Safety and Operations Committee

Board Information Item IV-B

October 14, 2021

Metrorail Fleet Plan and Rail Service Standards

Washington Metropolitan Area Transit Authority

Board Action/Information Summary

○ Action ◉ Information	MEAD Number: 202307	Resolution: ○ Yes ◉ No

TITLE:

Metrorail Fleet Plan and Rail Service Standards

PRESENTATION SUMMARY:

This presentation provides information about the draft long-term strategy for the management of the Metrorail fleet and associated system infrastructure.

Staff will also provide information on draft updates to rail service standards for the Board's consideration.

PURPOSE:

To review draft Metrorail fleet management strategy and consider potential updates to Metrorail service standards.

DESCRIPTION:

Please see the attached list of potentially interested parties associated with the Metrorail Fleet Management Plan.

Metro periodically procures, overhauls, and decommissions railcars as a part of normal ongoing rail operations. The procurement of Metro's next generation of railcars, the 8000-Series, is underway with vehicles expected to begin entering service in 2025. The Metrorail Fleet Management Plan is regularly updated to reflect system operations, review long-term ridership trends, and outline associated fleet and facility needs.

Service standards guide deployment of service, inform capital investment and operating resource needs, and offer information to riders about Metro's rail service schedules. Rail service standards provide the framework for adding and adjusting service to respond to demand. Developments since rail service standards were last updated in 2012 and 2013 include changes in service patterns and ridership, service adjustments for system renewal, and the increased use of eight-car trains.

Key Highlights:

• Metrorail operations and service are supported by a fleet of approximately 1,278 railcars, nine railcar storage locations and seven maintenance shops, and system infrastructure which includes 91 passenger stations and 117 two-

way route-miles.
• For long-term planning and decision-making purposes, and considering growth in line with regional population forecasts, Metro's draft plan outlines the investments required to move to 100% eight-car train operations and 7-minute headways system-wide by 2030. The draft plan also outlines the steps to pursue Metrorail fleet expansion through purchase options in the 8000-Series railcar procurement and storage and shop capacity expansions and reconfigurations to improve overall system efficiency in response to anticipated demand.
• Draft service standards increase train frequencies and update passenger load standards to improve passenger experiences.

Background and History:

The Metrorail Fleet Management Plan is periodically updated to reflect system operating conditions and anticipated future needs. Pre-pandemic, ridership was growing ahead of projections with a 7 to 8% increase in the first eight months of FY2020 and most lines above the rail standard of 100 passengers per car at peak load points. Metrorail ridership declined substantially during the Covid-19 pandemic and has recovered to approximately 30% of pre-pandemic levels on weekdays and 60% on weekends.

Metro last updated its rail service standards in 2012 and 2013, which established weekday rush and non-rush minimum train frequencies throughout the system, defined rush hour passenger per car crowding standards, and specified Metrorail operating hours.

Discussion:

In light of anticipated regional growth and ridership demand and system capacity constraints, the draft Metrorail Fleet Management Plan outlines steps to develop capacity for 100% eight-car train operations and the capability to run more frequent service at a 7-minute system headway level by 2030. To accommodate this level of service, the following capital investments are needed:

- Procurement of 8000-Series railcars to replace retiring 2000- and 3000-Series vehicles and support expansion of the fleet.
- Expansion of railyard storage and shop capacity to accommodate the operation and maintenance of eight-car trains and a larger railcar fleet.
- Continued investment in traction power capacity upgrades.

Draft rail service standards include the establishment of minimum train frequencies during regular service, to include:

- Daytime and Early Evening: from opening to 9:30pm, seven days a week:
  - 12 minutes on the Blue, Orange, Silver, Green, and Yellow Lines
  - 6 minutes on the Red Line
- Late Night: 9:30pm until close, seven days a week:

- 15 minutes on the Blue, Orange, Silver, Green, and Yellow Lines
- 10 minutes on the Red Line

The draft passenger loading standard for consideration targets average peak loads at or below 100 passengers per car, with the following definitions:

- Optimal: 80 to 100 passengers per car
- Crowded: 101 to 120 passengers per car
- Very Crowded: 121 or more passengers per car

These draft passenger loading standards would also target capacity for a seated load during off-peak service.

FUNDING IMPACT:

There is no funding impact from providing this information to the Board.

TIMELINE:

Previous Actions	• October 2012 – Rail Service Standards • July 2013 – Rail Service Standards Phase II • 2015-2016 – Most recent update to Metrorail Fleet Management Plan
Anticipated actions after presentation	• December 2021 – Present Metrorail Fleet Management Plan for Board adoption • December 2021 – Submit Rail Service Standards staff recommendation for Board consideration

The following parties may have an interest in the decisions made by the Board with regard to these topics:

