cost	FY27 Cost	F28 Cost	10 Year Total
Track Circuits, Metrorail, Systemwide	4.48	4.99	89.45	\$132.21	\$0.34	\$0.35	\$0.36	\$0.37	\$0.38	\$0.39	\$0.41	\$0.42	\$0.43	\$135.66
Electrification Distribution, Metrorail, Line L	4.81	4.50	86.71	\$1.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$1.20
Electrification Distribution, Metrorail, Line B	4.72	4.52	85.31	\$7.04	\$0.00	\$0.38	\$0.04	\$1.40	\$0.00	\$0.43	\$0.01	\$1.57	\$0.00	\$10.87
Underground, Metrorail, Leak Mitigation	4.48	4.69	84.07	\$92.27	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$92.27
Electrification Distribution, Metrorail, Line F	4.54	4.42	81.49	\$4.49	\$0.01	\$0.00	\$0.05	\$1.47	\$0.00	\$0.04	\$0.00	\$1.64	\$0.00	\$7.70
Electrification Distribution, Metrorail, Line G	4.60	4.32	79.76	\$2.97	\$0.00	\$0.00	\$0.07	\$1.25	\$0.00	\$0.00	\$0.02	\$1.40	\$0.04	\$5.75
Signals/interlockings, Metrorail, Line G	4.37	4.49	77.26	\$39.60	\$0.14	\$0.15	\$0.15	\$0.15	\$0.16	\$0.24	\$0.17	\$0.17	\$0.18	\$41.10
Electrification Distribution, Metrorail, Line E	4.33	4.35	75.87	\$5.73	\$0.01	\$0.18	\$0.01	\$0.33	\$0.00	\$0.00	\$0.00	\$0.40	\$0.53	\$7.19
Signals/interlockings, Metrorail, Line D	4.18	4.47	74.74	\$124.41	\$0.32	\$0.33	\$0.34	\$0.35	\$0.36	\$0.37	\$0.38	\$0.40	\$0.41	\$127.68
Signals/interlockings, Metrorail, Line C	4.16	4.48	74.52	\$157.02	\$0.48	\$0.49	\$0.51	\$31.69	\$0.54	\$0.55	\$0.57	\$0.59	\$0.60	\$193.04
Electrification Distribution, Metrorail, Line J	4.32	4.26	74.10	\$1.76	\$0.03	\$0.04	\$0.00	\$0.06	\$0.00	\$0.00	\$0.08	\$0.00	\$0.00	\$1.98
Signals/interlockings, Metrorail, Line B	4.13	4.47	73.95	\$119.46	\$0.40	\$0.41	\$0.43	\$6.26	\$0.45	\$0.47	\$0.48	\$0.50	\$0.68	\$129.55
Signals/interlockings, Metrorail, Line A	4.13	4.47	73.87	\$129.61	\$1.44	\$0.56	\$0.43	\$0.44	\$30.86	\$0.58	\$0.49	\$0.50	\$0.52	\$165.42
Electrification Distribution, Metrorail, Heaters and Power Cable	4.25	4.31	73.44	\$399.24	\$4.02	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$284.36	\$0.00	\$0.00	\$687.63
Signals/interlockings, Metrorail, Line K	4.09	4.46	72.88	\$84.28	\$0.30	\$0.36	\$0.32	\$0.33	\$0.34	\$0.35	\$34.70	\$0.37	\$0.39	\$121.75
Signals/interlockings, Metrorail, Line E	4.04	4.47	72.09	\$84.91	\$0.35	\$0.33	\$0.34	\$0.35	\$10.99	\$0.37	\$0.38	\$0.42	\$0.40	\$98.83

