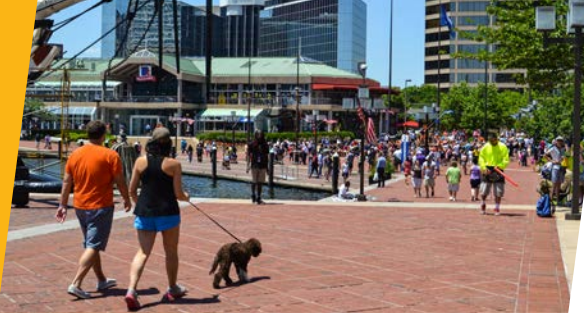


Asset Management Plan



1 | Program Overview, Goals, and Objectives

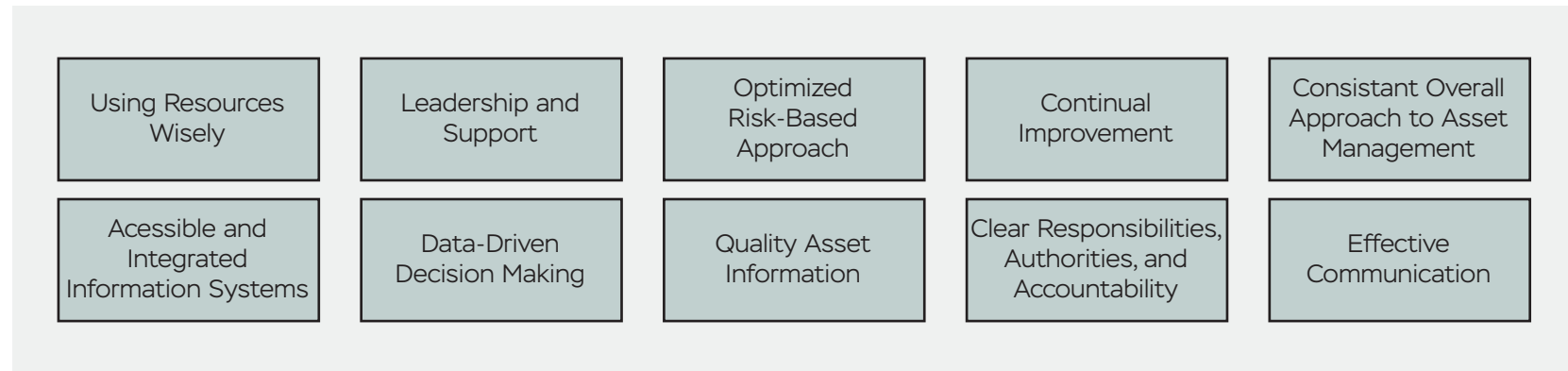


Department Asset Management Policy

The Maryland Department of Transportation (MDOT) will strategically manage its assets through a comprehensive approach based on sound asset management practices aligned with the Department's overall strategic direction.

The asset management program will support MDOT's goals of system preservation, safety and security, quality of service, and fiscal responsibility by committing appropriate resources to asset management. The program will further MDOT's commitment to its customer-focused approach through the establishment and management of levels of service.

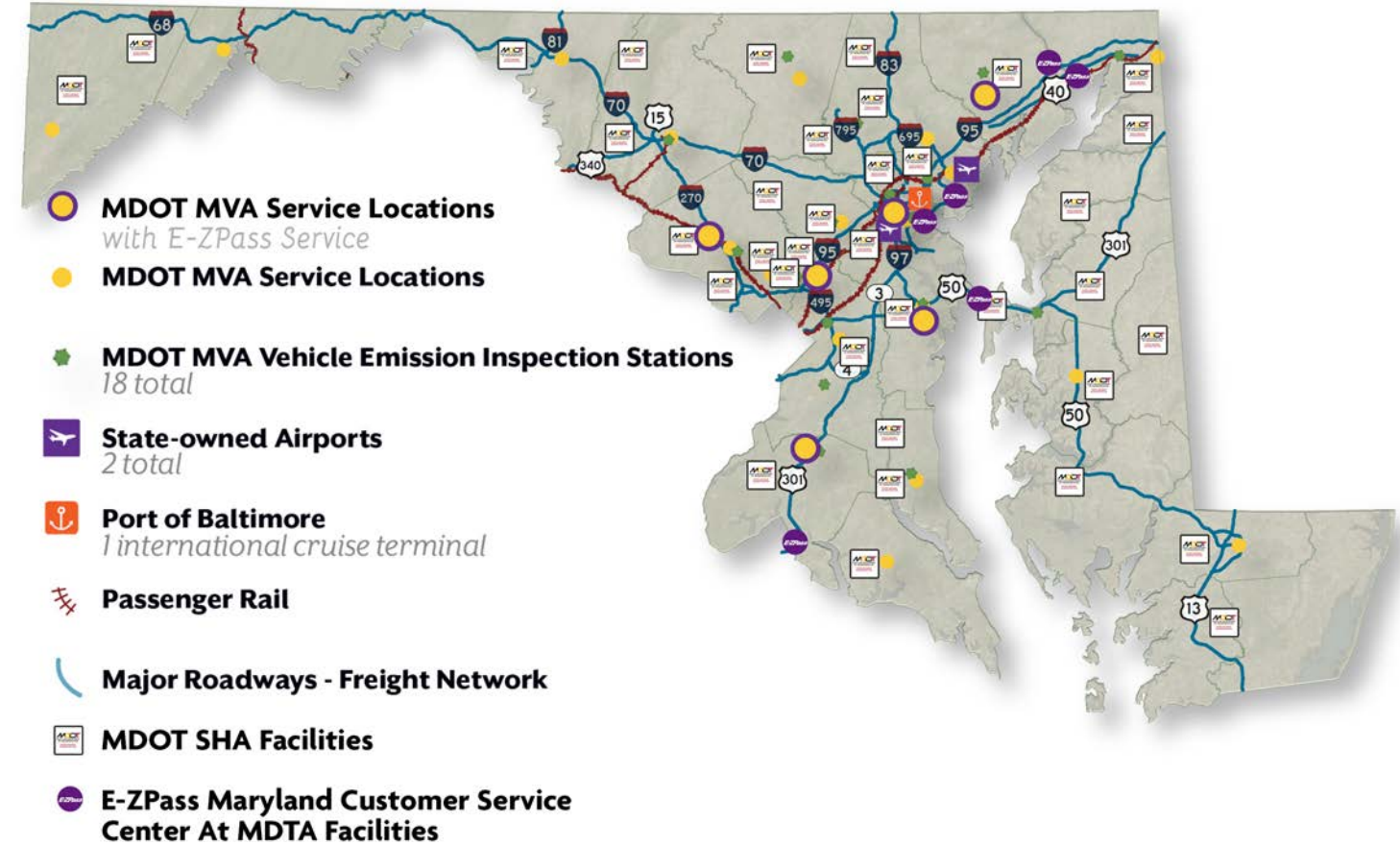
MDOT is committed to the following principles for managing its assets:



Key Assets

MDOT manages a wide range of asset classes that make up the infrastructure base to provide services to Maryland's residents and businesses, along with those traveling to or through the State. Its asset management program is focused on seven asset classes defined as critical by the Department.

MDOT's transportation system contains complex infrastructure including major interstates, highways, tunnels, and bridges; a transit system that includes local and commuter bus, light rail, heavy rail, paratransit, and commuter rail services; an international port, and an international airport. In addition to this extensive transportation system, MDOT operates highly secure IT systems that support MDOT Motor Vehicle Administration (MDOT MVA) and law enforcement operations throughout the State.



Asset Classes						
Facilities	Pavement	Structures	Tunnels	Rail	Vehicle Fleet and Equipment	Major IT Systems
858 customer, operations and maintenance, and administrative buildings	182 million square yards of roadway, airfield, and parking pavement	11,254 roadway and pedestrian bridges, retaining walls, and other waterfront structures	19.6 miles of road and rail tunnels	188 miles of passenger and freight rail	6,360 revenue and non-revenue producing vehicles and equipment	150 hardware, software, and other major IT systems

Goals and Objectives

MDOT has established five asset management goals for the Department. These will build from one another and progress over time.

Define and record the assets we own	Determine the condition of our assets	Established a plan for maintaining a state of good repair (SGR)	Commit to asset management practices	Develop framework and guidance for asset management software
<ul style="list-style-type: none"> Conduct asset inventory for all major assets annually (or more frequently) Establish guidelines for how to estimate the replacement value of assets 	<ul style="list-style-type: none"> Conduct condition assessments and develop a program for ongoing condition assessments Track maintenance activities and major modifications to assets 	<ul style="list-style-type: none"> Determine the criticality of each asset with an initial focus on highly critical/high risk assets Document and maintain a plan to establish SGR needs 	<ul style="list-style-type: none"> Develop knowledgeable management staff Establish asset management principles applied at all levels Utilize the Excellerator program to embed continuous improvement practices 	<ul style="list-style-type: none"> Define minimum data standards for assets Identify software integrations Develop an asset management system map for software Identify a business intelligence (BI) tool to aggregate asset data

Each of MDOT's transportation business units (TBUs) has defined specific goals and objectives aligned with their missions, visions, and strategic plans. To highlight some of these, MDOT Maryland Port Administration's (MDOT MPA) and MDOT Maryland Transit Administration's (MDOT MTA) objectives are as follows:



MDOT Maryland Port Administration (MDOT MPA)	MDOT Maryland Transit Administration (MDOT MTA)
<ul style="list-style-type: none"> Maintain and enhance infrastructure at a high level of service and reliability to attract top-tier businesses, increase waterborne commerce, and drive economic development Fully inventory and assess the condition of all assets to ensure that assets are promptly repaired or replaced as needed Develop an asset management program which reflects private sector best practice and continues to attract more business to the Port of Baltimore Ensure that projects comply with environmental regulations Eventually incorporate navigation channels and dredged material containment facilities (DMCFs) into a robust asset management program 	<ul style="list-style-type: none"> Integrate transit asset management and safety measurement systems (SMS) to improve overall system safety Implement risk-based decision-making for capital planning and asset maintenance Migrate from preventative to predictive maintenance for revenue vehicles Strategically coordinate maintenance and construction activities to improve the accuracy of capital needs forecasting and project scoping



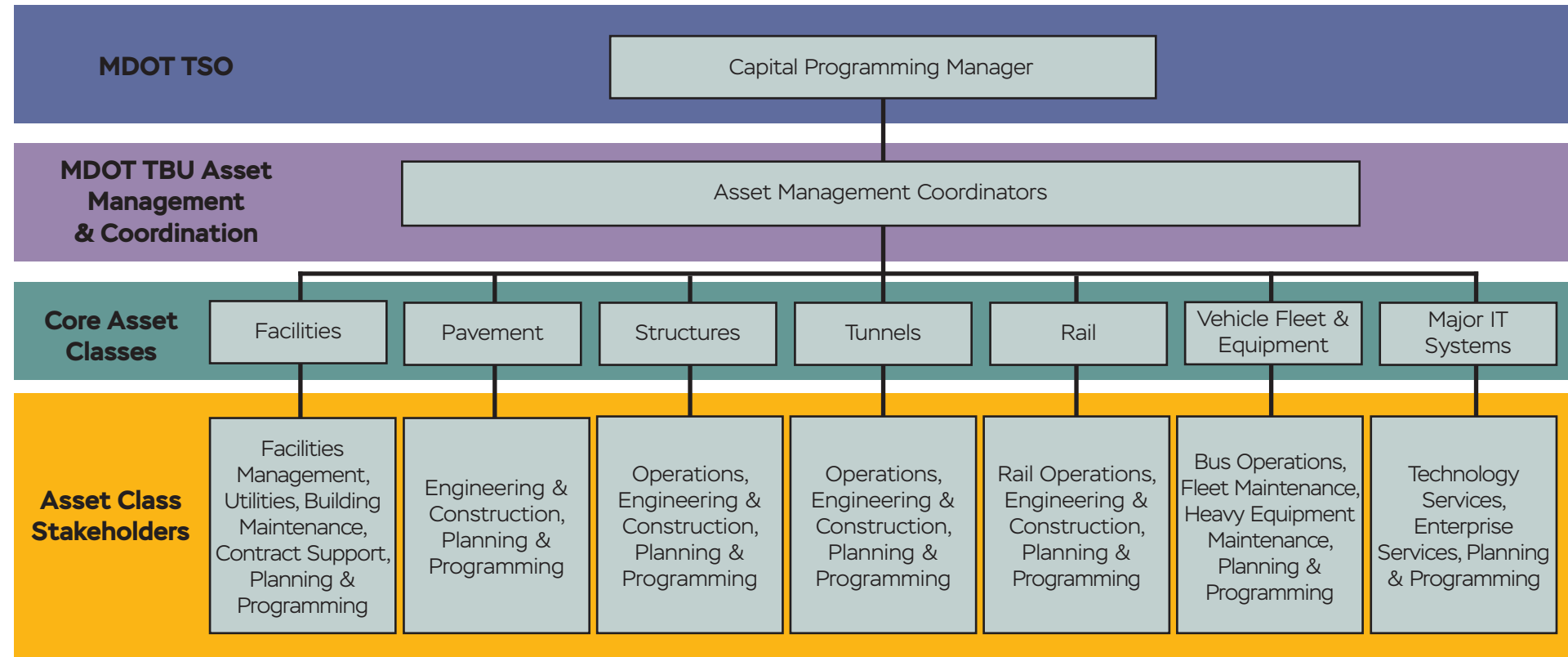
2 | Structure, Roles, and Responsibilities



Organizational Structure

Asset management is not a single department's function but a coordinated, strategic, and systematic process involving employees at all levels. Embracing an asset management culture requires change management champions to fully realize the benefits and outcomes of an asset management-centered organization.