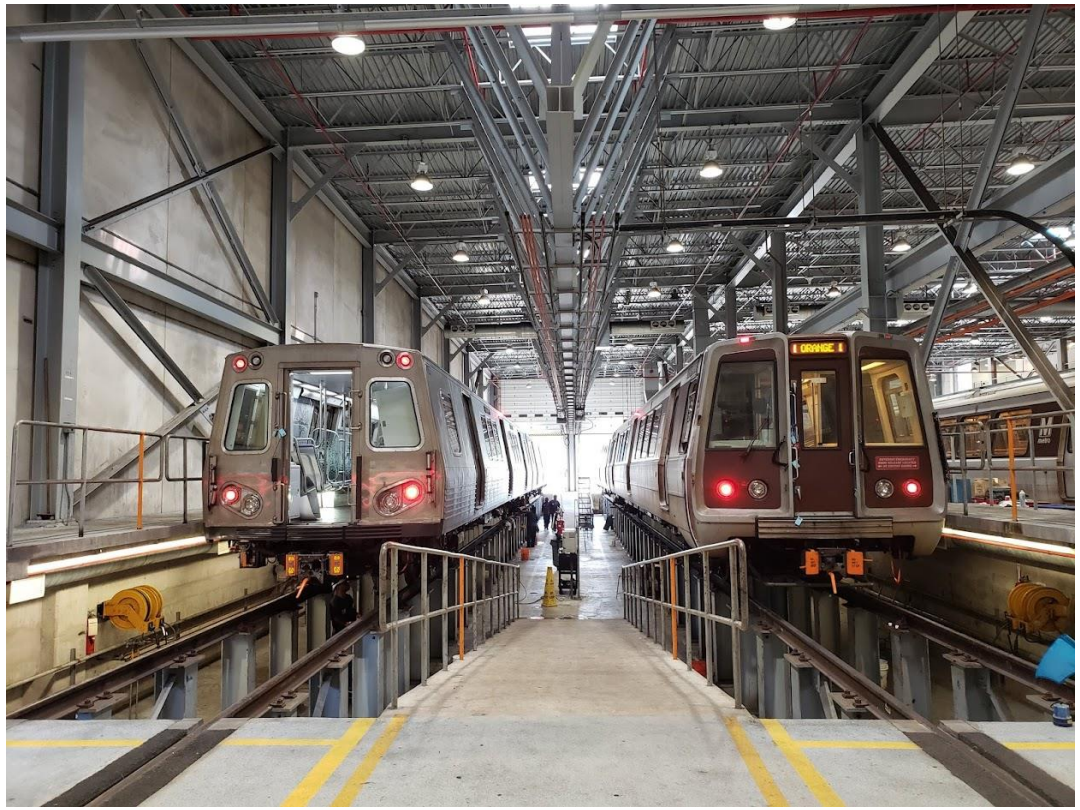
- **AECOM**
- **Alstom**
- **Baltimore Gas & Electric Company**
- **C3M Power Systems, LLC**
- **City Construction**
- **Construcciones y Auxiliar de Ferrocarriles (CAF)**
- **Craddock Local Solutions, LLC**
- **DHA/RK&K Joint Venture**
- **Dominion Energy**
- **eVigilant Security**
- **F.H. Paschen**
- **Faiveley Transport**
- **Gannett Fleming-Parsons Joint Venture**
- **Hensel Phelps Construction**
- **Hitachi Rail**
- **Jacobs Engineering Group**
- **Johnson, Mirmiran & Thompson**
- **Kal Krishnan Consulting Services, Inc.**
- **Kawasaki**
- **Knorr Brake Company**
- **LTK Engineering**
- **Merak**
- **Mott MacDonald I&E, LLC**
- **Orion Management, LLC**
- **Patuxent Roofing**
- **Pepco – an Exelon Company**
- **Phillips Corporation**
- **Potomac Construction**
- **RailQuick**
- **Saft America**
- **Siemens Mobility**
- **Standard Steel**
- **Urban Engineers**
- **W. M. Schlosser Co. Inc.**
- **WSP**

Metrorail Fleet Management Plan & Rail Service Standards Update

Safety and Operations Committee
October 14, 2021

Purpose

- Review draft Metrorail Fleet Management Plan
- Review draft updated rail service standards



New Carrollton posted rail maintenance bay

Metrorail Fleet Management Plan

Context

- Fleet plans updated periodically, most recently in 2016
- Enables coordination of capital investments, including railcars, railcar storage, maintenance, traction power, and system throughput to meet future service needs
- Fleet plans submitted to Federal Transit Administration (FTA); required for oversight and award of federal funds

Metrorail Fleet Management Plan Key Considerations

1. **What level of service** does Metro expect to supply in the future?
2. **How many railcars** should Metro operate to meet demand and service requirements?
3. **How will Metro's rail maintenance and storage facilities** meet evolving fleet needs?

Context

- Uncertainty of post-pandemic ridership and travel patterns
- Since last update in 2016: multiple service changes, 7000-Series deliveries completed
- 8000-Series railcars expected to begin entering service in 2025
- New heavy repair and overhaul facility to be constructed in Landover, Maryland

Several factors determine overall Metrorail system capacity

Current system capacity can deliver **75% eight-car trains** at **8-minute** peak system headway*

Fleet size: number of railcars operating in daily service and spare requirements

Yard Storage: amount and configuration of railcar storage tracks in rail yards

Maintenance Shops: capacity of maintenance shops to service and overhaul railcars

Traction Power: capacity to provide power for vehicle propulsion

Core Throughput: maximum number of trains able to move through core segments of system, typically measured as trains per hour

Terminal Capacity: number of trains able to turn around at end-of-line terminals, typically measured as trains per hour

Stations: impact of platform lengths on maximum cars per train; dwell time impacts from crowding and station passenger flow

*Or 100% eight-car trains at 10-minute peak system headway. The system headway refers to the typical interval between trains departing end-of-line terminals. The Red Line, which operates a two-line pattern, and interlined segments, where two or more lines overlap, have lower effective headways. Red Line Grosvenor-Strathmore turnbacks were eliminated in 2018.

Impact of System Capacity on Riders

More frequency and capacity enable serving more riders and improving customer experience

System Headway (End-of-Line Interval Between Trains*)	Line Capacity (Passenger Throughput)	Capacity Improvement
8-minute 75% eight-car trains (current)	5,000 to 6,000 passengers / hour	-
7-minute 100% eight-car trains	6,850 passengers / hour	~20%
6-minute 100% eight-car trains	8,000 passengers / hour	~35-40%