Grouped Need Description	Risk Prob. Score	Risk Conseq. Score	Priority Score	FY19 Cost	FY20 Cost	FY21 Cost	FY22 Cost	FY23 Cost	FY24 Cost	FY25 Cost	FY26 Cost	FY27 Cost	F28 Cost	10 Year Total
Electrification Distribution, Metrorail, Line A	4.20	4.22	71.62	\$10.46	\$0.13	\$3.06	\$0.00	\$3.25	\$0.00	\$3.44	\$0.00	\$29.83	\$0.00	\$50.17
Trackwork, Metrorail, Line C.J	3.63	4.90	71.26	\$0.56	\$0.03	\$0.03	\$0.03	\$0.03	\$0.03	\$0.03	\$0.03	\$0.03	\$0.03	\$0.82
Signals/Interlockings, Metrorail, Line J	4.02	4.43	71.10	\$28.71	\$0.11	\$0.11	\$15.05	\$0.14	\$0.12	\$0.38	\$0.13	\$0.13	\$0.14	\$45.02
Radio, Agencywide	4.48	3.94	70.66	\$293.85	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$293.85
Trackwork, Metrorail, Line CK	3.60	4.90	70.62	\$0.64	\$0.05	\$0.05	\$0.05	\$0.06	\$0.06	\$0.06	\$0.06	\$0.06	\$0.07	\$1.16
Centralized Train Control, Metrorail	4.48	3.89	69.83	\$117.50	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$117.50
Signals/Interlockings, Metrorail, Line F	3.92	4.45	69.76	\$84.64	\$0.36	\$0.37	\$0.38	\$0.40	\$0.41	\$0.42	\$35.70	\$0.44	\$0.46	\$123.59
Trackwork, Metrorail, Line A	3.57	4.89	69.74	\$95.40	\$83.71	\$11.44	\$11.78	\$12.13	\$12.50	\$12.87	\$13.26	\$13.66	\$14.07	\$280.82
Cable Transmission System (CTS), Metrorail	4.52	3.80	68.66	\$0.02	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.02
Trackwork, Metrorail, Line B	3.52	4.86	68.52	\$45.84	\$61.90	\$9.75	\$10.04	\$10.34	\$10.65	\$10.97	\$11.30	\$11.64	\$11.99	\$194.43
Trackwork, Metrorail, Line CL	3.49	4.90	68.37	\$0.02	\$0.03	\$0.03	\$0.03	\$0.03	\$0.03	\$0.03	\$0.03	\$0.03	\$0.03	\$0.29
Trackwork, Metrorail, Line DG	3.49	4.83	67.32	\$0.05	\$0.05	\$0.05	\$0.05	\$0.06	\$0.06	\$0.06	\$0.06	\$0.06	\$0.06	\$0.57
Electrification Distribution, Metrorail, Line D	3.93	4.14	65.65	\$5.55	\$0.00	\$0.00	\$0.00	\$1.58	\$0.00	\$0.00	\$0.00	\$1.78	\$18.23	\$27.15
Articulated Bus, Metrobus	3.56	4.48	63.87	\$0.00	\$20.66	\$25.54	\$0.00	\$0.00	\$0.00	\$0.00	\$8.36	\$30.50	\$0.00	\$85.05
30ft Bus, Metrobus	3.56	4.48	63.87	\$0.00	\$29.45	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$34.67	\$6.41	\$70.53
Electrification Distribution, Metrorail, Line C	4.03	3.88	63.61	\$18.71	\$0.00	\$0.00	\$0.00	\$1.04	\$0.00	\$0.00	\$0.00	\$1.17	\$0.00	\$20.91
40ft Bus, Metrobus	3.53	4.48	63.32	\$52.11	\$86.90	\$121.15	\$38.57	\$75.75	\$103.37	\$92.38	\$89.91	\$57.67	\$102.93	\$820.74
Elevated Structure, Metrorail, Line A	3.63	4.34	63.01	\$2.41	\$0.20	\$0.21	\$0.22	\$0.22	\$0.23	\$0.24	\$0.24	\$2.28	\$0.26	\$6.50
Electrification Distribution, Metrorail, Line K	3.82	4.09	62.97	\$5.92	\$0.00	\$0.16	\$0.00	\$0.77	\$0.00	\$0.00	\$24.00	\$0.87	\$0.00	\$31.72

Appendices

Grouped Need Description	Risk Prob. Score	Risk Consq. Score	Priority Score	FY19 Cost	FY20 Cost	FY21 Cost	FY22 Cost	FY23 Cost	FY24 Cost	FY25 Cost	FY26 Cost	FY27 Cost	F28 Cost	10 Year Total
Trackwork, Metrorail, Line K	3.53	4.44	62.63	\$59.53	\$18.96	\$9.11	\$9.38	\$9.22	\$9.50	\$9.78	\$10.07	\$10.38	\$10.69	\$156.61
Trackwork, Metrorail, Line C	3.50	4.44	62.19	\$54.22	\$8.65	\$7.76	\$7.99	\$8.23	\$8.48	\$8.73	\$8.99	\$9.26	\$9.54	\$131.86
Trackwork, Metrorail, Line L	3.56	4.37	62.17	\$6.56	\$1.07	\$1.10	\$1.13	\$1.17	\$1.20	\$1.24	\$1.27	\$1.31	\$1.35	\$17.40
Trackwork, Metrorail, Line G	3.54	4.38	62.09	\$36.19	\$3.41	\$3.51	\$3.62	\$3.72	\$3.84	\$3.95	\$4.07	\$4.19	\$4.32	\$70.81
Trackwork, Metrorail, Line D	3.50	4.43	62.05	\$33.90	\$7.45	\$7.19	\$7.41	\$7.63	\$7.86	\$8.09	\$8.33	\$8.58	\$8.84	\$105.27
Electrification Substations, Metrorail, Line B	3.77	4.09	61.80	\$65.61	\$0.91	\$0.04	\$14.00	\$0.04	\$2.53	\$1.24	\$14.01	\$0.02	\$0.00	\$98.39
Trackwork, Metrorail, Line J	3.51	4.39	61.67	\$33.87	\$12.22	\$4.93	\$5.07	\$5.23	\$5.38	\$5.55	\$5.71	\$5.88	\$6.06	\$89.90
Paratransit Vans, MetroAccess	3.79	4.07	61.66	\$23.03	\$0.06	\$36.73	\$7.96	\$25.92	\$0.07	\$41.34	\$8.95	\$29.18	\$0.07	\$173.31
Trackwork, Metrorail, Line CD	3.49	4.37	60.91	\$0.47	\$0.48	\$0.50	\$0.51	\$0.53	\$0.54	\$0.56	\$0.58	\$0.59	\$0.61	\$5.38
Trackwork, Metrorail, Line KN	3.49	4.37	60.91	\$1.73	\$1.78	\$1.83	\$1.89	\$1.94	\$2.00	\$2.06	\$2.13	\$2.19	\$2.25	\$19.81
Rail cars (all series), Metrorail	3.0911	4.7821	60.7761	\$13.36	\$0.00	\$37.01	\$93.58	\$640.37	\$394.16	\$364.70	\$383.53	\$542.97	\$96.73	\$2,566.41
SCADA, Metrorail	3.83	3.96	60.60	\$3.84	\$0.26	\$0.20	\$0.25	\$0.31	\$0.04	\$0.28	\$0.52	\$0.43	\$0.20	\$6.34
Electrification Substations, Metrorail, Line C	3.78	3.99	60.58	\$48.27	\$0.01	\$0.03	\$25.91	\$0.00	\$0.01	\$0.00	\$0.04	\$0.59	\$0.04	\$74.91
Elevated Structure, Metrorail, Line D	3.73	4.05	60.49	\$0.77	\$0.80	\$0.82	\$0.84	\$0.87	\$1.93	\$0.92	\$0.95	\$0.98	\$1.01	\$9.89
Elevated Structure, Metrorail, Line L	3.71	4.05	60.19	\$0.13	\$0.13	\$0.14	\$0.14	\$0.15	\$0.15	\$0.15	\$0.16	\$0.16	\$0.17	\$1.49
Elevated Structure, Metrorail, Line B	3.60	4.17	60.09	\$2.23	\$0.53	\$0.54	\$0.56	\$0.58	\$0.59	\$0.61	\$0.63	\$0.65	\$0.67	\$7.58
Electrification Substations, Metrorail, Line E	3.57	4.18	59.79	\$14.98	\$1.57	\$8.92	\$71.74	\$9.29	\$13.67	\$3.09	\$0.19	\$17.51	\$13.08	\$154.03
Trackwork, Metrorail, Line F	3.38	4.41	59.61	\$26.05	\$5.88	\$6.05	\$6.23	\$6.42	\$6.61	\$7.99	\$7.02	\$7.23	\$7.44	\$86.94