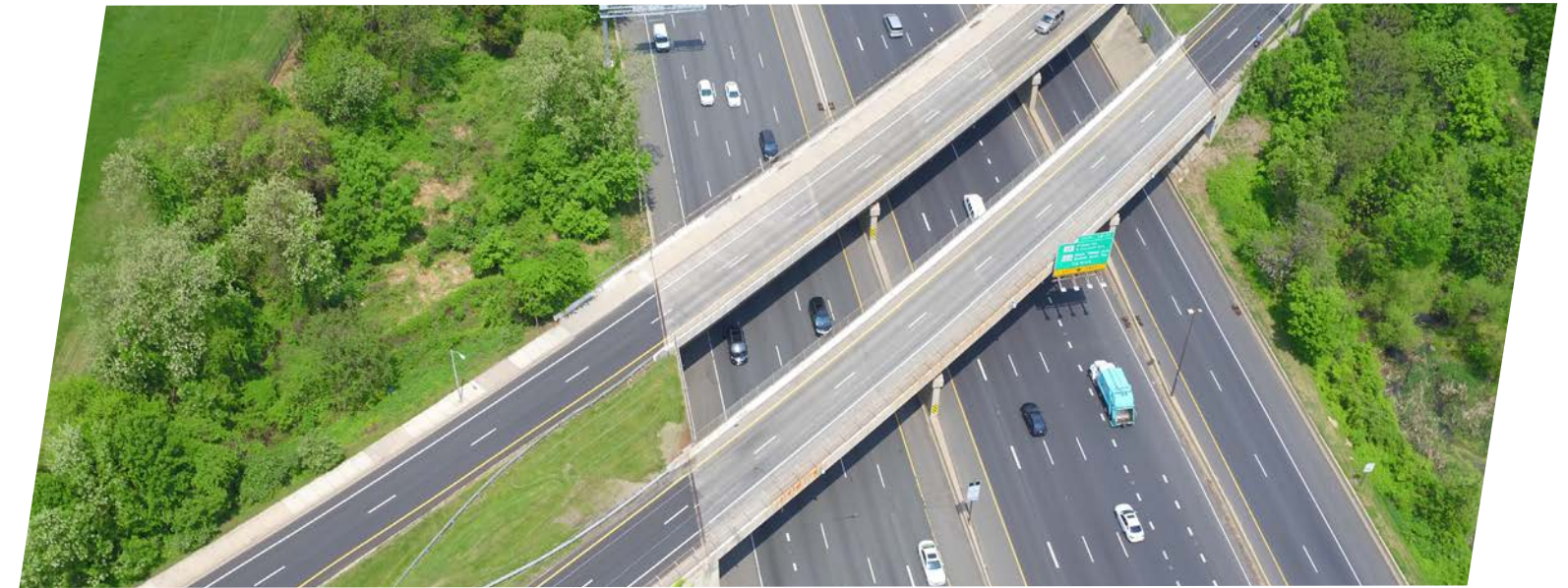
The Department's Office of Planning and Capital Programming at the MDOT Transportation Secretary's Office (MDOT TSO) oversees coordination and implementation of the asset management program. Each TBU has formed an asset management team composed of stakeholders responsible for planning, operations, and maintenance activities across several asset classes.



Implementation Responsibilities

Asset management is coordinated through a comprehensive planning process, with collaboration across asset stakeholders and offices, and responsibilities assigned to staff at all levels.

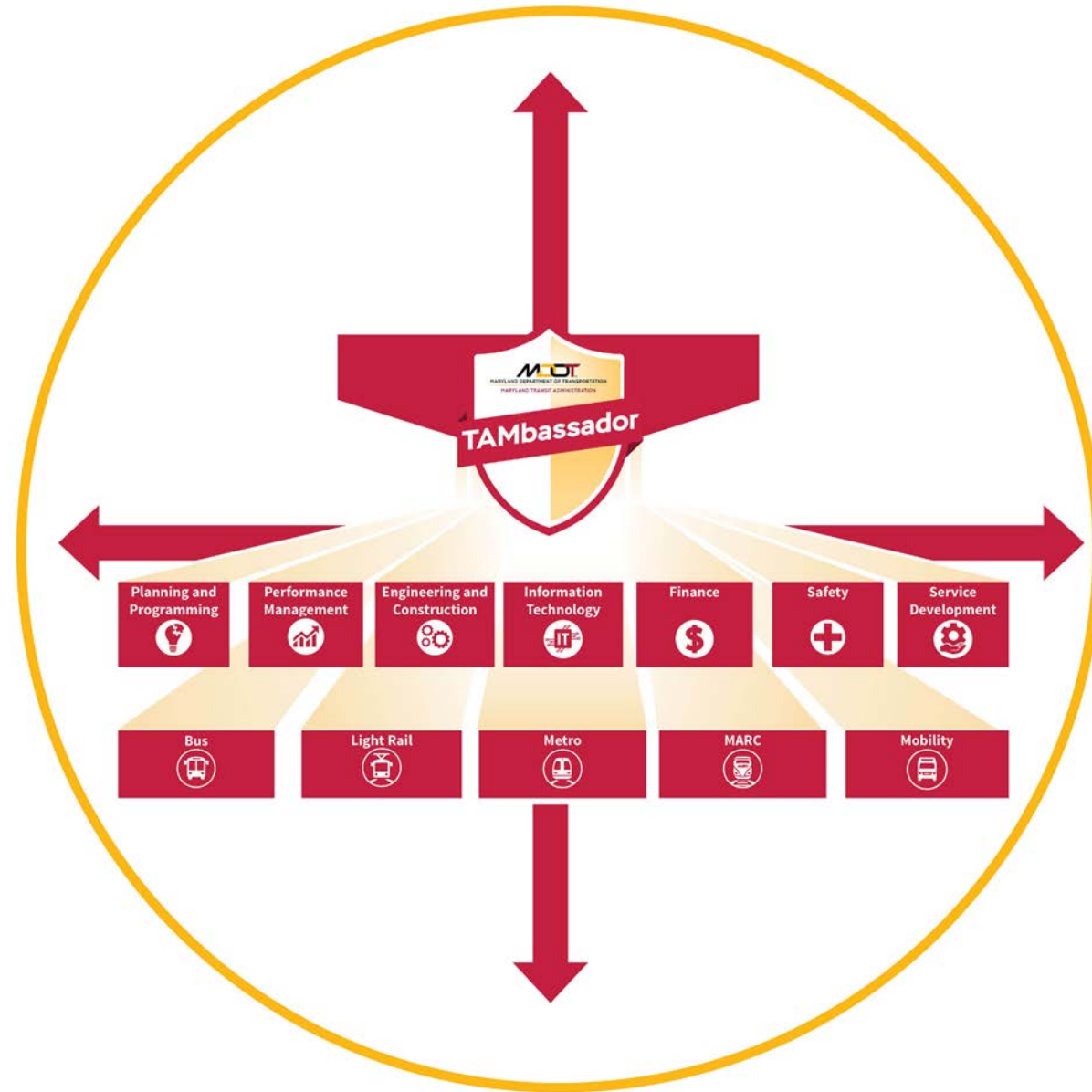
Department Role	Responsibilities	Considerations	Guiding Document (s)
Executive Leadership	Set vision, goals, and objectives	<ul style="list-style-type: none"> What is our vision? What are our strategic objectives and when do we need to achieve them? What resources are needed? How will we measure progress and success? 	Asset Management Strategy Asset Management Plan (AMP)
Senior Managers	Establish the strategy for achieving goals and objectives. Translate objectives into projects and tactical actions and assign actions	<ul style="list-style-type: none"> How will we achieve these objectives? Who will lead and oversee implementation of projects to achieve these objectives? 	
Asset Class Sponsors or Managers	Oversee and ensure successful implementation of projects to achieve the goals and objectives	<ul style="list-style-type: none"> How will we implement these projects? What is the timeline? Who needs to be engaged and how? 	Lifecycle Management Plans
Planning, Operations, Maintenance Staff	Implement projects and tactical actions for achieving goals and objectives	<ul style="list-style-type: none"> How will I implement the objectives in my daily activities? What projects do I need to contribute to and how? 	Guidebooks and standard operating procedures



MDOT MTA TAMbassador Program

MDOT MTA has adopted an innovative program for implementing and promoting asset management. The Transit Asset Management Ambassador (TAMbassador) Program engages leaders from across the business unit to ensure coordinated communications and actions to achieve MDOT MTA's mission and vision. Responsibilities of a TAMbassador include:

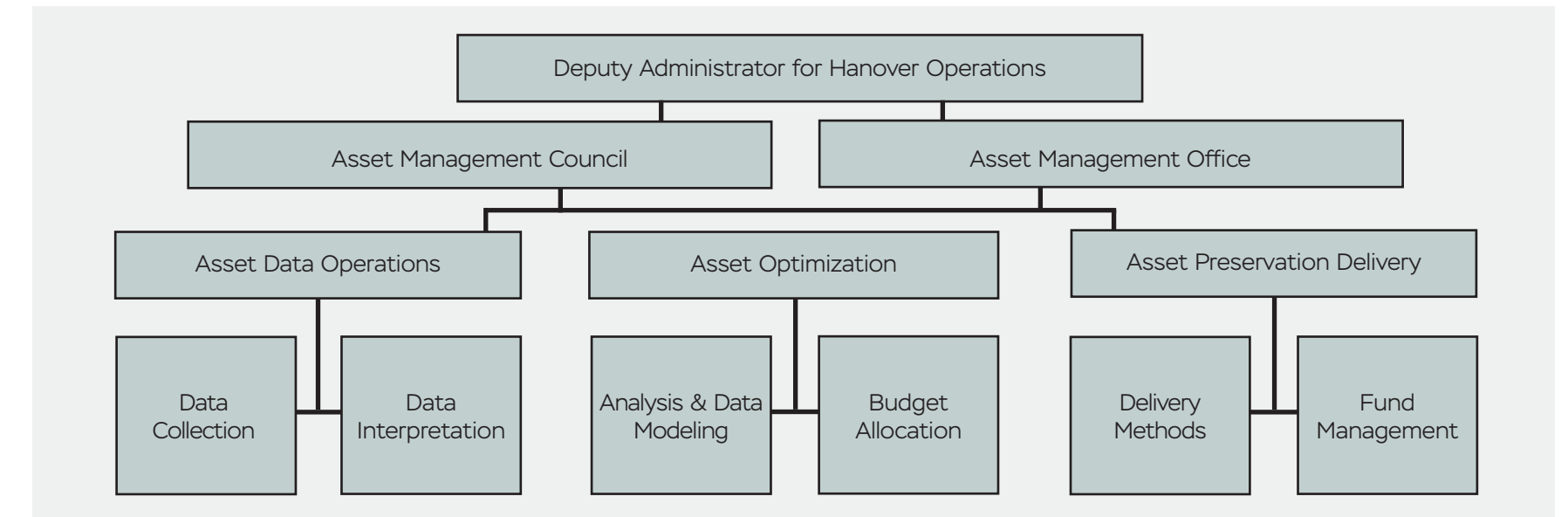
- Reviewing and shaping development of asset management projects & procedures
- Recommending asset management improvements and strategic actions
- Continually identifying ways for office to further engage in asset management
- Serving as primary liaison to the Asset Management Division ensuring members of their team are aware and prepared for TAM meetings, assisting with follow-up
- Attending all asset management-related meetings
- Educating colleagues on asset management
- Ensuring their office's fulfillment of asset management responsibilities
- Providing quality assurance/quality control (QA/QC) on asset management data



Moving Forward

The MDOT SHA Asset Management Council (AMC) guides implementation of business practices for asset management and is chaired by the Deputy Administrator for Hanover Operations. The asset management program will be directed by the new Asset Management Office (AMO).

The AMO formalizes performance and risk management of all assets through data collection, interpretation, and modeling to maximize the return on investment (ROI) from the asset preservation project delivery. The centralized operational asset management program implements standards, improves systems and data, fosters collaboration, and strengthens institutional knowledge.



3 | Information Systems and Data



Core Asset Management Applications

MDOT uses several applications to support asset management. These information systems maintain asset inventories, store plans and guidelines, map assets, schedule and track maintenance tasks, analyze condition data, create reports and more.

Pilot and Future Applications

MDOT is continually expanding its use of information systems applications to better track asset condition and maintenance, analyze trends, and integrate data sources to make better-informed decisions. Several pilot programs are underway at MDOT's TBUs to test new applications and integrations that demonstrate potential to improve asset management across MDOT.



Asset Management System Pilot at the MDOT MTA Eastern Bus Division

As illustrated in the Core Asset Management Applications table, asset management is supported by a variety of software applications or tools. Without a centralized master location for data to share across an organization, staff rely on intermediary spreadsheets, email transfer, or duplicate manual data entry.

Through the Asset Management Pilot at the Eastern Bus Division, MDOT MTA is working toward an Enterprise Asset Management System (AMS), an integrated and efficient system for asset management. An AMS will enable MDOT MTA to:

- Develop consistent standards for collecting and maintaining asset information
- Conduct more sophisticated data analysis to support better management decisions
- Establish a data governance structure for updating and using asset data

Application	Role/Function	MDOT SHA	MDOT MAA	MDOT MPA	MDOT MTA	MDOT MVA	MDTA
AIRPortal	Store engineering documents, spatial data, planning and engineering guidelines and standards, and other documents		✓				
ASIR	Manage structures asset inventory, manage inspection information/ reports and schedule and track work orders						✓
Bentley: ProjectWise and MicroStation	ProjectWise is for electronic file storage. MicroStation is software for plan preparation.	✓			✓		✓
Building Information Model (BIM)	Design buildings based on guidelines and provide data throughout construction, operation, and management		✓				
Cornerstone	Track employee training, key performance indicators (KPIs), and work plan initiatives	✓	✓				✓
Capital Management Asset Program System (CMAPS)	Develop and maintain capital budgets and schedules and budgets for active projects		✓		✓		✓
Esri ArcGIS	Map assets, and conduct location-based analysis	✓	✓	✓	✓		✓
Financial Management Information System (FMIS)	Manage the State of Maryland's finances in fulfillment of federal, state, and local accounting requirements	✓	✓	✓	✓	✓	
Federal Transit Administration (FTA) Transit Economic Requirements Model Lite (TERM Lite)	Track inventory by age, produce condition estimates, prioritize asset replacement needs, analyze backlog, and produce asset to project mapping, tying SGR funding needs to projects				✓		
IBM Maximo and EZMaxMobile	Maintain asset inventory, track labor and cost, schedule and track work orders, and create reports	✓	✓	✓	✓	✓	✓
Joint Environmental Tracking System (JETS)	Maintain environmental asset inventory, track tasks, create reports, and connect with geospatial data		✓				
Microsoft Dynamics SL	Manage MDTA finances and meet organizational accounting requirements						✓
Optram	Manage rail asset maintenance through layout, inventory, condition, and maintenance work records				✓		
Pavement Data Warehouse (PDW)	Maintain construction history information, manage and store pavement condition data	✓					✓
PAVER™	Maintain pavement inventory, forecast maintenance and repair needs, generate maintenance programs, compare budget scenarios and lifecycle costs		✓				
Port View	Track the location, attributes, and condition of berths, pavement, rail, utilities, terminal lighting, fences, and gates			✓			
S&A Systems FleetWatch	Monitor fluid usage and schedule preventative maintenance				✓		
Trapeze Bus Stop Manager	Manage bus stop inventory and create work orders				✓		