Shorter wait times

Better chance of boarding

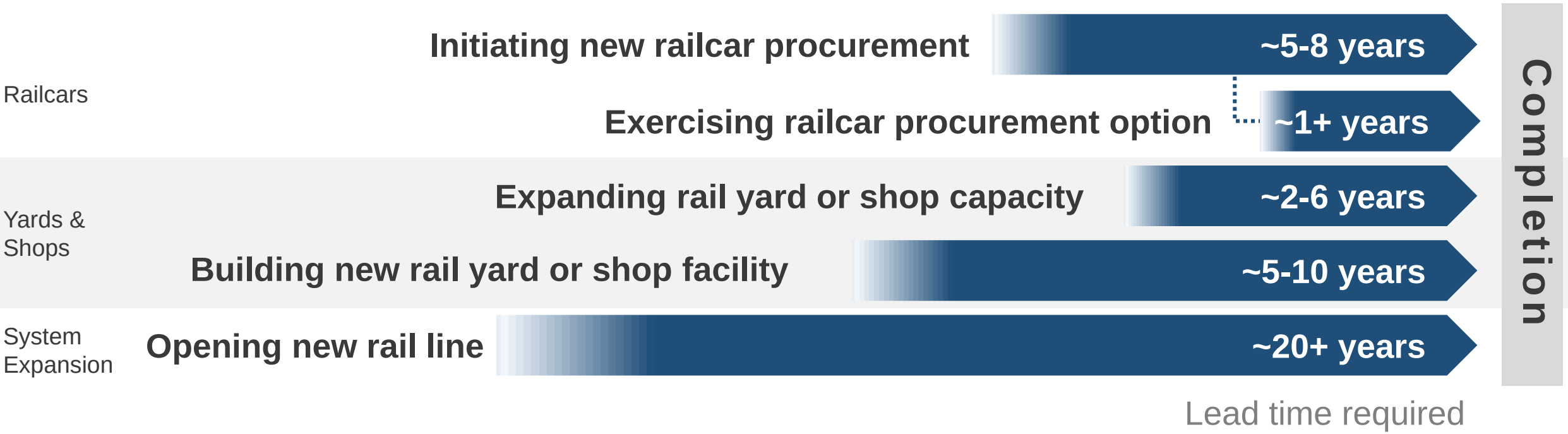
Less crowding

Seats available more often

*The system headway refers to the typical interval between trains departing end-of-line terminals. The Red Line, which operates a two-line pattern, and interlined segments, where two or more lines overlap, have lower effective headways. e.g., trains arrive at stations every 2.7 to 8 minutes at an 8-minute system headway and every 2.3 to 7 minutes at a 7-minute system headway. Red Line Grosvenor-Strathmore turnbacks were eliminated in 2018.

Lead Time and Development for Capacity Investments

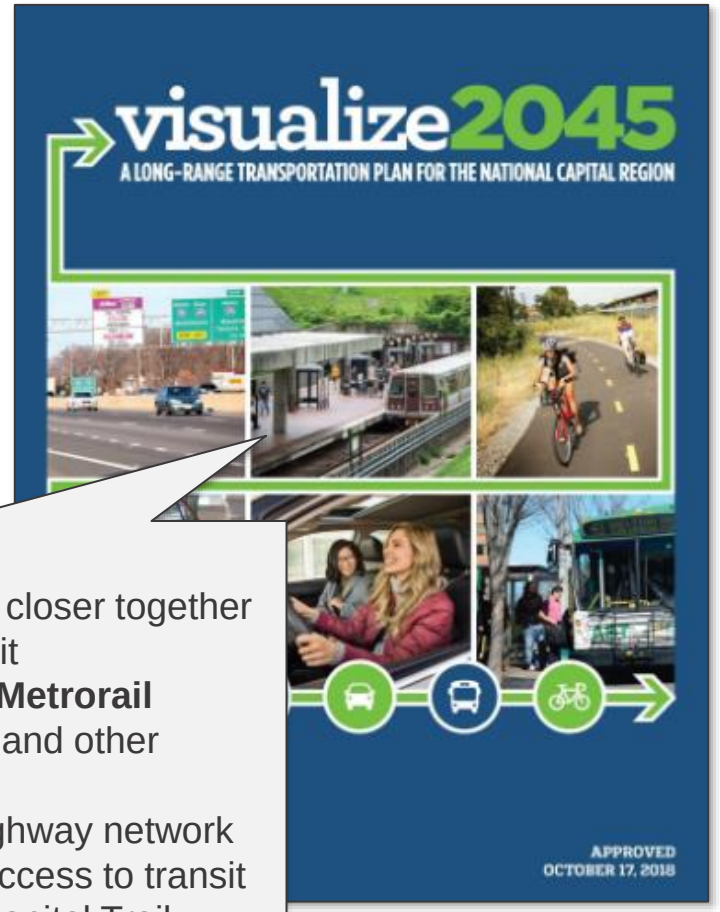
Long-term system planning and investment requires decisions made well in advance



Regional Goal to Increase Trips on Transit

- Regional transportation plans call for expanded Metrorail service to carry more riders in growing metropolitan area

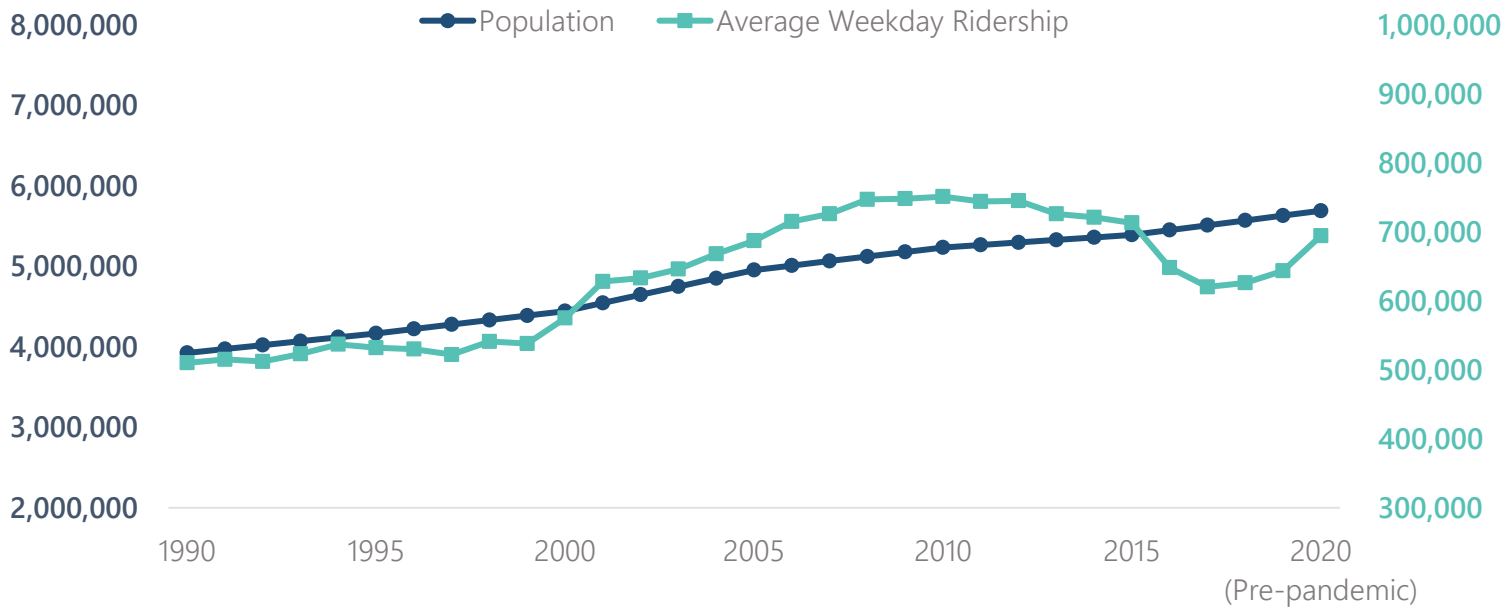
- Benefits include increased access to jobs and destinations, more vibrant neighborhoods and efficient land use, and cleaner air and reduced climate impact