Grouped Need Description	Risk Prob. Score	Risk Conseq. Score	Priority Score	FY19 Cost	FY20 Cost	FY21 Cost	FY22 Cost	FY23 Cost	FY24 Cost	FY25 Cost	FY26 Cost	FY27 Cost	F28 Cost	10 Year Total
Electrification Substations, Metrorail, Line K	3.72	3.99	59.45	\$37.43	\$0.70	\$0.00	\$15.13	\$0.00	\$0.29	\$0.00	\$0.09	\$0.11	\$0.23	\$53.98
Electrification Substations, Metrorail, Line J	3.56	4.17	59.37	\$10.11	\$0.13	\$0.04	\$4.81	\$0.21	\$0.52	\$33.04	\$0.42	\$0.07	\$0.40	\$49.75
Electrification Substations, Metrorail, Line F	3.59	4.12	59.25	\$15.94	\$11.49	\$7.99	\$17.39	\$0.25	\$0.00	\$0.15	\$0.14	\$20.22	\$16.32	\$89.87
Electrification Substations, Metrorail, Line A	3.69	4.01	59.22	\$39.22	\$2.09	\$0.01	\$32.84	\$0.00	\$0.02	\$0.00	\$9.46	\$6.55	\$2.40	\$92.59
Trackwork, Metrorail, Line E	3.32	4.45	59.02	\$13.69	\$19.32	\$8.49	\$8.74	\$10.99	\$9.28	\$9.56	\$9.84	\$10.14	\$10.44	\$110.49
Electrification Substations, Metrorail, Line D	3.76	3.90	58.98	\$28.95	\$0.00	\$0.00	\$32.81	\$0.04	\$0.03	\$0.03	\$0.00	\$0.00	\$0.00	\$61.87
Trackwork, Metrorail, Line EF	3.37	4.37	58.80	\$0.59	\$0.61	\$0.62	\$0.64	\$0.66	\$0.68	\$0.70	\$0.72	\$0.75	\$0.77	\$6.74
Elevated Structure, Metrorail, Line C	4.12	3.57	58.02	\$15.27	\$1.09	\$1.12	\$1.15	\$1.19	\$1.22	\$1.26	\$1.30	\$1.34	\$1.38	\$26.32
Communications, Metrorail, Line E	4.32	3.34	57.74	\$0.02	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.02
Guideway Utilities - Drainage, Metrorail	3.59	3.99	57.18	\$3.97	\$1.53	\$1.58	\$2.71	\$15.25	\$2.87	\$1.78	\$3.25	\$0.00	\$0.65	\$33.59
Elevated Structure, Metrorail, Line F	3.49	4.05	56.64	\$0.75	\$0.77	\$0.79	\$0.82	\$0.84	\$0.87	\$0.89	\$0.92	\$0.95	\$0.98	\$8.57
Elevated Structure, Metrorail, Line G	3.56	3.95	56.40	\$0.66	\$0.37	\$0.38	\$0.40	\$0.41	\$0.42	\$0.43	\$0.45	\$0.46	\$0.90	\$4.88
Communications, Metrorail, Line B	4.08	3.34	54.56	\$0.02	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.02
Elevated Structure, Metrorail, Line J	3.52	3.87	54.55	\$0.19	\$0.19	\$0.20	\$0.21	\$0.21	\$0.22	\$0.22	\$0.23	\$0.24	\$0.25	\$2.16
Phone System, Metrorail	4.36	3.10	54.27	\$0.03	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.03
Underground, Metrorail, Line D	2.96	4.50	53.33	\$1.31	\$1.34	\$1.38	\$1.43	\$1.47	\$1.51	\$1.56	\$1.61	\$1.65	\$1.70	\$14.96
Guideway Utilities - Lighting, Metrorail	3.93	3.33	52.84	\$115.52	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$115.52
Electrification Substations, Metrorail, Line G	3.59	3.65	52.42	\$7.21	\$0.08	\$0.21	\$0.00	\$0.04	\$5.28	\$0.03	\$0.11	\$0.16	\$5.03	\$18.15