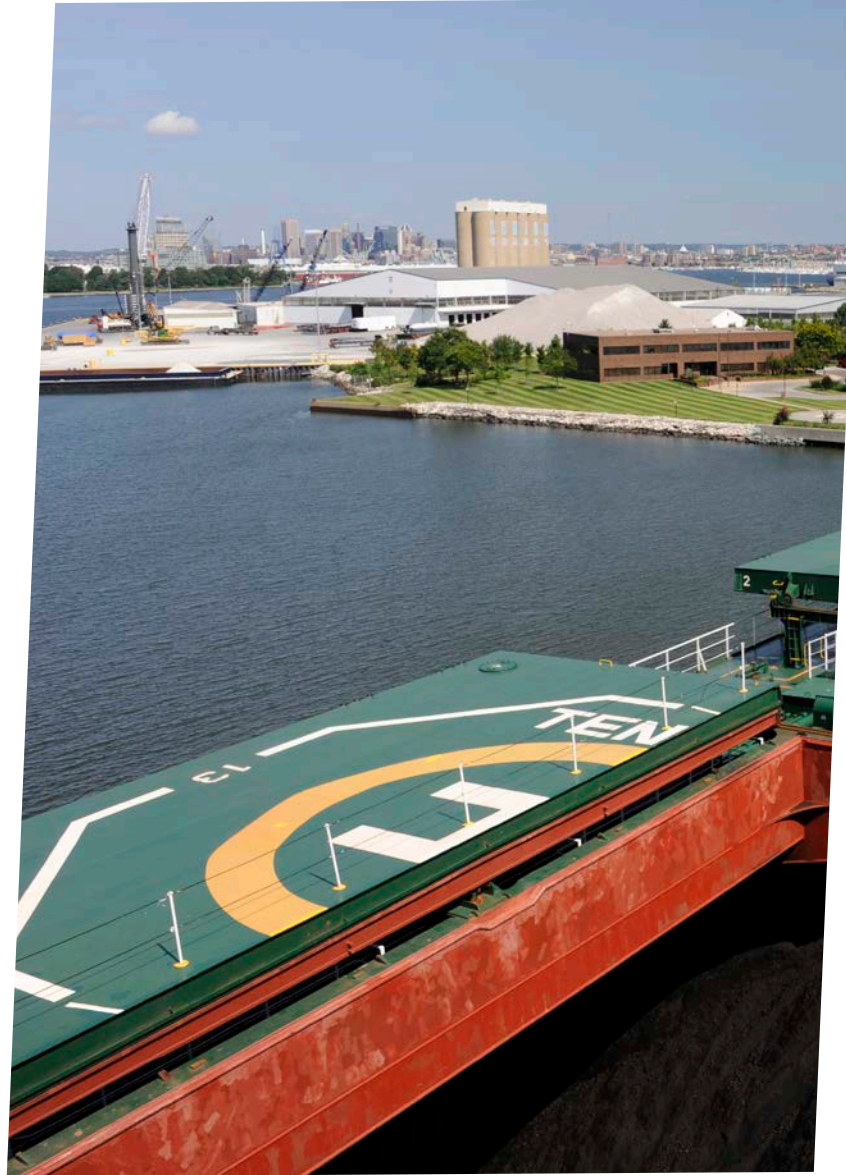
Facilities Assessment Pilot at MDOT MVA

MDOT MVA is currently piloting use of EZMaxMobile software to enable facilities technicians to access Maximo via mobile tablet. Accessing Maximo via tablet will reduce time spent inputting data and enable the collection of more asset performance and cost data. These inputs will eventually enable MDOT MVA to leverage Maximo's analytics and reporting capabilities to make more informed asset management decisions. Upon completion of the Facilities Assessment Pilot, MDOT MVA will begin integrating its other critical asset classes, beginning with vehicle fleet and equipment.

Maximo Implementation for Facility Asset Management at MDOT MPA's Terminals and World Trade Center

MDOT MPA's Maintenance Division has used Maximo for over 10 years to manage preventive maintenance and repair work on the Administration's vehicle fleet, cranes, and facilities assets. Work orders are created on an annual, quarterly, monthly, weekly, and daily basis for staff to perform, log, and check preventive maintenance activities and repairs on MDOT MPA's terminals.

Since 2019, MDOT MPA has expanded its use of Maximo to a pilot program to improve building maintenance at the World Trade Center (WTC) building at Baltimore's Inner Harbor. The WTC's new building services provider is using Maximo to track the condition of the building's assets and all associated preventive maintenance activities. MDOT MPA will use data gathered through Maximo to make better-informed asset management decisions for WTC, ultimately improving the building's condition at efficient cost.



Integration: Bridging What and Where at MDOT Maryland Aviation Administration

MDOT Maryland Aviation Administration (MAA) is actively researching and meeting with software companies to create a bridge between Maximo asset records and geographic information systems (GIS) mapping. Bridging these systems would establish an authoritative asset inventory that records both the what (Maximo) and where (GIS) of its assets. This bridge would offer the following benefits:

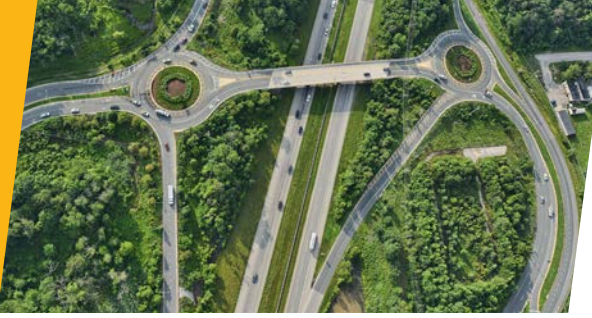
- Establish authoritative asset registry to systematically record what (Maximo) and where (GIS)
- Reduce time spent on duplicate efforts
- Improve accuracy of asset inventories
- Develop procedures for removing outdated or inaccurate data, and reconciling changes between databases

MDOT MAA is also working to integrate its BIM manager with Maximo and GIS to quickly and accurately transfer information about newly constructed assets into its asset inventory.

Given the amount of information that will link between Maximo and GIS, MDOT MAA is exploring the idea of an asset data warehouse to serve as a single authoritative source for asset attribute, history, and location data.



4 | State of Infrastructure



Current Asset Portfolio

As described in **Section 1**, MDOT defines seven asset classes as critical to the Department's infrastructure portfolio. Each TBU has additional asset classes critical to their specific services.

MDOT TBU	Facilities	Pavement	Structures	Tunnels	Rail	Vehicle Fleet and Equipment	Major IT Systems
MDOT SHA	✓	✓	✓			✓	✓
MDOT MAA	✓	✓	✓			✓	✓
MDOT MPA	✓	✓	✓	✓	✓	✓	✓
MDOT MTA	✓	✓	✓	✓	✓	✓	✓
MDOT MVA	✓	✓				✓	✓
MDTA	✓	✓	✓	✓		✓	✓

Exceptions

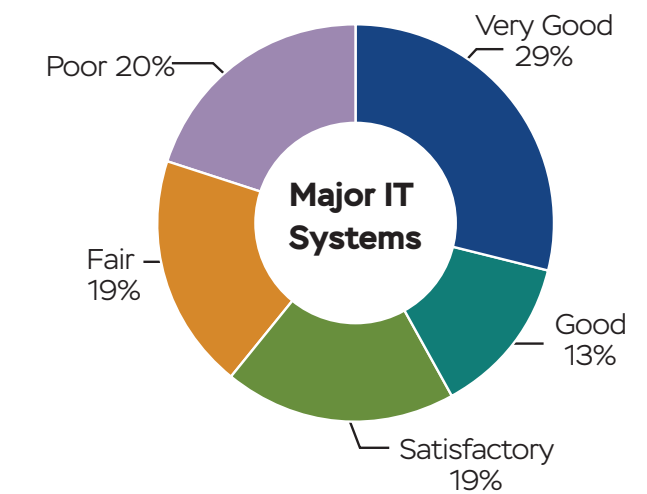
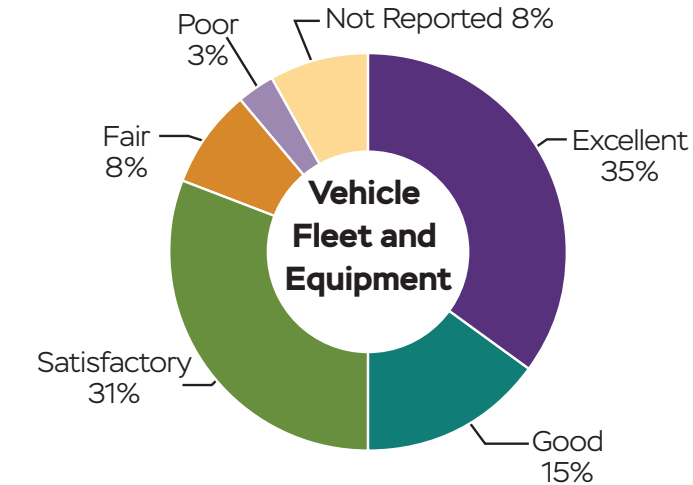
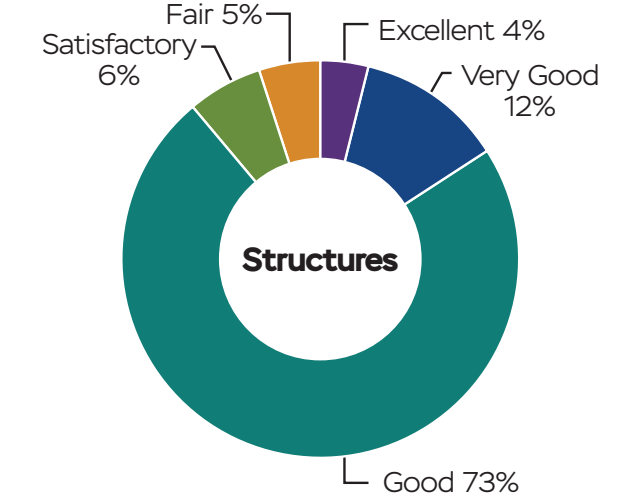
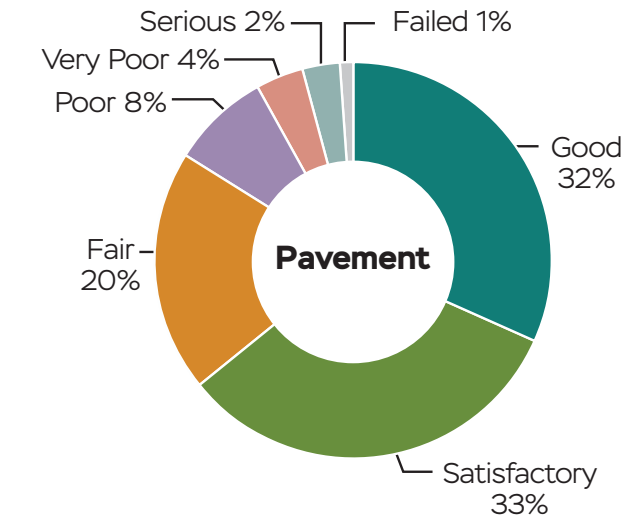
Some assets owned by MDOT, such as the Seagirt Marine Terminal at the Port of Baltimore, are leased to private companies who operate and maintain them. Other assets, including nine of MDOT MVA's customer-facing facilities, are leased by MDOT and maintenance is the responsibility of the owner. These assets are not included in this AMP.

Condition, Age, and Useful Life

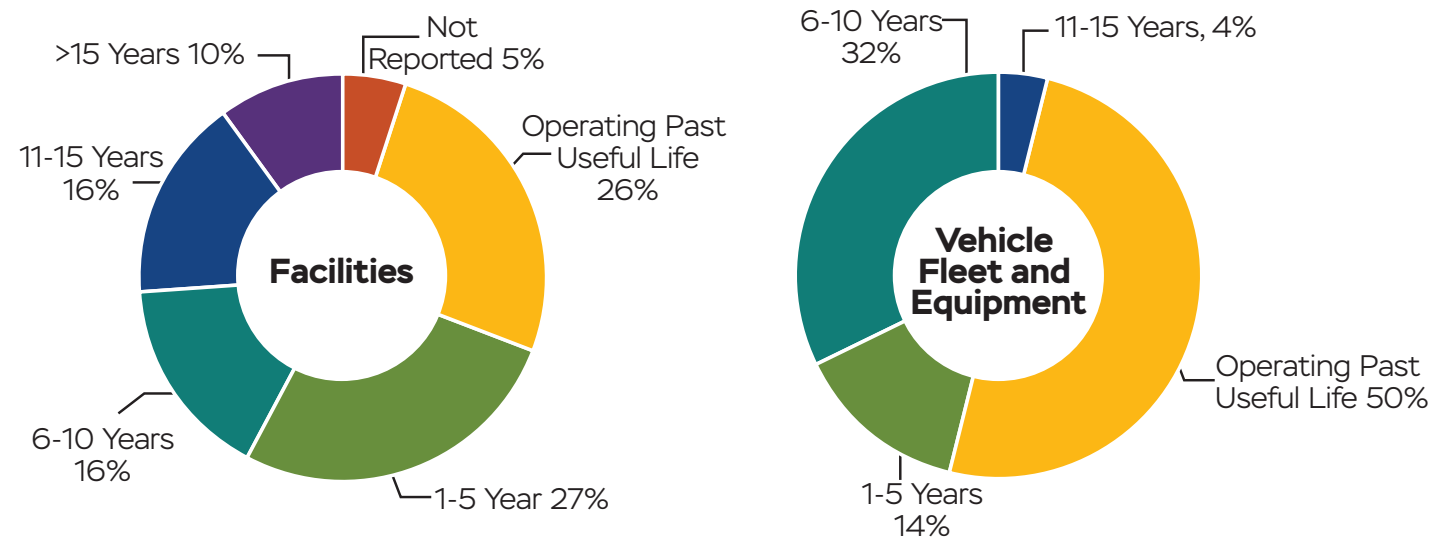
MDOT MAA

MDOT MAA has completed inspections of its pavement, structures, vehicle fleet and equipment, and major IT systems assets. The following charts illustrate the condition and remaining useful life of these assets.