Regional goals:

1. Bringing jobs and housing closer together
2. Expanding bus rapid transit
3. **Moving more people on Metrorail**
4. Increasing telecommuting and other options for commuting
5. Expanding the express highway network
6. Improving walk and bike access to transit
7. Completing the National Capital Trail

Metrorail ridership has historically increased with regional population growth and system expansion



# of Metrorail Stations	61	74	78	86	86	91	91	98

- Approximately 1% annual population growth projected by Metropolitan Washington Council of Governments (MWCOG) through 2040
- Share of people living near transit projected to rise from 29% today to 38% by the 2040s

FY2020 ridership reflects pre-pandemic figures
98 Metrorail stations expected by 2022 upon completion of Silver Line Phase 2 and Potomac Yard Station

Recent Ridership Trajectory

- Pre-pandemic, ridership was growing ahead of projections with a 7 to 8% increase in first eight months of FY2020 and most lines above 100 passengers per car target level at peak load points

- Metrorail ridership declined substantially during pandemic and has recovered to approximately 30% of pre-pandemic levels on weekdays and 60% on weekends

Passengers Per Car
October 2019 (FY2020)

RD	**121**
YL	107
GR	105
BL	89
OR	109
SV	107

Service Demand Projections

Metro could outgrow current service levels based on long-term projected ridership at core peak load points

Planning for **100% eight-car train operations** and capacity to run more frequent service at a **7-minute system headway level by 2030**

Average Peak Hour Passengers per Car (PPC) at Peak Load Points

	System Headway	2020 Actual [1]	2030 Forecast	2040 Forecast
RD	8-minute	121	132	141
	7-minute		100	107
YL	8-minute	107	102	109
	7-minute		89	95
GR	8-minute	105	112	125
	7-minute		98	110
BL	8-minute	89	119	127
	7-minute		88	93
OR	8-minute	109	158	167
	7-minute[2]		101	107
SV	8-minute	107	143	148
	7-minute		101	105

PPC <100 | PPC 100-120 | PPC > 120

1 – 8-minute scenario includes a mix of six- and eight-car trains; 7-minute scenario includes 100% eight-car trains. Reflects Red Line operation of two-line pattern and other lines with interlined segments. FY2020 actual ridership is based on October 2019 weekday ridership – higher than forecast levels on some lines.

2 – Assumes two tripper trains providing additional one-way service are operated on Orange Line.

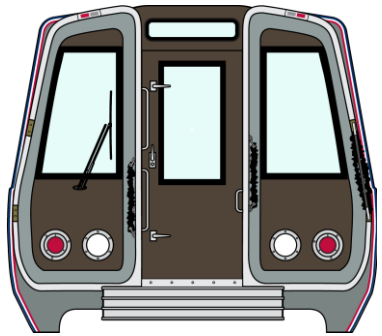
Changes from previous projections and potential Covid-19 implications

- 2016 plan projected system to require 6-minute system headway at 100% eight-car trains by 2030; updated plan revised to 7-minute system headway with 100% eight-car trains by 2030
- Exact pace of post-pandemic ridership recovery remains uncertain
- For purposes of fleet and system planning, anticipated capacity growth previously expected to be needed in 2025 deferred to 2030

8000-Series Railcar Procurement Options and Timing

- Procurement of 8000-Series railcars initiated; expected **service entry beginning in 2025**
- Order structured to allow flexibility
  - Base order of **256** railcars
  - Options to fully replace 2000-Series and 3000-Series must be exercised by **2025**; options for fleet expansion by **2026** for up to **800** railcars