Appendices

Grouped Need Description	Risk Prob. Score	Risk Conseq. Score	Priority Score	FY19 Cost	FY20 Cost	FY21 Cost	FY22 Cost	FY23 Cost	FY24 Cost	FY25 Cost	FY26 Cost	FY27 Cost	F28 Cost	10 Year Total
Special Structures, Metrorail, Line N	4.69	2.77	52.01	\$1.05	\$0.00	\$1.11	\$0.00	\$1.18	\$0.00	\$1.25	\$0.00	\$1.33	\$0.00	\$5.93
Elevated Structure, Metrorail, Line E	3.37	3.85	51.86	\$0.20	\$0.10	\$0.10	\$0.11	\$0.11	\$0.11	\$0.12	\$0.12	\$0.13	\$0.13	\$1.24
Underground, Metrorail, Line L	3.49	3.72	51.67	\$0.27	\$0.27	\$0.28	\$0.29	\$20.59	\$0.31	\$0.32	\$0.33	\$0.34	\$0.35	\$23.34
At Grade, Metrorail, Line C	3.56	3.62	51.57	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$115.80	\$0.00	\$115.80
At Grade, Metrorail, Line G	3.56	3.61	51.40	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$7.38	\$7.38
At Grade, Metrorail, Line L	3.56	3.60	51.26	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$4.30	\$0.00	\$0.00	\$0.00	\$0.00	\$4.30
Guideway Utilities - Ventilation, Metrorail	4.01	3.09	51.21	\$65.39	\$0.00	\$11.23	\$0.68	\$5.19	\$8.86	\$0.00	\$2.80	\$0.01	\$2.68	\$96.84
Phone System, Systemwide Assets	4.15	3.07	51.01	\$0.03	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.03
Phone System, Metrobos	3.89	3.24	50.37	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Underground, Metrorail, Line G	2.89	4.34	50.17	\$1.28	\$1.32	\$1.36	\$1.40	\$1.44	\$1.48	\$1.53	\$1.57	\$1.62	\$1.67	\$14.66
Guideway Utilities - Safety, Metrorail	3.73	3.32	49.57	\$11.45	\$1.54	\$1.77	\$0.00	\$2.69	\$0.21	\$0.00	\$0.66	\$0.53	\$0.00	\$18.85
Underground, Metrorail, Line C	2.92	4.24	49.55	\$2.16	\$2.22	\$2.29	\$2.36	\$2.43	\$2.50	\$2.58	\$2.65	\$2.73	\$2.82	\$24.73
Communications, Metrobos, Modewide	3.70	3.34	49.46	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Passenger Communications Systems, Metrorail	3.69	3.35	49.45	\$17.90	\$0.55	\$0.63	\$0.73	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$19.82
At Grade, Metrorail, Line A	3.56	3.45	49.19	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$181.36	\$0.00	\$181.36
At Grade, Metrorail, Line D	3.56	3.44	49.03	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$138.04	\$0.00	\$0.00	\$0.00	\$0.00	\$138.04
Special Structures, Metrorail, Line E	3.74	3.27	48.87	\$0.78	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.78
Communications, Systemwide Assets	3.66	3.34	48.84	\$3.92	\$1.24	\$2.33	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$7.48
Underground, Metrorail, Line F	2.70	4.50	48.58	\$2.55	\$2.63	\$2.71	\$2.79	\$2.87	\$2.96	\$3.05	\$3.14	\$3.23	\$3.33	\$29.26
Special Structures, Metrorail, Line F	3.83	3.11	47.64	\$0.51	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.51