MDOT MAA Asset Condition



MDOT MAA Asset Remaining Useful Life



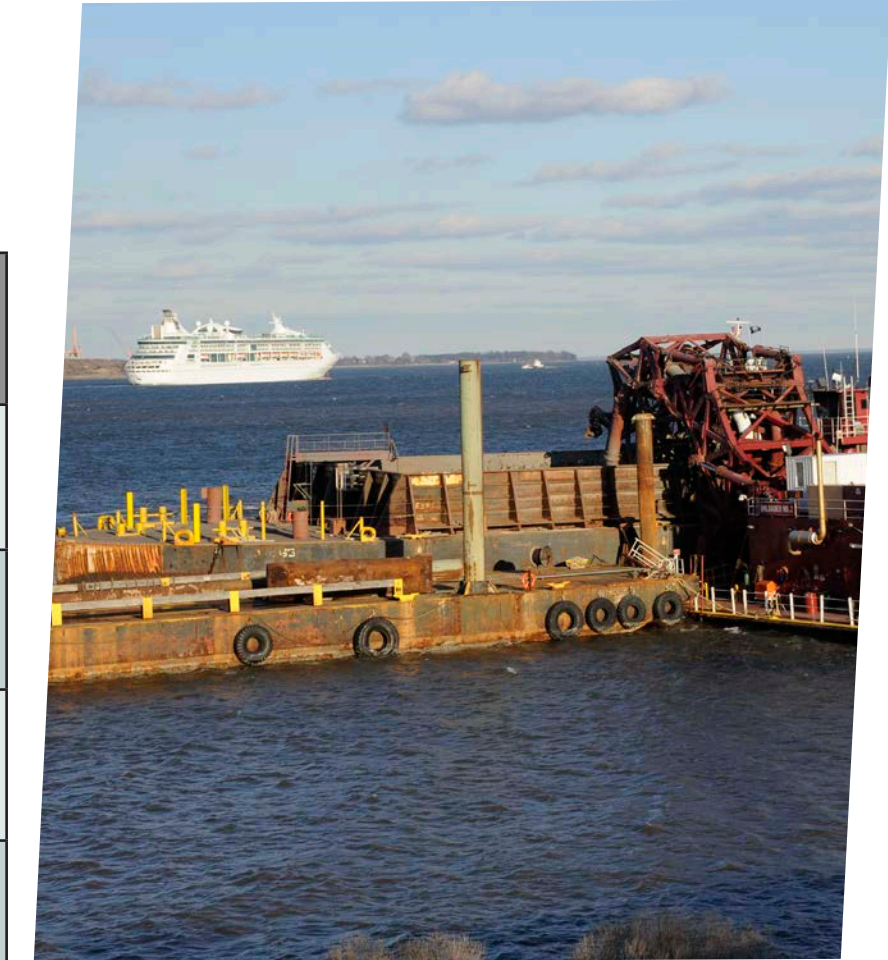
Providing detailed information about the Baltimore Washington International (BWI) Thurgood Marshall Airport Terminal has been deferred to the next iteration of the AMP due to of the size, complexity, and scope of those assets. However, the terminal is inspected daily and maintained by MDOT MAA. MDOT MAA is currently working to implement facility assessment programs for parking garages and other facilities.



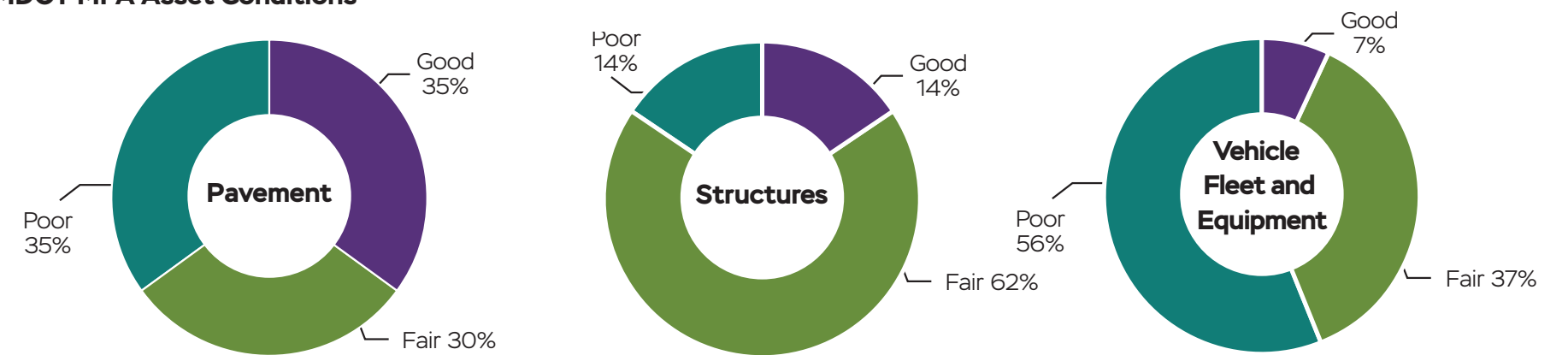
MDOT MPA

MDOT MPA has completed inspections of its pavement and structures assets and has partially completed inspections of its vehicle fleet and equipment assets. The following charts illustrate the condition and remaining useful life of these assets. MDOT MPA is currently working to assess the condition of its facilities assets.

Asset Class	Average Age	Approximate Useful Life Benchmark
Structures (Berths)	33 years	50-75 years
Vehicle Fleet and Equipment	10 years	10 years
Rail	75 years	50-100 years
High Mast Lights	45 years	50 years








MDOT MPA Asset Conditions



MDOT MTA

MDOT MTA's capital asset inventory is currently organized by transit asset classes that align with FTA reporting requirements. It has completed inspections of its vehicles, rail, systems, facilities, and stations assets. The following table (June 2020) describes the condition and remaining useful life of these assets. Asset condition is rated from one (poor) to five (excellent).

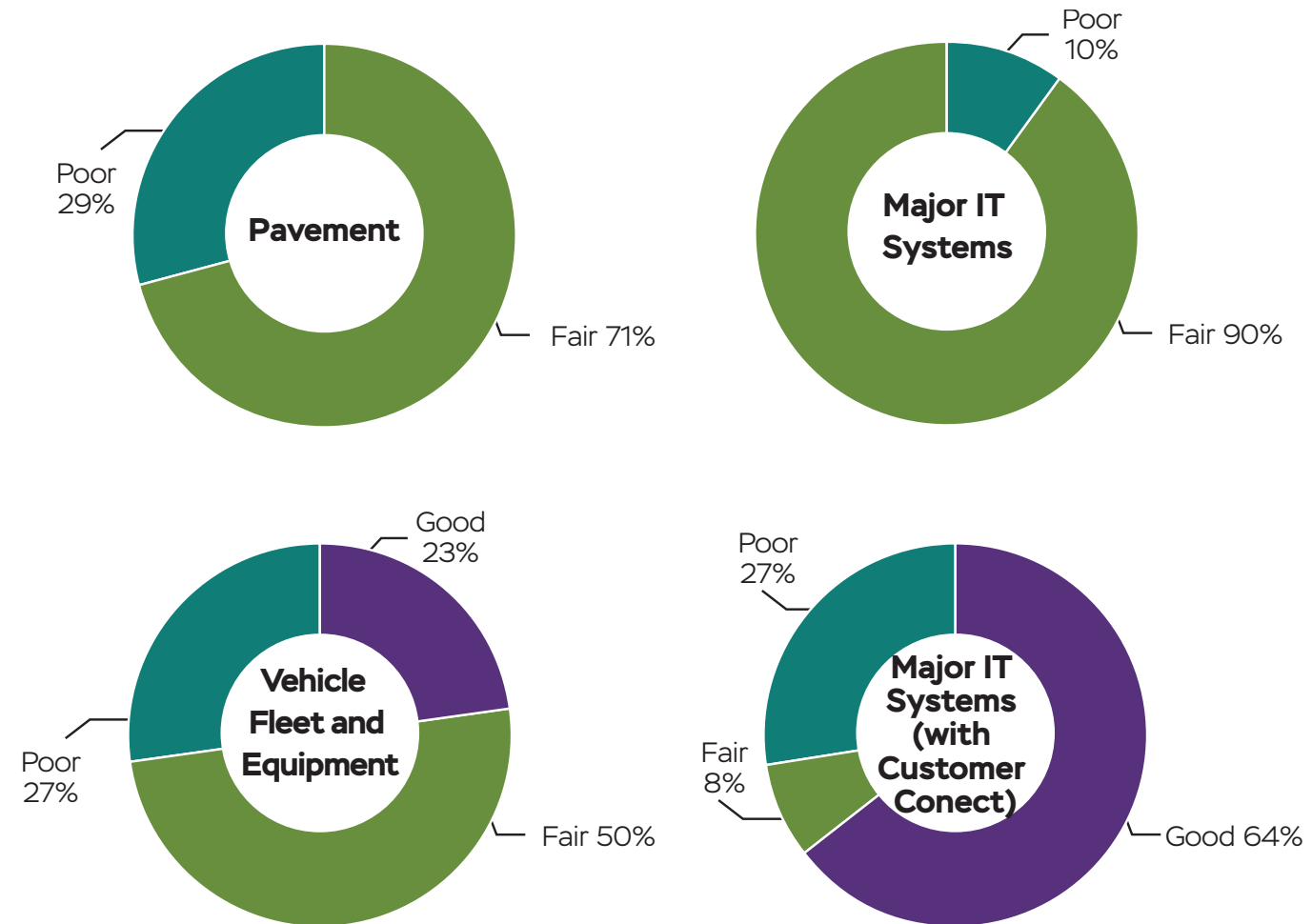
Asset Classes	Asset Type	Average Condition	Asset Operating Past Useful Life
Vehicles 	Revenue Vehicles	3.11	3.18 26%
	Non-Revenue Vehicles		3.00 41%
	Equipment/Parts		1.97 59%
Rail 	Guideway	2.67	3.21 15%
	Bus Guideway		4.86 0%
	Special Structures		2.87 0%
	Trackwork		2.30 67%
Systems 	Communications	2.72	3.04 19%
	Electrification		2.21 57%
	Intelligent Transportation Systems (ITS)		2.25 97%
	Revenue Collection		2.44 83%
	Train Control		2.98 26%
	Uninterruptible Power Supplies (UPS)		3.31 25%
	Utilities		2.91 10%
Facilities 	Buildings	2.42	2.60 49%
	Central Control		3.75 0%
	Equipment		2.38 69%
	Storage Yard		3.36 10%
Stations 	Access	2.78	2.59 41%
	Building		2.19 77%
	Complete Station		3.54 4%
	Platform		2.68 30%
	Signage & Graphics		2.33 85%

MDOT MVA

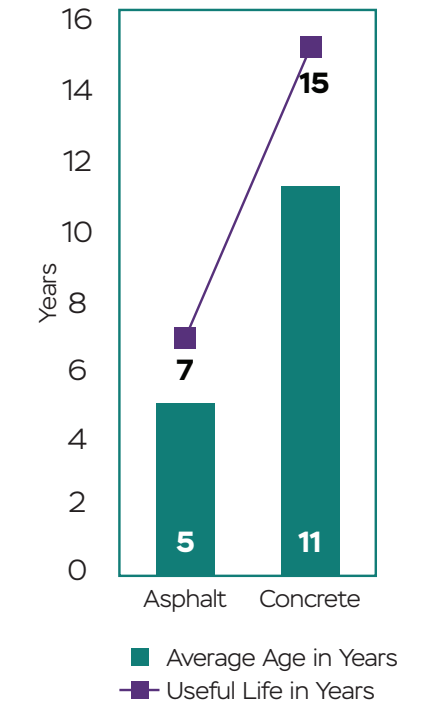
MDOT MVA has completed inspections of its pavement, vehicle fleet and equipment, and major IT systems assets. The following charts illustrate the condition of these assets and the remaining useful life of its pavement assets. MDOT MVA is currently in the process of inspecting its facilities assets through the ongoing Facilities Assessment Pilot.

MDOT MVA is currently updating and upgrading 38 of its 59 major IT systems to the new Customer Connect cloud-based IT platform. The new platform will substantially improve the average condition of its major IT systems from 90% in poor condition to 64% in good condition.

MVA Asset Conditions



MDOT MVA Pavement Average Age and Useful Life

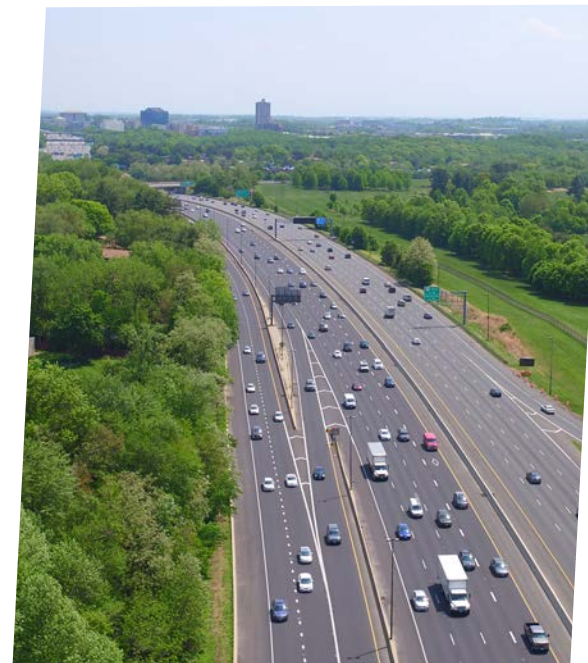


MDTA Pavement Condition

MDTA roadways fall into the inspection program operated by MDOT SHA's Office of Materials Technology (OMT). These condition assessments are performed on an annual basis using Automated Road Analyzer (ARAN) technology. Results from the ARAN provide MDTA with crucial information to strategically maintain pavement and make improvements to the roadway segments that are most in need. Paved lots are assessed separately from roadways on a tri-annual basis. Inspection results are used to prioritize improvements to paved lots.