Current and Future Fleet Composition

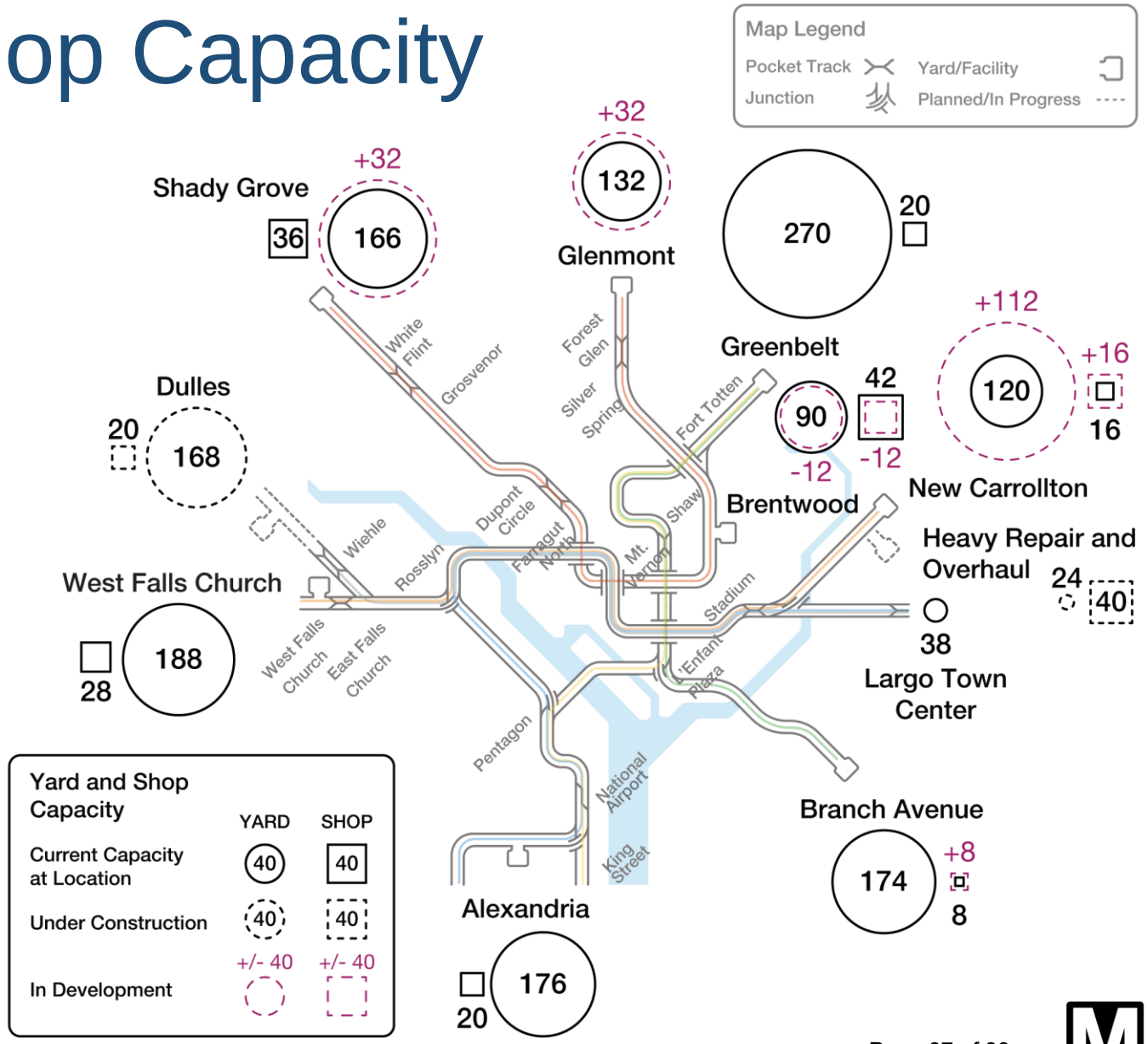


Railcar Series	Entered Service	Current	2030
2000-Series	1983-1984	74	0
3000-Series	1984-1988	276	0
6000-Series	2006-2008	180	180
7000-Series	2015-2020	748	748
8000-Series	2025-	0	256 – 800
TOTAL		**1,278**	**TBD**

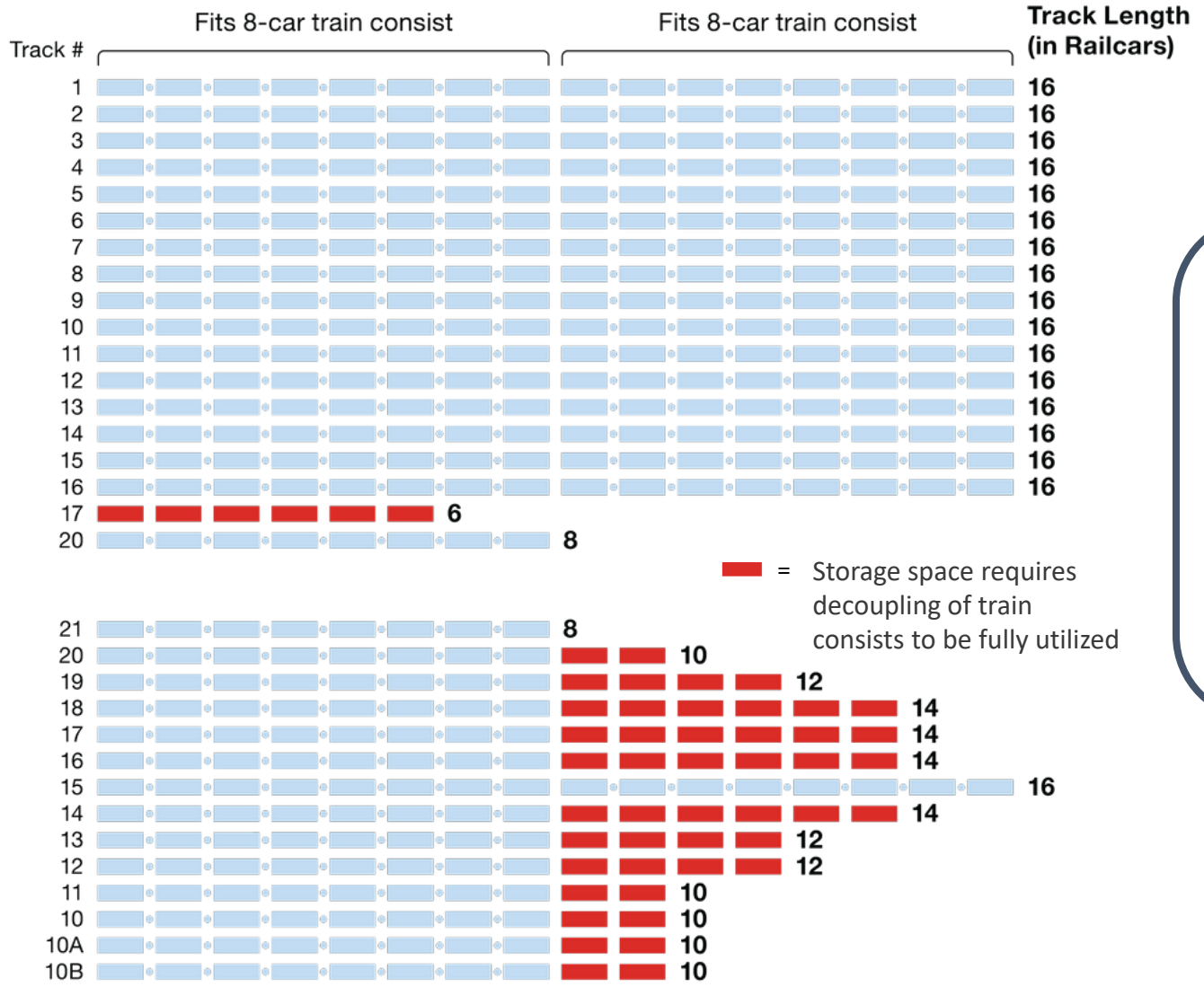
Railcar Storage and Shop Capacity

Capacity expansions to deliver 7-minute system headway:

- Red Line: Add a net of **52 storage spaces**
  - Opening Heavy Repair & Overhaul facility will allow Brentwood conversion to primarily support Red Line Railcar Maintenance and Track Equipment Maintenance
- New Carrollton: Add **112 storage spaces** and **16 shop spaces**
- Branch Avenue: Add **8 shop spaces**