Grouped Need Description	Risk Prob. Score	Risk Conseq. Score	Priority Score	FY19 Cost	FY20 Cost	FY21 Cost	FY22 Cost	FY23 Cost	FY24 Cost	FY25 Cost	FY26 Cost	FY27 Cost	F28 Cost	10 Year Total
Maintenance Equipment, Metrorail	3.67	3.20	46.83	\$118.09	\$12.07	\$0.65	\$13.22	\$0.57	\$54.28	\$0.24	\$21.72	\$172.34	\$19.24	\$412.43
Underground, Metrorail, Line K	2.83	4.11	46.58	\$0.98	\$1.01	\$1.04	\$1.07	\$1.10	\$1.13	\$1.17	\$1.20	\$1.24	\$1.27	\$11.20
Underground, Metrorail, Line E	2.60	4.46	46.40	\$2.42	\$2.50	\$2.57	\$2.65	\$2.73	\$2.81	\$2.89	\$2.98	\$3.07	\$3.16	\$27.79
Office Equipment & IT, Systemwide Assets	4.32	2.71	46.37	\$122.30	\$4.31	\$54.13	\$10.62	\$51.53	\$77.78	\$48.76	\$24.86	\$65.51	\$8.09	\$467.88
Elevated Structure, Metrorail, Line K	2.85	4.05	46.24	\$0.58	\$0.39	\$0.41	\$0.42	\$0.43	\$0.44	\$0.46	\$0.47	\$0.48	\$0.50	\$4.58
Safety and Security, Metrobus	3.56	3.24	46.16	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Safety and Security, Metrorail	3.66	3.14	46.03	\$1.88	\$0.04	\$0.23	\$3.92	\$0.15	\$2.52	\$0.01	\$0.08	\$0.00	\$0.08	\$8.92
Elevators, Metrorail	3.45	3.31	45.73	\$48.31	\$0.43	\$7.18	\$1.21	\$2.06	\$0.88	\$8.61	\$12.68	\$2.87	\$19.42	\$103.65
Underground, Metrorail, Line B	2.82	4.04	45.59	\$1.57	\$1.62	\$1.66	\$1.71	\$1.77	\$1.82	\$1.87	\$1.93	\$1.99	\$2.05	\$17.99
Underground, Metrorail, Line J	2.60	4.35	45.29	\$0.15	\$0.15	\$0.16	\$0.16	\$0.17	\$0.17	\$0.18	\$0.18	\$0.19	\$0.20	\$1.71
Stations, Metrorail, Line -	3.58	3.15	45.15	\$18.36	\$5.57	\$5.74	\$5.91	\$6.09	\$6.27	\$6.46	\$6.65	\$0.00	\$0.00	\$61.04
Signals/Interlockings, Metrorail, Line N	2.54	4.44	45.06	\$0.28	\$0.25	\$0.21	\$0.22	\$0.22	\$0.23	\$0.24	\$0.24	\$0.25	\$0.27	\$2.40
Maintenance Equipment, Systemwide Assets	3.77	2.97	44.95	\$1.88	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.04	\$0.00	\$0.00	\$1.92
Communications Huts, Systemwide Assets	3.67	3.04	44.69	\$0.15	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.15
Safety and Security, Systemwide Assets	3.62	3.05	44.06	\$4.69	\$0.40	\$0.02	\$0.08	\$0.00	\$0.50	\$0.00	\$0.00	\$0.01	\$0.00	\$5.70
Special Structures, Metrorail, Line J	3.75	2.92	43.79	\$2.35	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$2.35
Special Structures, Metrorail, Line B	3.62	2.99	43.23	\$40.57	\$0.00	\$0.00	\$0.00	\$0.00	\$0.08	\$0.00	\$0.00	\$0.00	\$0.00	\$40.65
Underground, Metrorail, Line A	2.92	3.69	43.05	\$4.47	\$4.60	\$4.74	\$4.88	\$5.03	\$5.18	\$5.34	\$5.50	\$5.66	\$5.83	\$51.24
Special Structures, Metrorail, Line D	3.61	2.97	42.93	\$35.19	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$35.19
Stations, Metrorail, Line J	3.49	3.07	42.90	\$0.08	\$0.83	\$21.85	\$0.76	\$0.00	\$0.00	\$0.00	\$0.45	\$0.00	\$0.00	\$23.98

Appendices

Grouped Need Description	Risk Prob. Score	Risk Conseq. Score	Priority Score	FY19 Cost	FY20 Cost	FY21 Cost	FY22 Cost	FY23 Cost	FY24 Cost	FY25 Cost	FY26 Cost	FY27 Cost	F28 Cost	10 Year Total
Special Structures, Metrorail, Line C	3.58	2.98	42.65	\$7.55	\$0.00	\$0.00	\$0.00	\$19.67	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$27.22
Special Structures, Metrorail, Line A	3.57	2.96	42.25	\$2.07	\$0.00	\$0.00	\$0.00	\$0.00	\$54.47	\$0.00	\$0.00	\$0.00	\$0.00	\$56.54
Special Structures, Metrorail, Line L	3.59	2.94	42.24	\$0.37	\$0.00	\$0.00	\$0.00	\$1.58	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$1.95
Maintenance Buildings, Metrorail	4.09	2.57	42.18	\$405.41	\$56.23	\$0.13	\$19.09	\$3.08	\$2.71	\$1.98	\$0.11	\$43.93	\$34.39	\$567.07
Stations, Metrorail, Line K	3.39	3.09	41.90	\$1.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$8.66	\$50.67	\$0.00	\$0.00	\$60.53
Special Structures, Metrorail, Line K	3.57	2.93	41.80	\$6.11	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$173.60	\$0.00	\$0.00	\$179.71
Stations, Metrorail, Line G	3.43	3.04	41.68	\$2.40	\$1.96	\$0.00	\$0.00	\$13.81	\$23.88	\$0.00	\$0.00	\$0.00	\$0.00	\$42.05
Passenger Communications Systems, Systemwide Assets	3.58	2.91	41.65	\$0.14	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$5.70	\$0.00	\$5.85
Escalators, Metrorail	3.58	2.86	40.99	\$366.66	\$1.91	\$48.38	\$11.41	\$9.78	\$11.21	\$19.41	\$91.41	\$3.87	\$61.70	\$625.74
Special Structures, Metrorail, Line G	3.59	2.80	40.14	\$2.42	\$2.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$4.41
Non-Revenue Vehicles, Metrorail	3.60	2.74	39.44	\$13.78	\$7.22	\$5.17	\$4.22	\$2.40	\$1.29	\$4.58	\$6.95	\$7.97	\$23.19	\$76.76
Stations, Metrorail, Line C	3.16	3.12	39.36	\$54.68	\$0.67	\$12.41	\$4.23	\$0.00	\$0.00	\$0.00	\$4.76	\$45.67	\$0.00	\$122.42
Maintenance Buildings, Metrobus	3.65	2.70	39.35	\$640.27	\$0.04	\$3.97	\$19.61	\$1.28	\$0.65	\$17.76	\$7.28	\$28.37	\$32.26	\$751.50
In-Station Revenue Collection, Metrorail	4.05	2.40	38.96	\$273.64	\$1.08	\$5.84	\$0.00	\$0.00	\$6.39	\$0.49	\$0.00	\$0.00	\$0.53	\$287.96
Trackwork, Metrorail, Line N	2.20	4.41	38.88	\$5.13	\$5.29	\$5.45	\$5.61	\$5.78	\$5.95	\$6.13	\$6.31	\$6.50	\$6.70	\$58.86
Bus Turnarounds, Metrobus	4.00	2.49	38.71	\$7.94	\$1.80	\$0.00	\$1.90	\$0.00	\$2.00	\$0.00	\$0.00	\$0.00	\$0.00	\$13.64
Maintenance Equipment, Metrobus	3.63	2.66	38.52	\$61.22	\$12.54	\$4.26	\$6.19	\$0.43	\$4.36	\$15.42	\$20.21	\$72.77	\$25.86	\$223.26
Stations, Metrobus, Bus Stops	3.58	2.68	38.47	\$28.29	\$13.12	\$13.46	\$0.25	\$0.44	\$0.45	\$0.00	\$0.00	\$0.00	\$0.00	\$56.00
Elevated Structure, Metrorail, Line N	2.44	3.91	38.26	\$0.86	\$0.82	\$0.84	\$0.87	\$0.97	\$0.92	\$0.95	\$0.97	\$1.09	\$1.03	\$9.31