MDTA Roadway Pavement Condition-Summary (2019)

Roadways	Square Yards	% of Area	Rating
	822,254	11%	1 - Poor
	591,025	8%	2 - Marginal
	1,683,027	22%	3 - Adequate
	2,195,491	29%	4 - Good
	2,232,101	30%	5 - Excellent
7,523,899	100%		

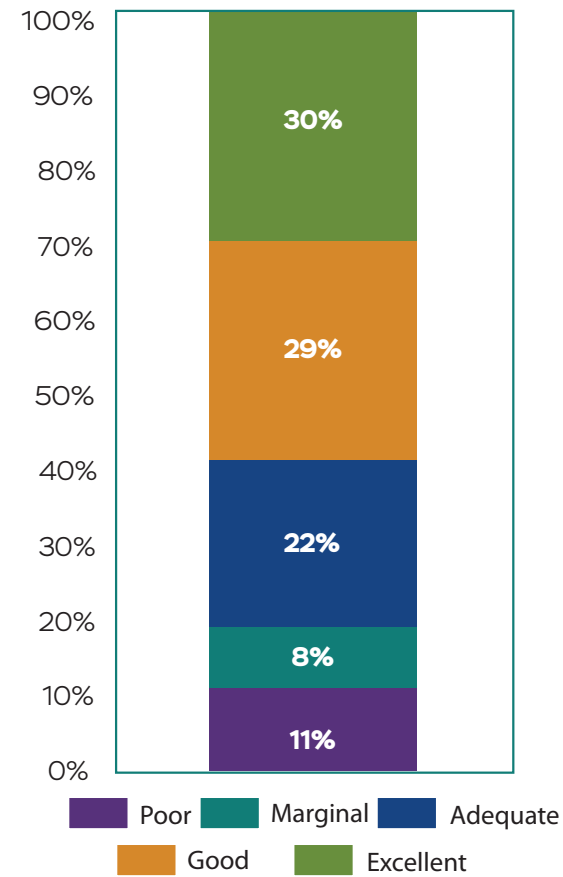


MDTA Bridge Condition

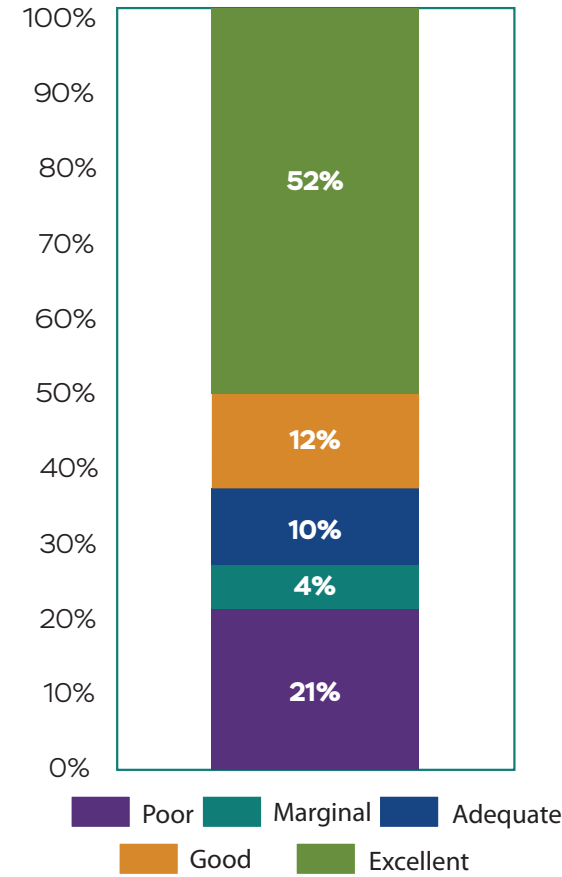
MDTA performs various types of inspections each year on all assets throughout the different facilities. The Federal Highway Administration requires all bridges to be inspected every two years. MDTA performs complete hands-on inspections of the bridges every two years to meet these requirements and a risk-based interim inspection on the off years. These risk-based inspections look at the higher priority defects to ensure no major changes have occurred.

MDTA also has a data driven bridge asset management program that evaluates the reported conditions, models future deterioration, and makes recommendations on possible projects. This helps MDTA evaluate possible projects and ensures the timely investment of repairs or rehabilitations for an efficient and safe bridge program.

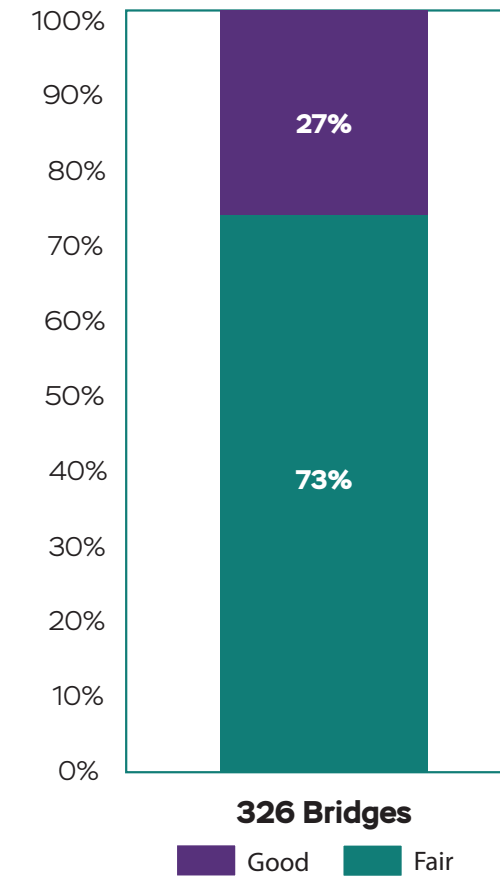
MDTA Roadways (2019) Overall Condition



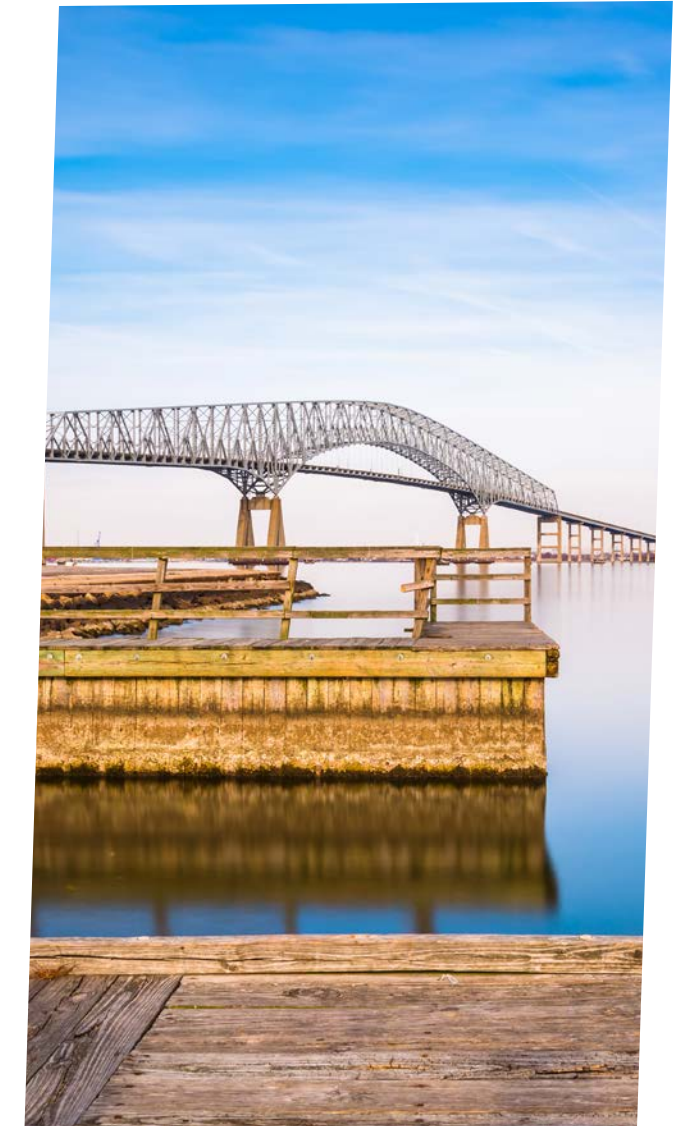
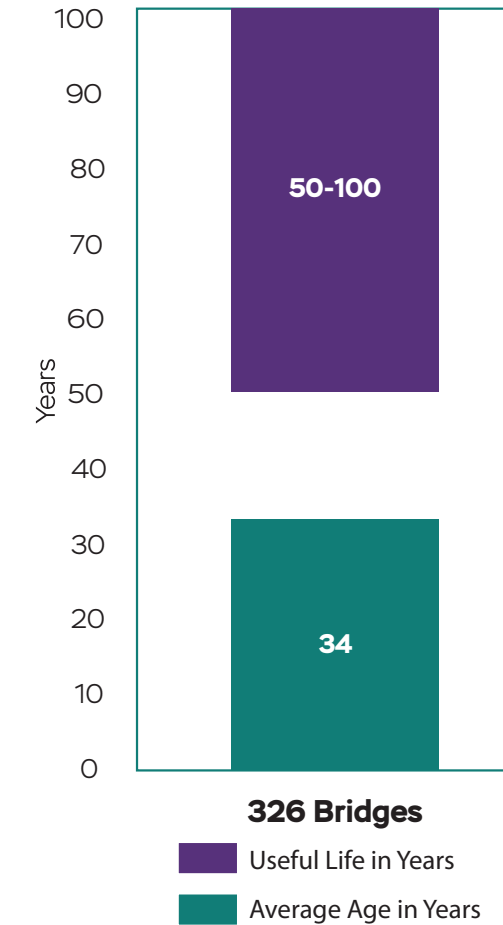
MDTA Paved Lot Condition Summary



MDTA Bridge Condition by Deck Area



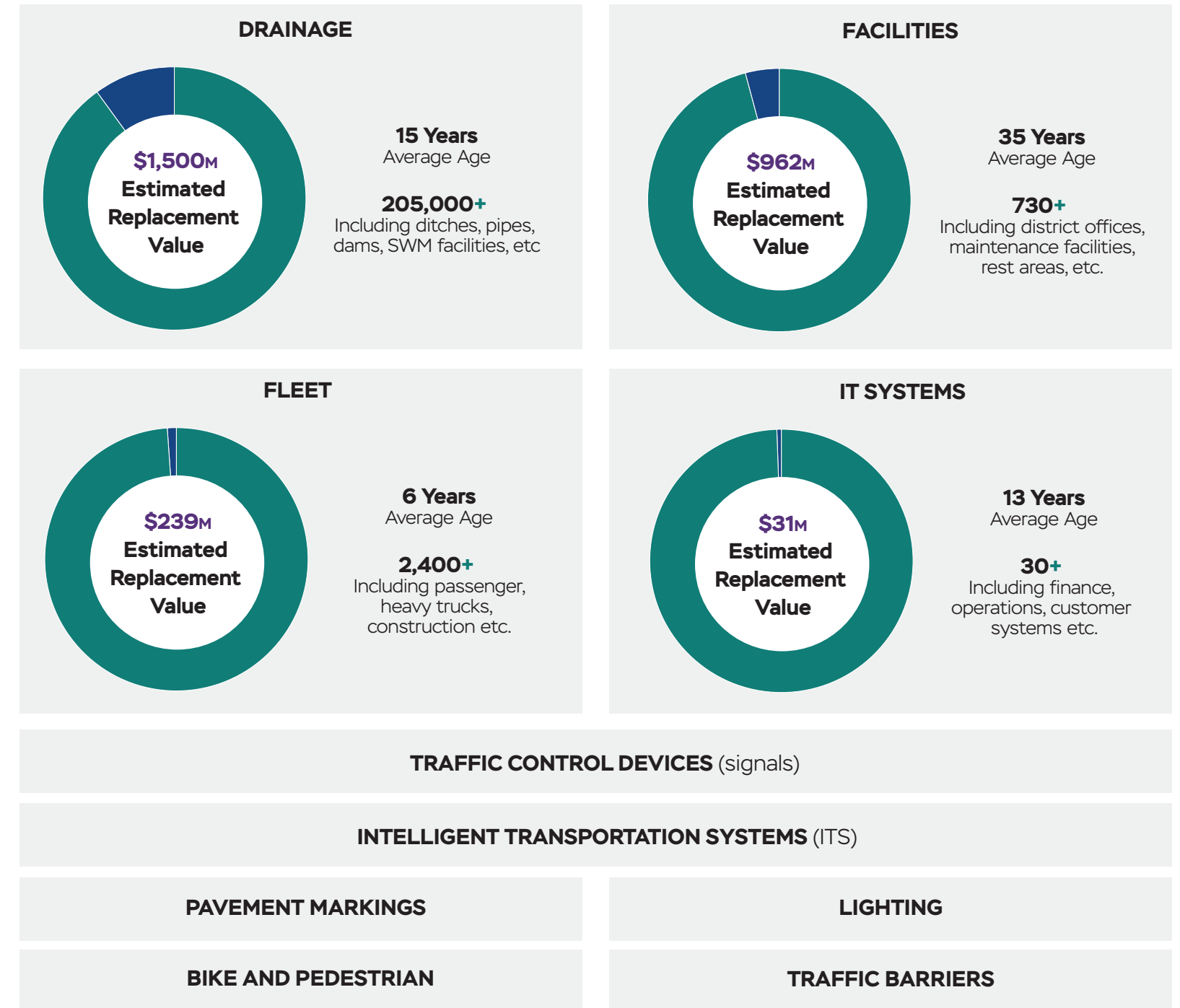
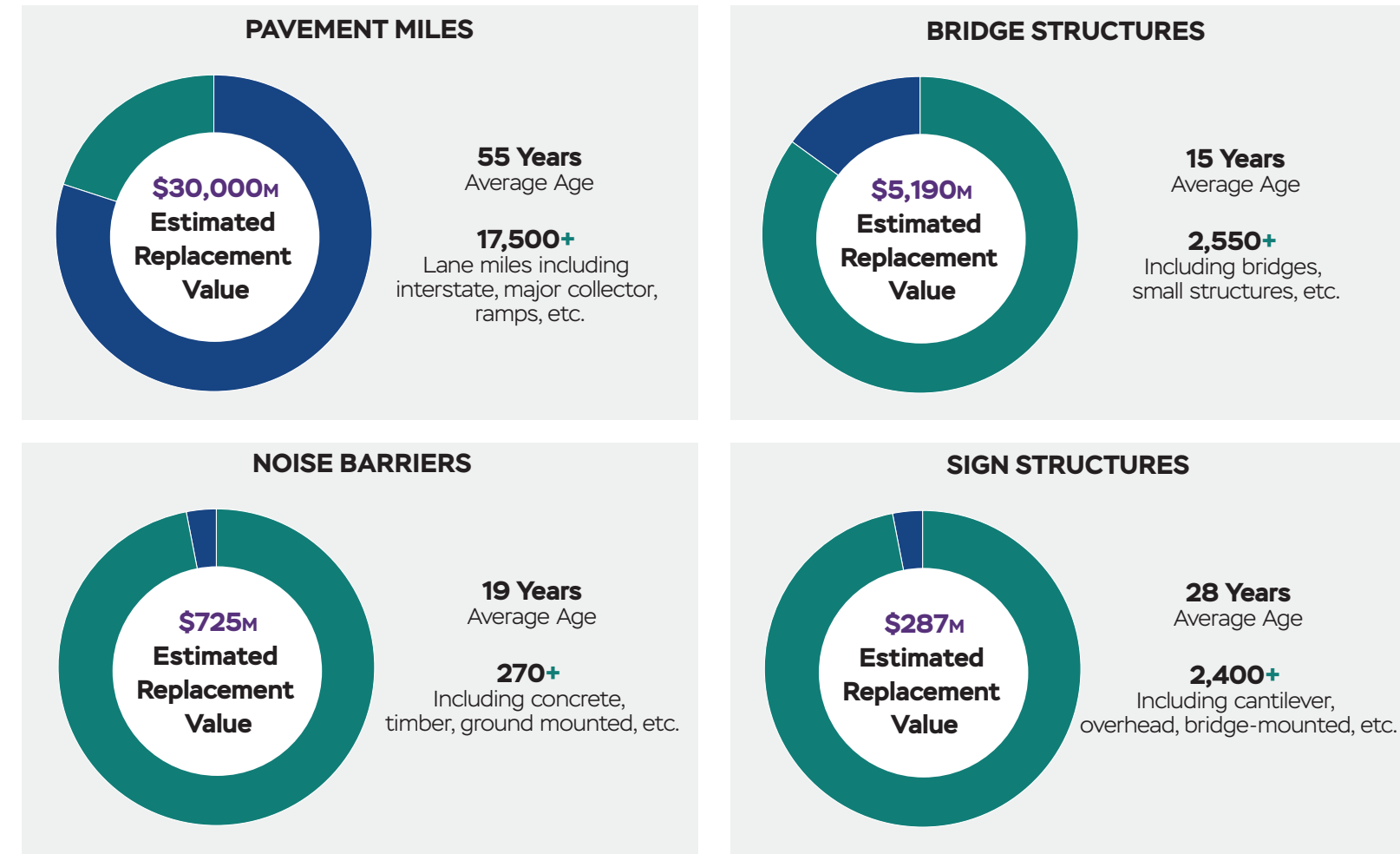
MDTA Average Bridge Age



MDOT SHA ASSET PORTFOLIO

MDOT SHA owns and maintains more than 75 types of transportation assets across 14 critical asset classes with a total replacement value of more than \$39 billion. Our program is continually evaluating and prioritizing asset needs based on age, condition, criticality, and risk.