Railcar Storage Efficiency for Eight-Car Trains



Opportunity to increase efficiency of eight-car train operations with yard improvements

Railcar Maintenance Efficiency

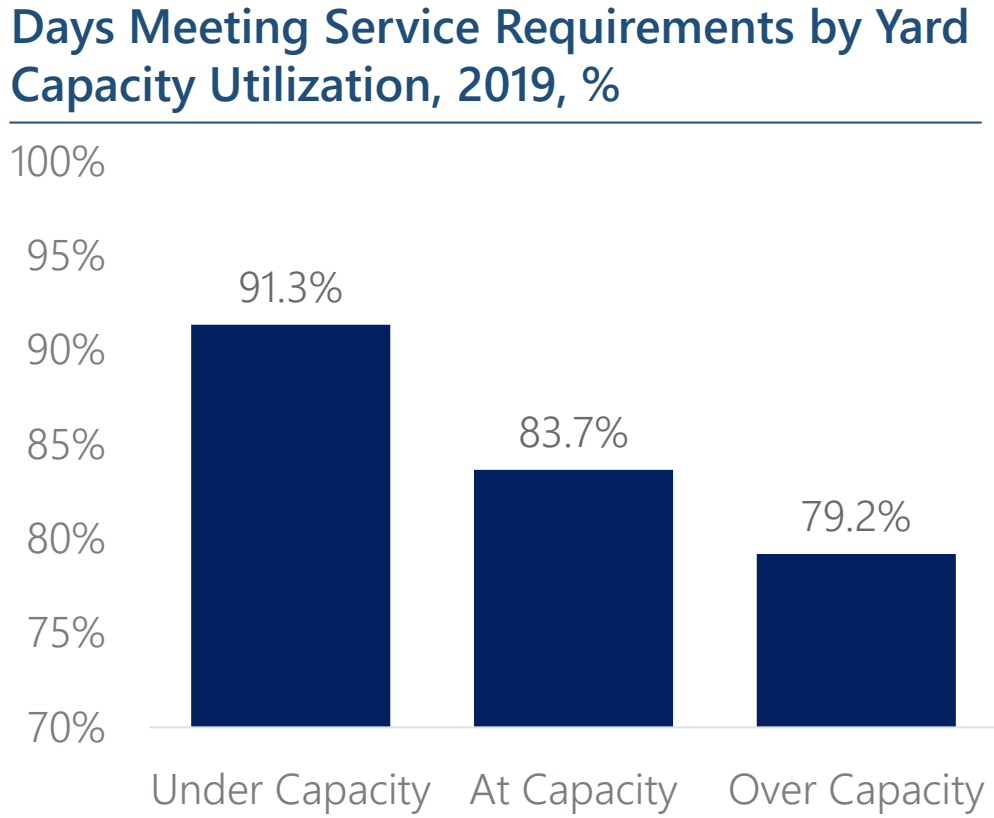
- Railcar shops without eight-car tracks complicate yard and maintenance operations
- Opportunity to configure capacity expansions to support maintenance of full eight-car train consists on posted rail tracks, consistent with global best practices

Shady Grove posted rail maintenance bay

Rail Yard Factors Impacting Service Delivery

More reliable service delivery in yards with:

- Lower railcar **storage capacity** utilization
- Simpler yard **track layouts** capable of storing **eight-car trains**
- Lower level of **shop-related operations** and maintenance equipment
    - Includes assembling and decoupling trains to support maintenance shops configured for married pairs



Traction Power and Core & Terminal Throughput

Power

- Upgrades completed sufficient for 100% eight-car trains at 8-minute headways and planned upgrades meet future needs

Throughput

- 7-minute headways accomplished within 26 train per hour core throughput standard and changes to terminal operations
- 6-minute headways require frequency reductions on one line or turnbacks and investments in terminal capacity upgrades

100% Eight-Car Trains	8-Minute Headway (2025-2030)	7-Minute Headway (2030)	6-Minute Headway (Beyond 2040)
Traction Power	✓	✓	✓
Core Throughput	✓	✓	X
Terminal Throughput	✓	✓	X

✓ Current capabilities meet requirements

✓ Planned upgrades, operational changes meet requirements

X Additional capacity needed

Rail System Capital Investment Estimates

- Incremental investment levels range from approximately **$1.05b to $1.95b** to enable Metro to deliver anticipated all **eight-car train** service with **7-minute or 6-minute minimum train frequencies**

Figures represent order of magnitude estimates based on preliminary analysis. Not official cost estimates; additional work required for development of projects at Metro facilities.

Category	**2030 7-Minute System Headway**	Beyond 2040 6-Minute System Headway
Yard Improvement and Expansion	**~$250m**	~$500m
Shop Improvement and Expansion	**~$200m**	~$400m
Fleet Expansion 8000-Series Railcars	**~$600m**	~$1.05b
Total	**~$1.05b**	~$1.95b