Grouped Need Description	Risk Prob. Score	Risk Conseq. Score	Priority Score	FY19 Cost	FY20 Cost	FY21 Cost	FY22 Cost	FY23 Cost	FY24 Cost	FY25 Cost	FY26 Cost	FY27 Cost	F28 Cost	10 Year Total
Stations, Metrorail, Line F	2.98	3.11	37.13	\$4.30	\$0.00	\$26.39	\$1.04	\$11.59	\$0.00	\$0.00	\$0.00	\$0.00	\$0.03	\$43.35
Stations, Metrorail, Line D	2.99	3.07	36.54	\$5.55	\$0.00	\$2.65	\$22.51	\$11.59	\$0.00	\$0.00	\$0.00	\$45.80	\$13.44	\$101.54
Guideway Utilities, Metrorail	3.59	2.54	36.47	\$8.26	\$1.70	\$1.75	\$1.81	\$1.86	\$1.92	\$1.97	\$2.03	\$0.00	\$0.00	\$21.31
Stations, Metrorail, Line B	2.88	3.17	36.45	\$12.86	\$2.77	\$1.15	\$0.00	\$0.00	\$6.05	\$1.05	\$25.34	\$0.21	\$0.00	\$49.43
Stations, Metrorail, Line A	2.98	3.09	36.42	\$5.95	\$0.00	\$1.48	\$0.00	\$2.41	\$11.94	\$0.00	\$19.00	\$9.52	\$0.00	\$50.31
Electrification Substations, Metrorail, Line N	2.26	3.97	35.87	\$0.10	\$0.43	\$0.05	\$0.07	\$0.05	\$0.00	\$0.00	\$0.00	\$0.00	\$0.27	\$0.97
Non-Revenue Vehicles, Systemwide Assets	3.83	2.33	35.61	\$60.61	\$12.93	\$7.67	\$7.52	\$2.47	\$10.31	\$66.63	\$13.60	\$8.15	\$10.25	\$200.12
Passenger Parking, Metrorail, Line D	3.89	2.15	33.48	\$52.49	\$0.00	\$0.00	\$0.00	\$0.00	\$3.75	\$3.19	\$0.00	\$0.00	\$0.00	\$59.42
Administrative Buildings, Systemwide Assets	3.55	2.34	33.26	\$7.59	\$41.63	\$4.25	\$2.87	\$1.50	\$319.86	\$1.64	\$0.53	\$2.33	\$2.38	\$384.59
Maintenance Buildings, Systemwide Assets	3.51	2.29	32.10	\$3.81	\$4.20	\$0.06	\$0.33	\$0.00	\$2.39	\$0.00	\$0.00	\$0.09	\$294.72	\$305.60
Passenger Parking, Metrorail, Line C	3.56	2.25	32.01	\$0.81	\$299.33	\$2.00	\$0.00	\$0.00	\$0.06	\$0.00	\$12.51	\$0.00	\$0.00	\$314.71
In-Station Revenue Collection, Systemwide Assets	3.57	2.24	31.98	\$8.99	\$4.60	\$4.72	\$4.84	\$4.96	\$5.09	\$5.22	\$5.36	\$0.00	\$0.00	\$43.77
On-Vehicle Revenue Collection, Metrobus	3.60	2.18	31.44	\$41.32	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$41.32
Passenger Parking, Metrorail, Line K	3.55	2.21	31.33	\$47.38	\$2.83	\$3.39	\$0.00	\$0.00	\$5.52	\$0.00	\$0.00	\$0.00	\$0.00	\$59.12
Passenger Parking, Metrorail, Line A	3.49	2.24	31.19	\$60.90	\$0.00	\$0.00	\$0.00	\$3.54	\$40.08	\$2.23	\$0.00	\$0.00	\$0.00	\$106.75
Passenger Parking, Metrorail, Line B	3.52	2.19	30.81	\$7.19	\$8.40	\$1.52	\$0.00	\$0.00	\$0.52	\$0.61	\$0.00	\$0.00	\$3.42	\$21.65
Administrative Buildings, Metrorail	3.41	2.24	30.54	\$0.83	\$0.00	\$0.00	\$2.81	\$0.00	\$0.00	\$0.00	\$0.06	\$0.03	\$0.00	\$3.73
Passenger Parking, Metrorail, Line E	3.44	2.20	30.28	\$3.52	\$0.00	\$0.00	\$0.00	\$65.40	\$32.63	\$0.00	\$0.00	\$0.00	\$4.61	\$106.16