14 Critical Asset Classes

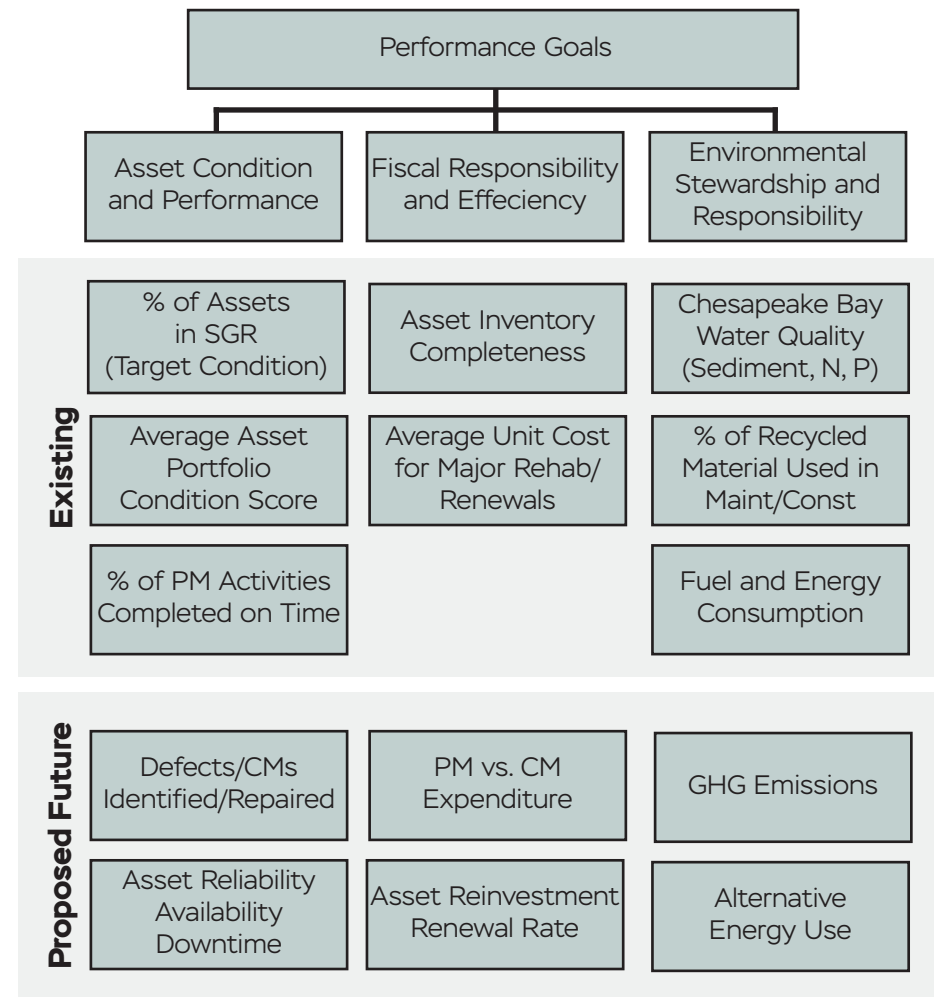




A robust performance management and level of service framework is a critical component of asset management. Access to real time information supports business focused decisions, measurable outcomes, and aligns with MDOT-wide performance reporting efforts.

Performance management has long been embedded in MDOT practices and tracked through the Maryland Transportation Plan (MTP), Managing for Results Summary, Attainment Report, Consolidated Transportation Program (CTP), and Excellerator. The MDOT performance management framework specifically links to asset management by:

- Allowing MDOT SHA to define the asset management program in terms of specific and measurable outcomes
- Defining tangible objectives and targets to manage day-to-day and long-term data-driven decisions
- Enhancing data-driven decisions by providing robust information



Level of Service and Performance Management at MDOT SHA

The Excellerator, MTP, CTP, and Attainment Report include key strategic goals and performance management themes. Three of these areas are most directly aligned with asset management.

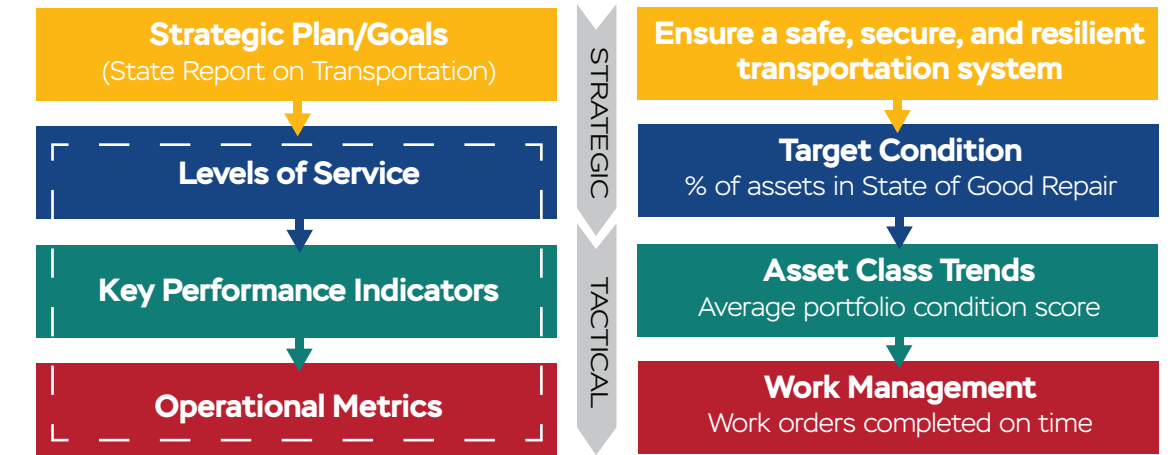
- **Asset Condition and Performance** including evaluation of SGR, overall portfolio condition, and preventive maintenance compliance
- **Fiscal Responsibility and Operational Efficiency** including completing a robust asset inventory and unit costs for key activities
- **Environmental Stewardship and Responsibility** including impacts to water quality, use of recycled materials, and resource consumption

As MDOT SHA continues to operationalize infrastructure asset management throughout the agency, additional key performance indicators and operational measures monitor progress and track change.

Enhancements for the Future

Empowered by improved collection and enhanced information systems, MDOT SHA is defining the right metrics needed to monitor and evaluate asset performance including tracking of defects and corrective maintenance activities, measuring asset reliability and downtime, and projecting our reinvestment/renewal rates.

Aligning Measures with Goals



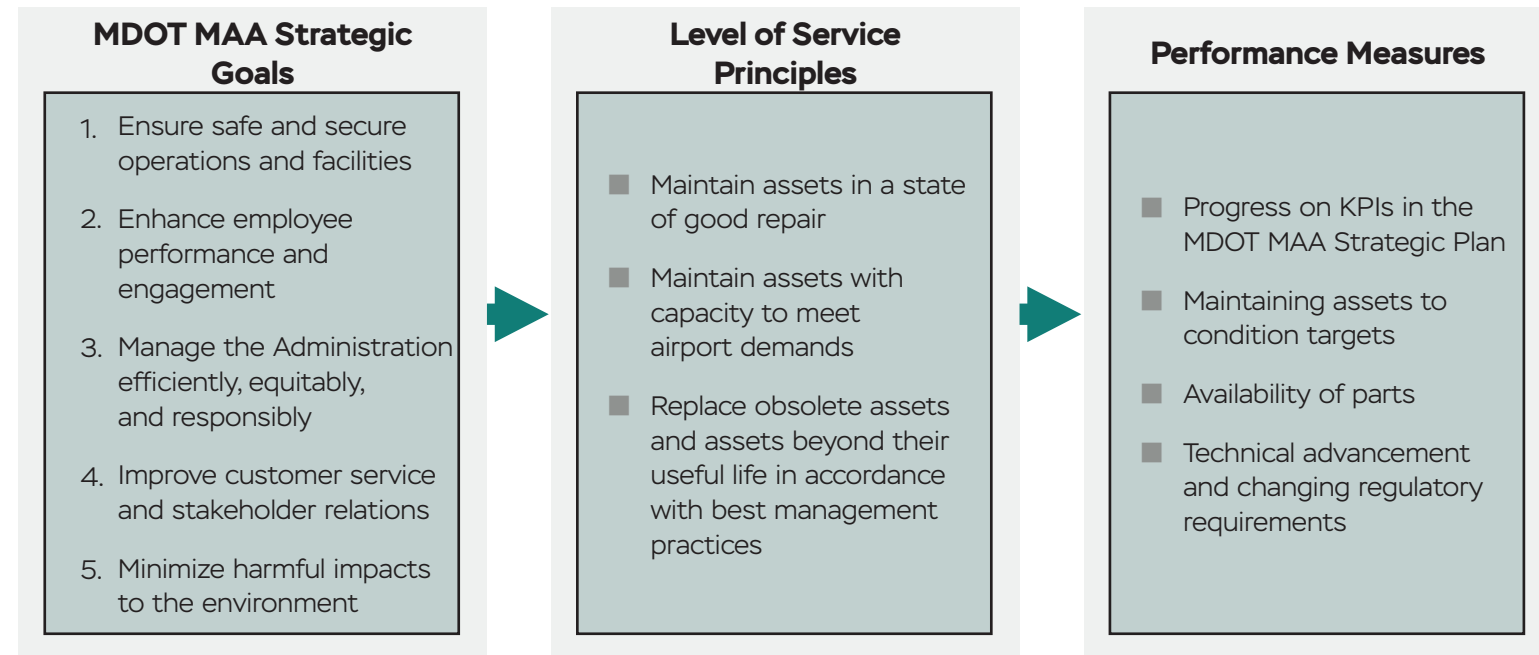
Measure	Description and Reporting Format	Focus Area/Benefit
Average Asset Portfolio Condition Score (Health Index)	Average condition score for each asset class across the current portfolio with represented condition scale (typically 1-5 but can vary based on established industry standards). Can be tracked and reported across all assets and for individual asset classes. In some cases portfolio scores may be weighted based on importance and/or asset value.	Asset Condition and Performance: Ensure appropriate condition and performance through ongoing maintenance and capital investment
	Report: Annually with long-term trend (rolling average). Target: Portfolio targets, typically above defined threshold for SGR, are under consideration.	
Percentage of Preventative Maintenance Activities Completed on Time	Percentage of preventative maintenance and/or inspection activities that are completed on or before their scheduled date. Based on formal tracking and reporting in work management system. Currently only formally tracked for fleet/vehicles.	Asset Condition and Performance: Ensure appropriate condition and performance through ongoing maintenance and capital investment
	Report: Tracked monthly and reported annually. Target: To be established but industry targets generally 90% or greater.	

Maintaining High-Performing Assets at MDOT MAA






The MDOT MAA Strategic Goals inform level of service (LOS) principles that provide guidance for maintenance practices and replacing assets as they reach the end of useful life. KPIs measure how well MDOT MAA's assets are meeting the LOS principles.

Assets are generally replaced at the end of their useful life, but replacement may be hastened if an asset violates any of the LOS principles. For example, an asset that is in a SGR may be prioritized for replacement if it is nearing the recommended end of useful life

and has become obsolete because replacement parts are no longer manufactured for it. MDOT MAA recognizes that assets are more likely to break down the closer they are to the end of the recommended useful life. Depending on the asset, failure may have a significant impact on airport services. Rather than waiting for a failure to occur, MDOT MAA may choose to prioritize replacing or upgrading the asset to minimize potential negative impacts of a failure.

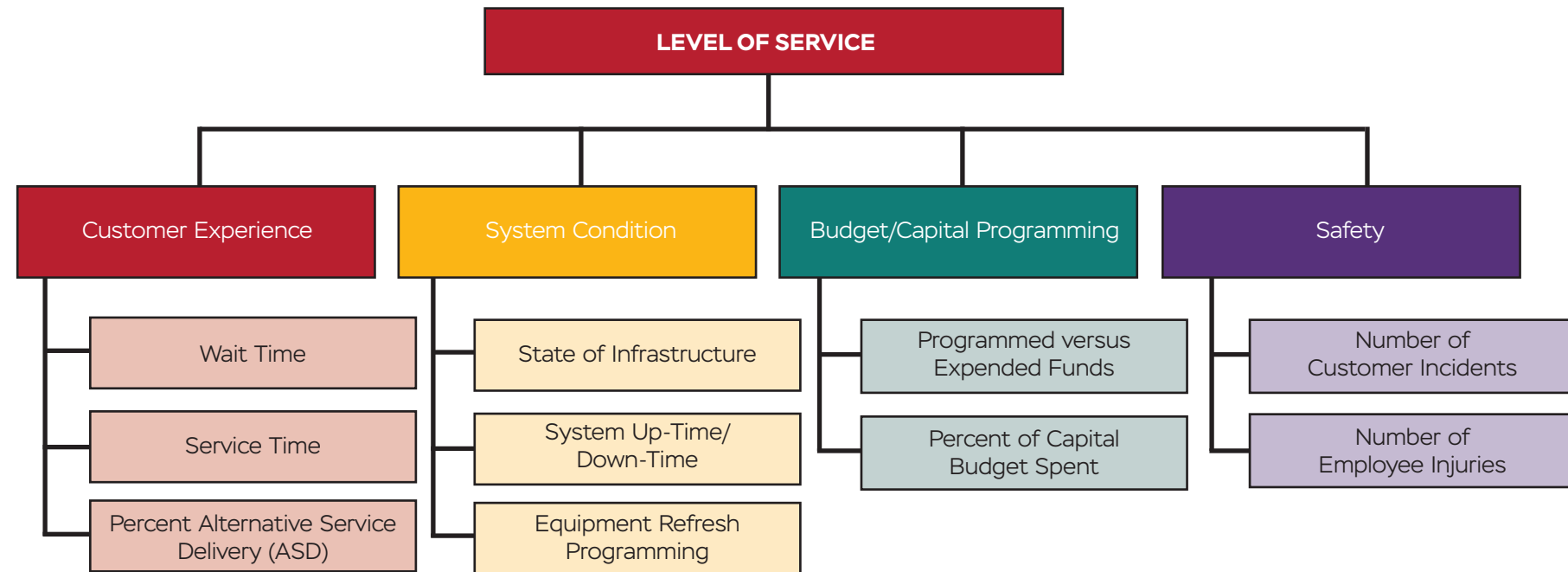


Applying LOS principles, MDOT MAA has developed the following KPIs to measure asset performance across its five asset classes.