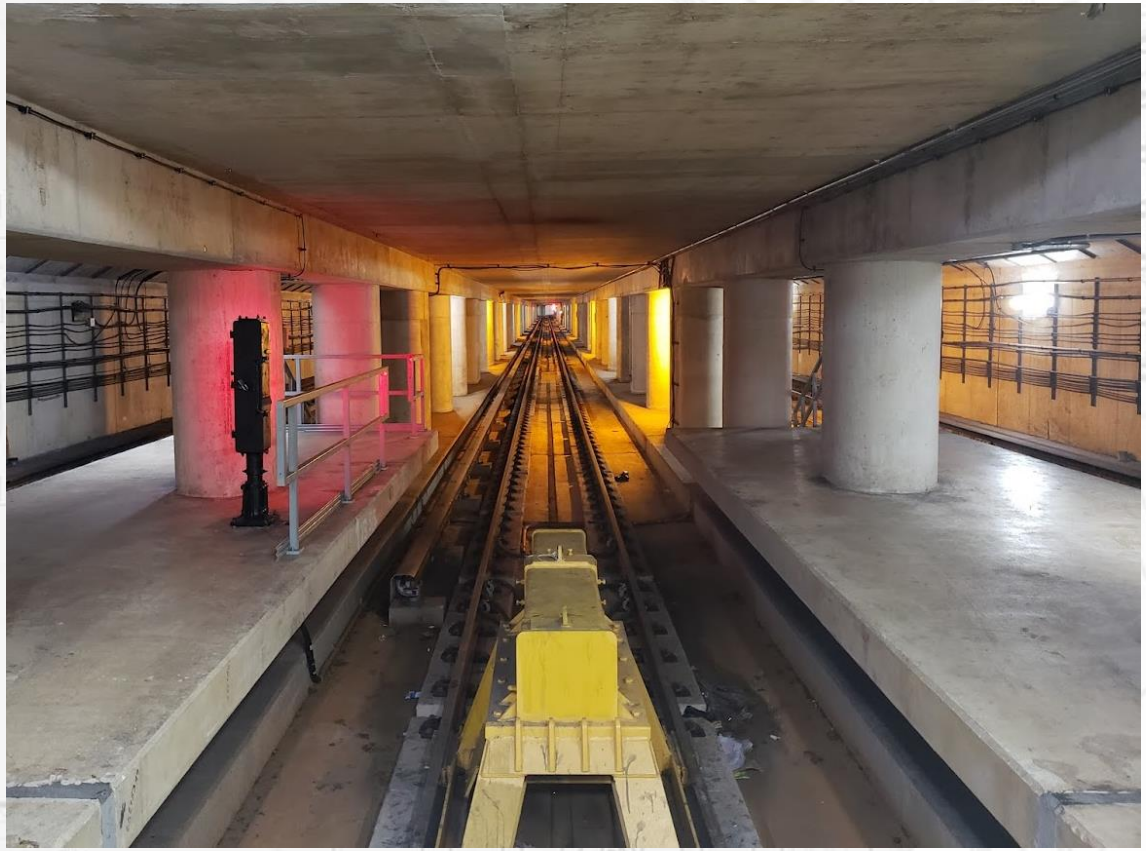
Current planning scenario

Draft Recommendations for Consideration

- Prepare for regional growth by planning for **100% eight-car train operations** and capacity to run more frequent service at a **7-minute system headway level by 2030**
  - Expand fleet through 8000-Series procurement options
  - Expand rail yard and maintenance shop capacity and improve efficiency for eight-car train operations
  - Continue traction power upgrades

Next Steps

- Board of Directors to review draft Metrorail Fleet Management Plan for adoption in December 2021
- Submit plan to Federal Transit Administration (FTA)
- Develop rail yard investments and propose projects for inclusion in capital improvement program



Largo Tail Tracks

Rail Service Standards Update

Context

- Most recent Board updates to Metrorail service standards in 2012 and 2013; Metrobus service guidelines updated in December 2020

- Opportunity to update standards to reflect current conditions and operating practices
  - Changes in service patterns and ridership
  - More service adjustments for system renewal
  - Increased use of eight-car trains

Current Rail Service Standards, adopted 2012-2013

- Define rush hour passenger per car crowding standards
- Set weekday rush and non-rush train frequencies
- Specify operating hours

Limitations of Current Standards
- Fixed rush period standard
- Less emphasis on off-peak and no standards for weekend service

Current Standards

Rush Period Passenger Load: Below an average of **100 passengers per car** (PPC) and between 80 and 120

Rush Period: 2.5 to 3 minutes on core interlined segments and up to **6 minutes** on all other segments except Arlington Cemetery, which will be **12 minutes**

Weekday Midday: Up to **6 minutes** on core interlined segments and up to **12 minutes** on all other segments.

Weekday Evenings: Up to **15 minutes** on core interlined segments and up to **20 minutes** on all other segments.

Weekend: Unspecified.

Service Standard Categories

Guide deployment of service, inform capital investment and operating resource needs, and offer information to the public about how Metro plans and schedules rail service

- **Minimum Train Frequencies**
  - Establish how frequently trains arrive at each station during base service periods
  - Defines minimum level of service quality for riders; impacts average wait times

- **Passenger Load Standards**
  - Define target passenger loads and crowding levels for service planning and capacity investments
  - Used to plan line-specific service levels during busy periods and informs total system capacity needs

Additional Potential Updates to Rail Service Standards

- **Train Consist Length**
  - Objective to maximize use of eight-car trains

- **Operating Hours**
  - Policy for opening early or staying open late

Draft Rail Service Standards

Minimum Train Frequencies (Regular Service)

- Daytime and Early Evening:
  Opening to 9:30 pm, 7 days a week
  - **12 Minutes**
    - Blue, Orange, Silver, Green, Yellow Lines
  - **6 minutes**
    - Red Line
- Late Night:
  9:30 pm until close, 7 days a week
  - **15 Minutes**
    - Blue, Orange, Silver, Green, Yellow Lines
  - **10 minutes**
    - Red Line

Draft Rail Service Standards Continued

Passenger Loads

- Target average peak loads at or below 100 passengers per car (PPC)
  - Optimal: 80 to 100 passengers per car
  - Crowded: 101 to 120 passengers per car
  - Very Crowded: 121 or more passengers per car
- Target capacity for seated load for off-peak service

Measured as average passenger loads over the busiest hour on the busiest segment of each line