Appendices

Grouped Need Description	Risk Prob. Score	Risk Conseq. Score	Priority Score	FY19 Cost	FY20 Cost	FY21 Cost	FY22 Cost	FY23 Cost	FY24 Cost	FY25 Cost	FY26 Cost	FY27 Cost	F28 Cost	10 Year Total
Maintenance Buildings, MetroAccess	3.05	2.40	29.17	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$2.48	\$0.00	\$0.00	\$0.00	\$0.00	\$2.48
Underground, Metrorail, Line N	1.66	4.35	28.79	\$0.20	\$0.21	\$0.21	\$0.22	\$0.23	\$0.23	\$0.24	\$0.25	\$0.26	\$0.26	\$2.32
Passenger Parking, Metrorail, Line F	3.24	2.21	28.60	\$0.00	\$0.00	\$33.86	\$0.00	\$0.00	\$0.00	\$0.00	\$3.74	\$0.00	\$0.00	\$37.61
Passenger Parking, Metrorail, Line G	3.28	2.18	28.56	\$11.44	\$13.72	\$0.00	\$0.00	\$0.00	\$59.53	\$0.00	\$0.00	\$0.00	\$0.00	\$84.68
Electrification Distribution, Metrorail, Line N	1.95	3.52	27.52	\$0.00	\$0.07	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.07
Stations, Metrorail, Line E	2.19	3.12	27.27	\$4.75	\$0.00	\$3.91	\$3.92	\$0.00	\$0.00	\$0.00	\$0.00	\$3.29	\$0.00	\$15.87
Bus Turnarounds, Metrorail	2.68	2.53	27.17	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.06	\$0.00	\$0.06
Passenger Parking, Metrorail, Line J	2.96	2.20	25.97	\$0.00	\$0.00	\$5.04	\$0.00	\$1.74	\$0.00	\$0.00	\$0.37	\$7.18	\$0.00	\$14.33
Stations, Metrorail, Line N	1.59	3.05	19.39	\$0.00	\$0.00	\$0.00	\$0.30	\$0.00	\$0.00	\$0.59	\$0.00	\$0.00	\$0.00	\$0.89
														10 Year Total SGR
														\$15,678.36

A.4 Acronyms

ACM	Annual Capital Maintenance
CCTV	Closed-Circuit Television
CFN	Call for New Investment Needs
CIP	Capital Improvement Program
CNF	Capital Needs Forecast
CNI	Capital Needs Inventory
CNG	Compressed Natural Gas
DC	District of Columbia
FTA	Federal Transit Administration
FY	Fiscal Year
HVAC	Heating, Ventilation, and Air Conditioning
IT	Information Technology
MAP-21	Moving Ahead for Progress in the 21st Century
MOWE	Office of Maintenance of Way Engineering
MTPD	Metro Transit Police Department
NTSB	National Transportation Safety Board
PI	Project Initiation Form
PA	Public Address System
PIDS	Passenger Information Display Systems
PM	Project Manager
PRIIA	Passenger Rail Investment and Improvement Act
ROW	Right-of-Way
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SGR	State of Good Repair
SPPM	Strategy, Planning and Program Management
SSRV	Office of Support Services
TAICA	Transit Asset Inventory and Condition Assessment
TAM	Transit Asset Management
TERM	FTA's Transit Economic Requirements Mode
TERM Lite	Local agency version of TERM federal
TPSS	Traction Power Substation
TVM	Ticket Vending Machine
WMATA	Washington Metropolitan Area Transit Authority
WMSC	Washington Metrorail Safety Commission
YOE	Year of Expenditure

A.5 Glossary

Annual Capital Maintenance – yearly investment to preserve an asset in good working order.

Asset Management – a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based on information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair during the life-cycle of the assets at minimum practical cost.

Backlog – scheduled capital investment postponed or put off until a later time; equivalent to FTA’s definition of backlog.

Capital Asset – assets of a material value and having a useful life of more than one year. Includes equipment, rolling stock, infrastructure, and facilities for use in public transportation and owned or leased by a recipient or sub-recipient of federal financial assistance. Also called fixed assets.