Asset	Measure	Description and Reporting Format	MAA Strategic Goal Alignment
Facilities 	Facilities Conditions	Percent of facilities in fair or better condition Report: Facility Assessment Program currently in development. Reporting goal for 2020 is to condition 25% of MDOT MAA Facilities.	Goal 1: Well-maintained facilities are safer for customers, tenants, and staff. Goal 4: Well-maintained facilities improve customer and tenant experience.
	Maximo Ticket Closure	Number of Maximo work order tickets closed within 7 days	Goal 2 & 3: Maximo ticket closer metrics quantify trends in business efficiency and employee performance.
Pavement 	Pavement Condition (PCI)	Percent of pavement at the critical PCI or better condition Report: PCI tracked in Paver 7.0 and annually reported in excel spreadsheet to MDOT TSO for Excellerator	Goal 1 & 5: Well-maintained pavement reduces risk of failure events such as crashes and accidents, which can negatively impact health, safety, and the environment.
	Bridge/Tunnel Condition	Percent of bridges and tunnels in fair or better condition Report: Annually reported in excel document to MDOT TSO for Excellerator	Goal 1 & 5: Well-maintained structures reduces risk of failure and the associated negative impacts to health, safety, and the environment.
Structures 	Retaining Wall Condition	Percent of retaining walls in fair or better condition Report: Annually reported in excel document to MDOT TSO for Excellerator	
	Vehicle Fleet and Equipment 	Fleet Condition	Percent of vehicles in fair or better condition Report: Annually reported to Maryland Transportation Authority (MDTA), which combines data from all TBUs or Excellerator
Fleet Availability		Percent of vehicles are in-service 95% of the year with no more than 19 days out of service a year	Goal 3 & 5: Fleet availability impacts customer service and employee's ability to complete work efficiently.
Major IT Systems 	IT System Condition	Percent of IT systems in fair or better condition	Goal 1 & 3: Well-maintained IT systems improve security and business efficiency.

Providing a Premier Customer Experience at MDOT MVA

MDOT MVA operates on a foundation of providing a premier customer experience. Accordingly, its asset performance management framework is centered around LOS metrics, with KPIs for customer service, system condition, budget/capital programming, and safety.



MDOT MVA has developed the following KPIs across four key service areas to measure how well its assets are delivering a premier customer experience. For each KPI, MDOT MVA has assigned a goal to achieve by 2024.



Service Area	Importance to Asset Management	KPI	2024 Goal
Customer Service	<ul style="list-style-type: none"> Maintaining a SGR is imperative to providing premier customer service Long service times and long wait times can increase wear on facility and pavement assets Transactions completed through Alternative Service Delivery (ASD) shift wear from pavement and facilities assets to IT assets 	Number of Customers Experiencing a Wait Time of 15 Minutes or Less	74% of all driver's license customers experiencing a wait time of 15 minutes or less
		Percent of Customers Experiencing a Service Time of 10 Minutes or Less	80% of all customers experiencing a service time of 10 minutes or less
		Percentage of Transactions Completed through ASD	71% of transactions completed through ASD
System Condition	<ul style="list-style-type: none"> An acceptable state of infrastructure is essential to reliably deliver services 	State of Infrastructure - Facilities	75% all facilities in fair or better condition
		State of Infrastructure - Pavement	80% all pavement in fair or better condition
		State of Infrastructure - Vehicle Fleet and Equipment	85% all vehicle fleet and equipment in fair or better condition
Budget/Capital Programming	<ul style="list-style-type: none"> Efficient cost estimation and priority planning maximize funding available for asset maintenance, rehabilitation, and replacement 	Programmed versus Expended Funds	Programmed capital dollars are 95% of expended capital dollars
		Projects Completed On-Time	87% of all projects are completed on time (national benchmark)
		Percent of Capital Budget Spent	Final project award is within 5% of estimated project award
Safety	<ul style="list-style-type: none"> Maintaining facilities in a SGR helps prevent injuries and safety incidents 	Customer Incidents	Reduce number of customer incidents by 15%
		Employee Injuries	Reduce number of employee incidents by 25%



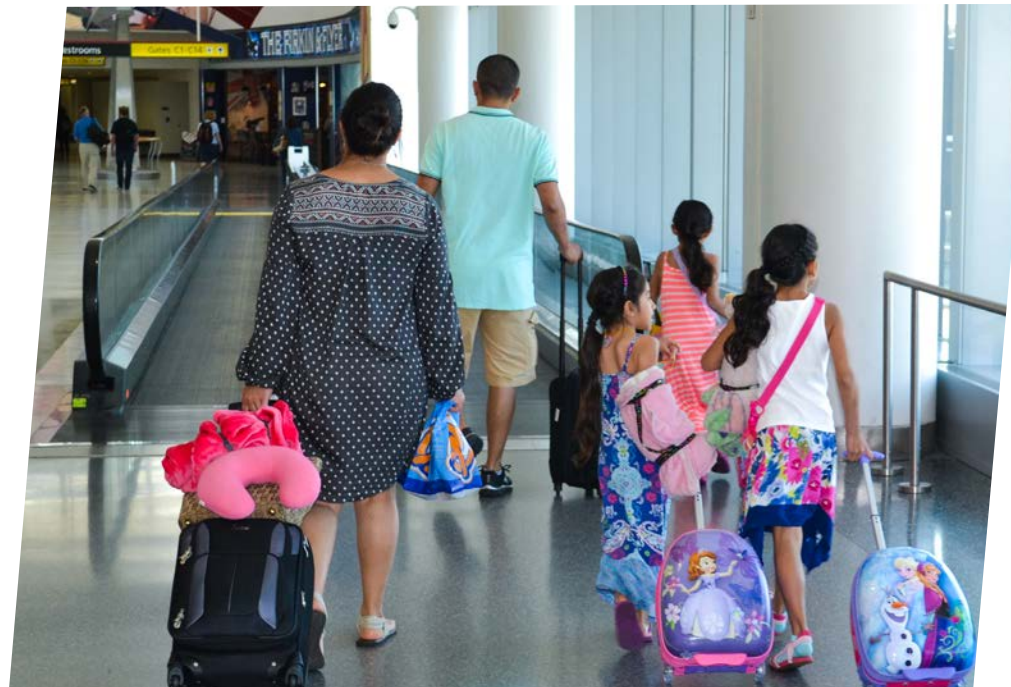
International Traffic at BWI Marshall Airport

On an ongoing basis, MDOT MAA considers whether current asset capacity can meet the demands of continued projected growth. One example of this is the Federal Inspection Station (FIS) at the BWI Marshall Airport International Terminal. Constructed in the 1990s, it was designed to accommodate approximately 1,000 passengers per hour.

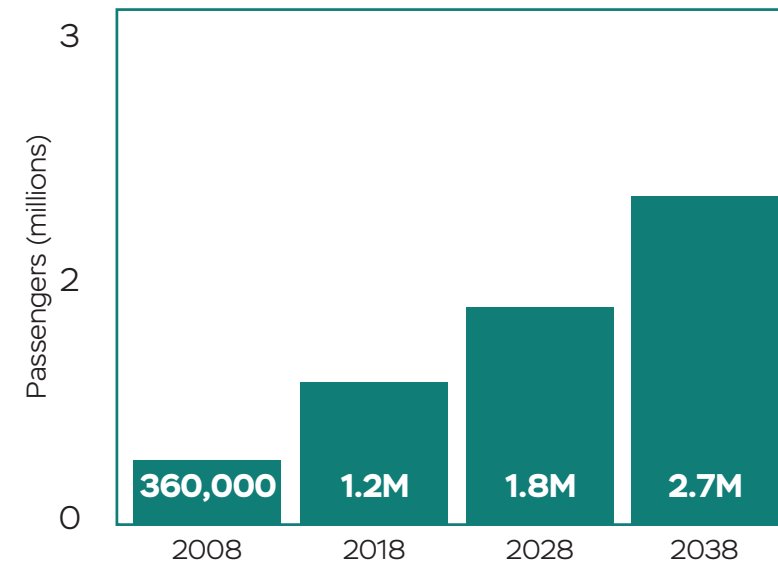
International passenger traffic more than tripled between 2008 and 2018, increasing FIS processing demand to approximately 1,200 passengers per hour. Operating beyond capacity causes delays for passengers who must wait to deplane until there is available space.

The Federal Aviation Administration (FAA) projects international traffic at BWI Marshall Airport to increase at an annual rate of approximately 4% over the next 20 years, which will further stress the system and negatively affect customer experience.

In addition to the immediate need for reconfiguration of the FIS, the current U.S. Customs and Border Protection standards indicate an additional 10,000 square feet of FIS space (at minimum) will be needed by the early 2030s to accommodate projected passenger growth. In response to this evolving situation, MDOT MAA has allocated funding to renovate the FIS to meet new regulatory standards and accommodate projected growth.



International Traffic Growth at BWI Marshall Airport

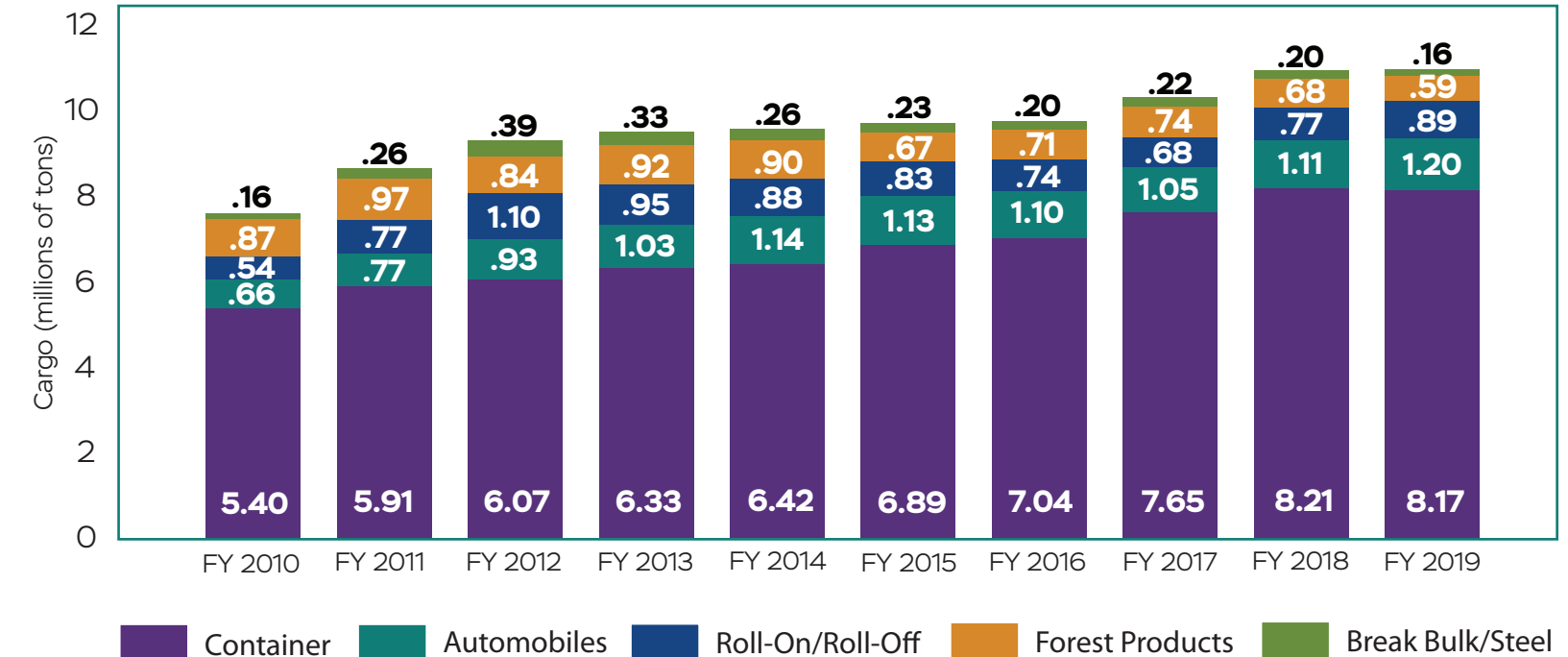


Growth at the Port of Baltimore

Activity at the Port of Baltimore has grown consistently during the last 15 years and is expected to continue through the next decade and beyond. Each year for nearly the past decade, container volumes have set new records for MDOT MPA terminals. The Port of Baltimore has successfully leveraged its proximity to one-third of the U.S. population and easy access to Midwest markets. It is currently the fourth largest port on the East Coast in international cargo tonnage.

Imports and exports at the Port have grown, respectively, five and seven percent annually (on average) since 2003, significantly faster than national rates. MDOT MPA expects growth at its facilities to continue to increase by between two and four percent per year. To accommodate this growth, the state has purchased land in recent years to handle additional cargo volumes, and made many improvements to respond to global changes, such as the increase in the size of ships that can use the Panama Canal.

Port of Baltimore General Cargo Growth



MDOT MPA has planned several major capital projects to maintain a SGR, increase resiliency, enhance existing facilities, and expand Port business. The following table describes some of these projects.