Approach to Peak Service Levels

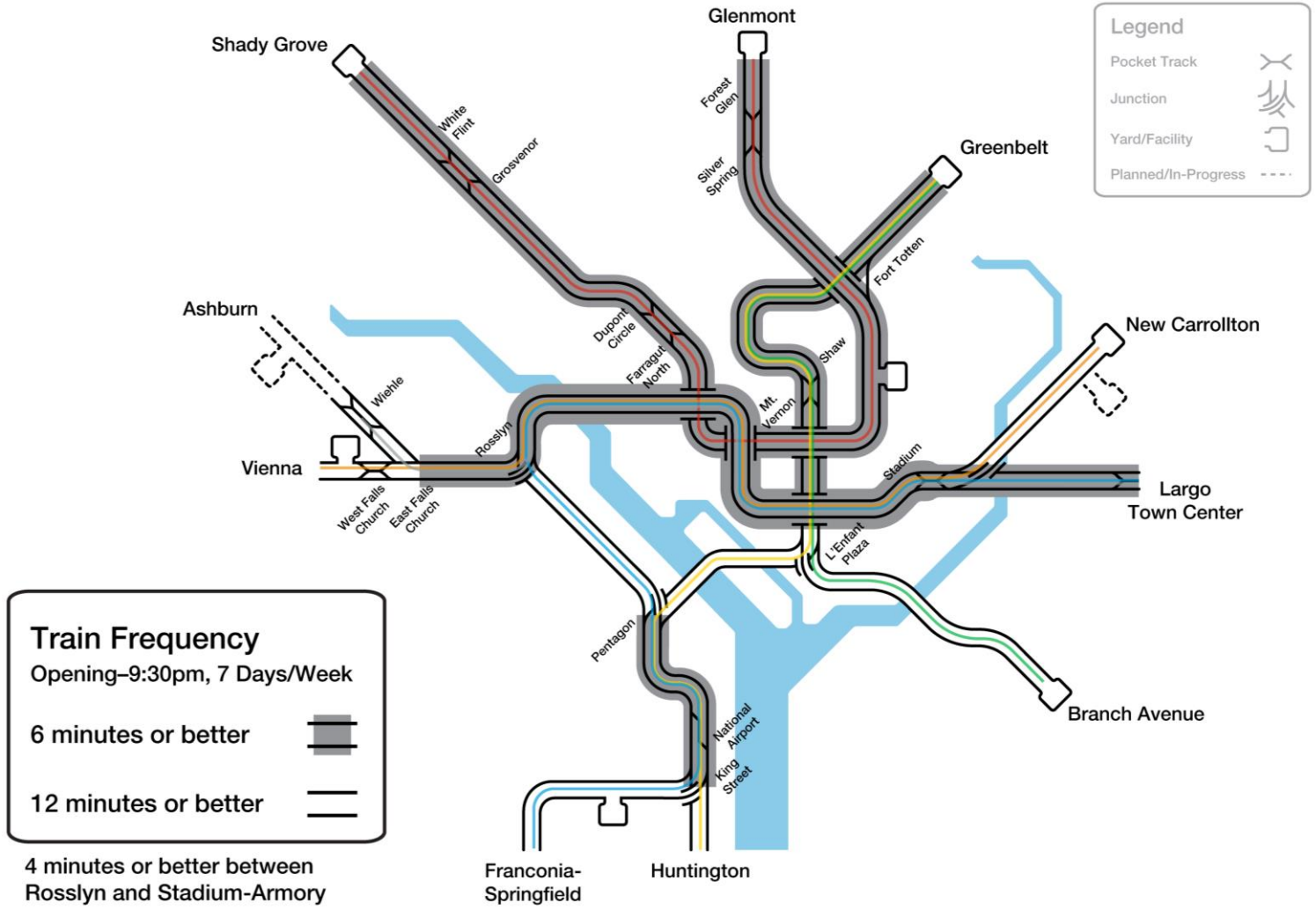
- Schedule peak service above minimum frequency levels to keep up with ridership and limit crowding, adding capacity to keep average loads between 80 and 100 passengers per car

- Standards provide a conditions-based framework for adapting service as ridership recovers from pandemic and patterns evolve

Effective Train Frequency by Segment

- Most riders receive better service than minimum line frequencies
  - Peak service runs more frequently
  - Interlined segments, where two or more lines overlap, and the Red Line have higher effective frequencies

Train frequency of **6 minutes or better** at **65 stations** (71% of all stations)



Next Steps

- Input and feedback on updated standards

- Staff recommendation on updated rail service standards in December 2021

Appendix

Current Rush Period Service Standard

- Metro targets an average of 100 passengers per car over the busiest hour on the busiest segment of each line
- 100 passengers approximately represents all seats occupied with an additional half as many standing

Rush Period Service Standard	Measured
Passenger loads below an average of **100 passengers per car** (PPC) and shall not exceed 120 PPC or fall below 80 PPC	Average during the peak hour, in the peak direction, at locations where vehicle passenger loads are greatest

Peak Vehicle Requirements by Line

Peak Vehicles Required for Service						
Type of Service	**2020**		**2030**		**2040**	
	Trains	Cars	Trains	Cars	Trains	Cars
Red Line	40	276	46	368	46	368
Yellow Line	16	126	18	144	18	144
Green Line	18	144	19	152	19	152
Blue Line	20	134	23	184	23	184
Orange Line	21	150	23	184	23	184
Silver Line	21	136	30	240	30	240
Total: All Lines	136	966	159	1,272	159	1,272
With 20% Operating Spares Ratio	**164**	**1,162**	**191**	**1,528**	**191**	**1,528**

Total Projected Fleet demand and Supply/Demand Balance

Vehicle Requirement	Total Fleet Requirements by Milestone Year		
	2020	2030	2040
Peak Vehicle Requirement (Service)	**966**	**1,272**	**1,272**
Out of Service for Rehabilitation (1.5%)	14	20	20
Out of Service for Periodic Maintenance and Inspection (2%)	20	26	26
Out of Service for Engineering (1%)	10	12	12
Out of Service for Parts (2%)	20	26	26
Out of Service for Miscellaneous (1%)	10	12	12
Out of Service for Corrective Maintenance (12.5%)	122	160	160
Total Maintenance Requirement	**196**	**256**	**256**
Total Fleet Demand	**1,162**	**1,528**	**1,528**
Projected Out of Service Ratio (% of total fleet demand)	17%	17%	17%
Projected Operating Spares Ratio (% of peak vehicles)	20%	20%	20%
Projected Vehicle Supply	**1,278**	**1,528**	**1,528**
Supply/Demand Balance	**116**	**0**	**0**

Railcar Storage Locations and Configurations

Yard	Location	Revenue Storage Track Spaces	Railcars Storable as 8-Car Trains	Percent Stored as 8-Car Trains	Non-Revenue Storage Track	Maintenance Bays
A99	Shady Grove	166	120	72%	28	36
B98	Glenmont	132	88	67%	20	0
B99	Brentwood	90	72	80%	0	42
C99	Alexandria	176	136	77%	50	20
D99	New Carrollton	120	88	73%	54	16
E99	Greenbelt	270	264	98%	38	20
F99	Branch Avenue	174	120	69%	16	8
G05	Largo	38	32	84%	0	0
K99	West Falls Church	188	144	77%	24	28
N99	Dulles	168	128	76%	16	20
	Total	**1522**	**1192**	**78%**	**246**	**190**