Capital Budget – the portion of the budget that provides for the funding of improvements, projects and major equipment purchases.

Capital Improvement Program – the six-year plan of capital projects to be completed by Metro.

Capital Need – represents a capital request to rehabilitate, replace, or add a group of assets to the system. Each capital need consists of a group of similar or interdependent assets.

Close-Out – a phase of capital project within project execution timeline when final project costs are settled and paid. Also known as “Project Phase 6”.

Decay Curves – graphic representation of the relationship between an asset’s condition and its age and type. TERM Lite’s asset decay curves predict/forecast condition based on age and type.

Development and Evaluation – a phase of capital project within planning timeline when SPPM and project sponsor develop project information to support Go/Go-go decision. Also known as “Project Phase 2”.

Facilities – buildings (excluding stations), major shops, storage yards, central control, and equipment necessary for operating the system.

Guideway Elements – trackwork and related structures including tunnels, tubes, aerials, platforms, retaining walls, and fences.

Implementation – a phase of a capital project within project execution timeline when a project sponsor implements the project. Also known as “Project Phase 4”.

Metro – the Washington Metropolitan Area Transit Authority

MetroAccess – the operating unit of Metro that offers service for eligible people with disabilities who are unable to use regular accessible Metrorail, Metrobus and local bus service (fixed route). Federal civil rights legislation passed in 1990 that requires public transportation services to be accessible to, and usable by, persons with disabilities.

Metrobus – the operating unit of Metro that provides regional and non-regional bus services.

Metrorail – the operating unit of Metro that provides heavy rail service (subway, aerial and surface) and 91 passenger stations.

Military Standard (MIL-STD) 882E - “Department of Defense Standard Practice System Safety” identifies the DoD approach for identifying hazards and assessing and mitigating associated risks encountered in the development, test, production, use, and disposal of defense systems

Moving Ahead for Progress in the 21st Century (MAP-21) – transportation and reauthorization bill signed into law on July 6, 2012. It is a policy and programmatic framework designed to create a performance-based surface transportation program for highway, transit, bike, and pedestrian programs.

Needs Identification – a phase of capital project within planning timeline when a project sponsor identifies needs to be addressed with capital funds. Also known as “Project Phase 0”.

Operations Activation – a phase of a capital project execution timeline when a completed project is tested before entering operation and staff is trained. Also known as “Project Phase 5”.

Paratransit – refers to scheduled service for people who cannot use regular fixed-route bus service. MetroAccess uses vans and sedans to provide this service in the Washington Metropolitan area.

PIDS (Passenger Information Display System) – refers to signs located on each platform and mezzanine of every rail station to provide information to customers including next train’s scheduled time of arrival, service delays, elevator outages, and free shuttle arrangements when elevators are out of service.

Project Development – a phase of capital project within project execution timeline when a project sponsor readies the project for implementation. Also known as “Project Phase 3”.

Project Initiation – a phase of capital project within planning timeline when a project sponsor submits information; SPPM verifies and assigns Project ID#. Also known as “Project Phase 1”.

Rehabilitation – act of restoring an asset to its original state or a condition close to its original state.

Revenue – an increase in fund assets from operational activity such as passenger fares, parking and advertising.

Soft Costs – capital expenditures that are required to complete a project but that are not spent directly on construction or procurement. These expenses are incurred on professional services that are necessary to complete the project, which include, but are not limited to, project design, project management, legal work, and testing.

State of Good Repair (FTA/MAP-21 Final Rule, July 2016) – the condition in which an asset is able to operate at a full level of performance. Three objective standards define “full level of performance”:

- The asset is able to perform its manufactured design function.
- The use of the asset in its current condition does not pose a known unacceptable safety risk.
- The asset’s life-cycle investment needs have been met or recovered, including all scheduled maintenance, rehabilitation and replacements.

Stations – includes bus shelters, passenger parking facilities, and assets related to rail stations. Rail station assets include station buildings, elevators, escalators, station-specific electrification assets, and other related components. Passenger parking facilities include both surface lots and garages.

Systems – includes hardware and software assets necessary to operating the system. Types include: communications systems, electrification, revenue collection, train control, and utilities.

System Modernization – needs that improve existing services with new technology, address compliance needs with new assets, increase functionality, or improve passenger circulation.

TAICA – the acronym used for Transit Asset Inventory and Condition Assessment.

TERM Lite (Transit Economic Requirements Model) – local/state version of analysis tool designed to help transit agencies assess their SGR deferred capital needs (total dollar value and by asset type), level of annual investment to attain SGR or other investment objective, impact of variations in funding on future asset conditions and reinvestment needs, and investment priorities (by mode and asset type).

Useful Life – estimated lifespan of a capital asset during which it can be expected to contribute to operations.

Vehicles – includes both revenue vehicles (rail cars, buses, and vans) and non-revenue vehicles.

WMATA – the acronym used for Washington Metropolitan Area Transit Authority serving the Washington Metropolitan area which consists of Washington, DC, suburban Maryland (Montgomery County and Prince George’s County) and Northern Virginia counties of Arlington and Fairfax and the cities of Alexandria, Fairfax, and Falls Church. Also known as Metro.

10-Year Capital Needs Forecast

FY2019 - 2028

Washington Metropolitan
Area Transit Authority