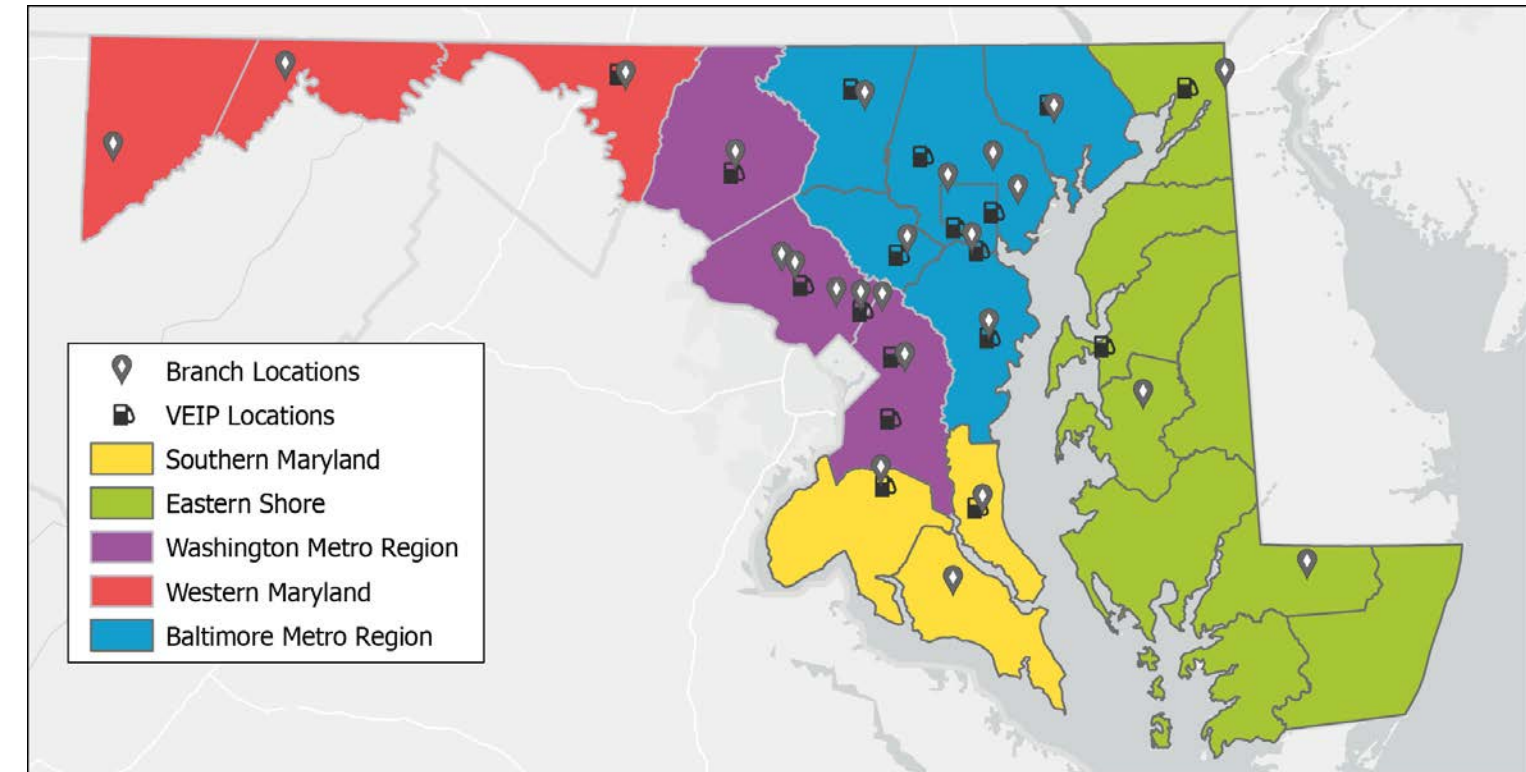
Project Name	Project Description	Estimated Cost	Project Category
Howard Street Tunnel Expansion	Expand the Howard Street rail tunnel to accommodate double stacked containers	\$466 million	Business Expansion
Dundalk Marine Terminal Berths 1-3 Rebuild	Reconstruct and deepen vessel berths built in the 1960s	\$90-100 million (phased)	SGR
Dundalk Marine Terminal Stormwater Resiliency Management	Increase capacity of storm drain systems to meet changing climate conditions	\$85 million (phased)	Resiliency
North Locust Point Pier 4/5 Repair	Repair piers to meet demand of larger Panamax ships	\$12 million	SGR



Population Growth in Southern Maryland and the Eastern Shore

MDOT MVA manages 24 customer-facing facilities (branches) and 18 Vehicle Emissions Inspection Program (VEIP) stations to serve its customers throughout the state. Over half of its facilities are in the Baltimore and Washington Regions, which is where 82% of the State's population lives, and these locations have some of the highest customer traffic in the state.

Although the majority of Maryland's population is in the urban regions, Southern Maryland and the Eastern Shore are projected to be the fastest growing regions. MDOT MVA has made improvements to its major IT systems to better meet customers' needs and expectations. MDOT MVA is implementing the Customer Connect platform to modernize all customer-facing IT systems, including driver services, vehicle services, and business licensing. The platform will create a more cohesive experience for customers and employees and help meet the demands of future population growth. In addition, MDOT MVA continues to expand ASD so that customers can be served without needing to visit a physical location.



7 | Managing Risk Profile



Quantifying Risk at MDOT MAA

As the MDOT MAA asset management program continues to grow, it has developed a long-term quantitative approach to assess and quantify asset risks. Quantifying risk will enable MDOT MAA to prioritize work orders and activities when airport needs exceed funding. It calculates risk as follows:

RISK = PROBABILITY OF FAILURE × CONSEQUENCE OF FAILURE

It is expected that an asset in poor condition will have a very high likelihood of failure compared to an asset in good condition. Therefore, asset condition and age data can be used as a proxy for probability of failure.



The consequence of failure is slightly more complicated to assess. First, the asset's importance to the overall system must be evaluated and the following questions must be addressed:

QUESTION: If this asset fails, would a substitute be readily available?

STEPS: Asset stakeholders must assess the criticality of function performed by the asset.

QUESTION: Would failure of the asset impact or delay service?

STEPS: Asset management team and asset stakeholders must consider the exposure of the public to injury or loss of life.

In addition to establishing optimal risk treatment strategies and ensuring cost-effective processes, MDOT MAA considers:

- Avoiding or minimizing risks through proactive management strategies
- Assigning higher priority to risk-prone assets that require replacement
- Mitigating asset risks by clearly identifying performance measures and outcomes that impact asset resilience and exposure
- Collaborating with partner agencies and stakeholders to manage and monitor risks

Expanding MDOT MTA's Risk Management Framework

Risk management will be an increasingly important driver of continuous asset management and safety improvement, enabling MDOT MTA to progressively become more proactive with its management decisions. Historically, MDOT MTA's risk management process focused solely on injury, illness, death, or damage, including loss of equipment or property, or environmental damage. The risk management process was adopted through MDOT MTA's System Safety Program Plan (SSPP). Section 6.0 of the SSPP describes MDOT MTA's hazard analysis and risk management processes.

More recently, MDOT MTA has made advancements in its risk management framework to capture the assessment of a variety of risk categories beyond safety, including but not limited to:

- Financial
- Emergency
- Resilience
- Operations/service delivery
- Legal/regulatory
- Security/cyber
- Customer/brand/reputation
- Workforce

Regular review and update of the AMP, lifecycle management plans, and agency safety plan will consider risks identified in the development process to shape the refinement of the objectives, strategies, and implementing projects/actions in those documents.



Understanding Risks and Prioritizing Needs at MDOT SHA

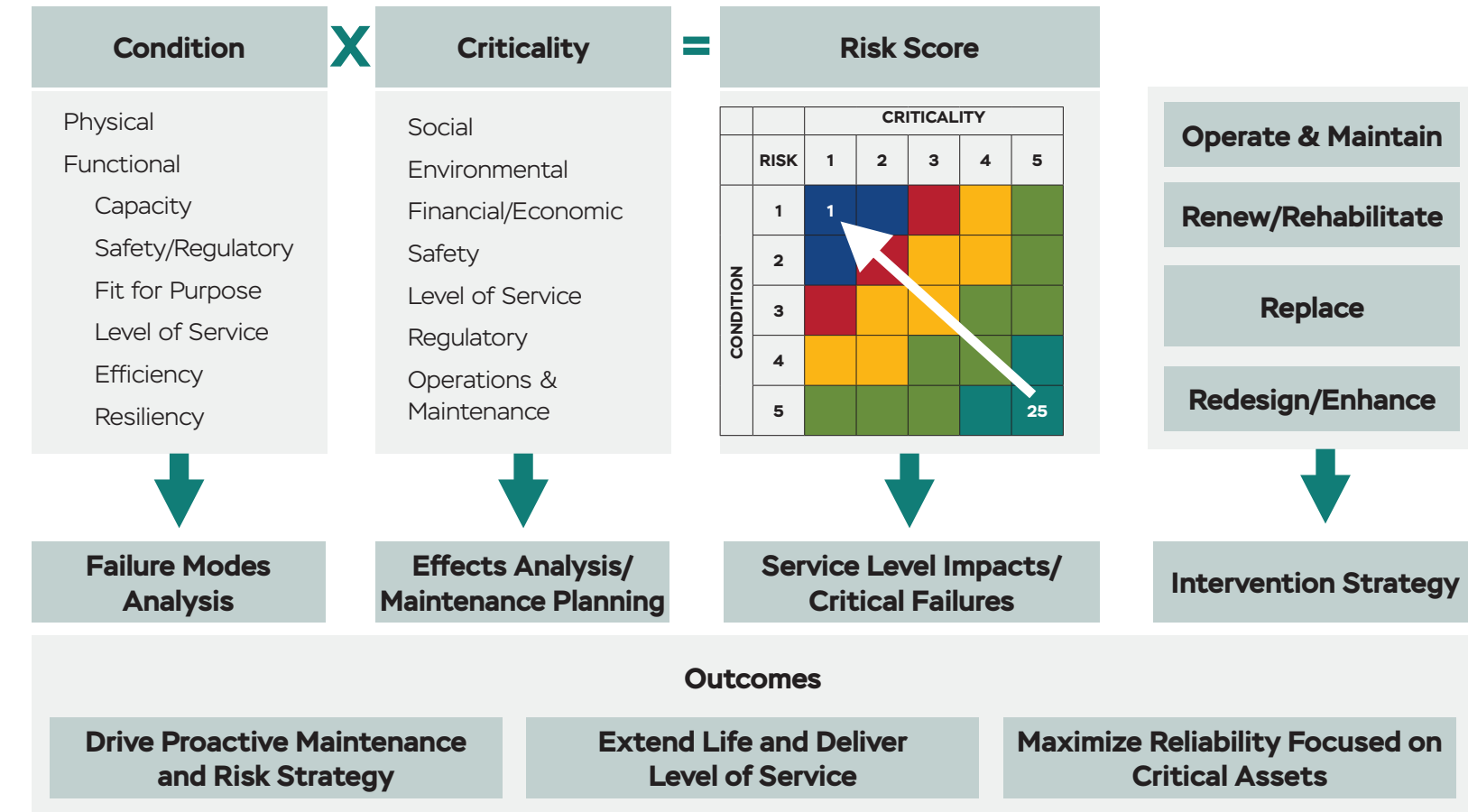
MDOT SHA is actively implementing risk-based approaches that apply triple bottom line (social, environmental, and financial) considerations to decision making.

While MDOT SHA strived to ensure SGR across all our assets, understanding which ones are the most critical are important - both for assigning the appropriate maintenance strategy and for helping to prioritize our dollars when funding levels are more constrained.

Having a comprehensive understanding of the condition of assets and their criticality to the system helps MDOT SHA to balance needs across the asset portfolio and ensure cost-effective service to the public. Multi-tiered geospatial inventory tracking and comprehensive inspection programs provide foundational data needed to understand SGR needs. Additionally, by defining criticality for all assets and implementing risk management approaches, MDOT SHA is better able to prioritize the greatest needs of the system and affect the largest impact and benefit.



Illustrative Risk Matrix to Support MDOT SHA Decision Making



Addressing Risks at MDOT MPA

MDOT MPA, like other major ports throughout the country, faces a variety of potential risks—some universal and some agency-specific. While these potential risks cannot all be fully mitigated and vary in their ability to be addressed by asset management, MDOT MPA is committed to making every effort to become as resilient as possible in the face of changing climate conditions.

Risk		Mitigation Strategy
Climate Change and Sea Level Rise	Ports	Recognizing that Port operations may be threatened by changing climate conditions, the MDOT MPA has adopted a three-pronged “MEM” strategy: <ol style="list-style-type: none"> Migrate: Move terminal functions out of the flood plain as is feasible Elevate: Design new facilities and structures that must remain on the terminals to be two feet above the 100-year flood elevation as is feasible Mitigate: Reinforce facilities and structures that cannot be migrated or elevated to handle inundation and limit potential weather damage
	Bridges	Clearance at Francis Scott Key Bridge and William Preston Lane Jr. Memorial (Bay) Bridge is 185 feet. It is not uncommon that an especially tall, fully stacked ship must wait for a non-high tide situation so that it can safely pass under these bridges. This could potentially become a greater concern as sea levels rise in the coming decades.
Security and Cybersecurity Threats		MDOT MPA has been awarded more than \$22 million in federal funds in the last 10 years to address security and cybersecurity threats. Through federal port security grants, MDOT MPA has made technology upgrades to improve cybersecurity and update its facility security program. Through Federal Emergency Management Agency (FEMA) grants, MDOT MPA has developed a sophisticated closed-circuit television (CCTV) system, created a CCTV Video Analytics program, integrated security systems within its CCTV monitoring center, conducted a cyber assessment of physical security technology, and opened an off-terminal access control center.
Competition from Other Ports and Market Shifts		Although the Port of Baltimore has a geographically superior position among east coast ports, it is still susceptible to competition. This can come in the form of other ports offering exceptional shipping rates, faster transferring times via better equipment, or other unforeseen factors. To address competition risks, MDOT MPA monitors market trends and developments in technology. Additionally, approximately 95% of MDOT MPA’s imports leave terminals via truck rather than rail. Being so reliant on a single mode of transportation could leave MDOT MPA vulnerable to changes in intermodal transportation and technology. Expanding the Howard Street Tunnel to accommodate double stacked containers will increase the utility of existing rail infrastructure at the port and reduce reliance on trucking.

Sudden Growth and Surges	If MDOT MPA does not maintain its current assets in a SGR, its future ability to maintain current tenants who wish to expand, recruit new tenants, and meet seasonal shipping surges, will be threatened. If tenants lose confidence in the ability of the Port to meet their needs, they may explore moving operations to other facilities. Implementing an AMP and more robust inspection procedures will help identify potential issues related to the quality and condition of assets before they impact business operations.
Chromium Contamination	MDOT MPA is working with its construction partners and tenants to test for and, if necessary, safely contain or dispose of chromium contaminated material at terminal locations.
Fire Protection Systems	MDOT MPA serves customers who require large sheds for the storage of their goods, such as wood pulp. These sheds have specialized fire protection systems which are vital to the safety and protection of tenants’ cargo. The fire protection systems have significant replacement costs. Although condition data on these systems are currently limited, MDOT MPA will give greater attention to the condition and cost of these systems in the future.

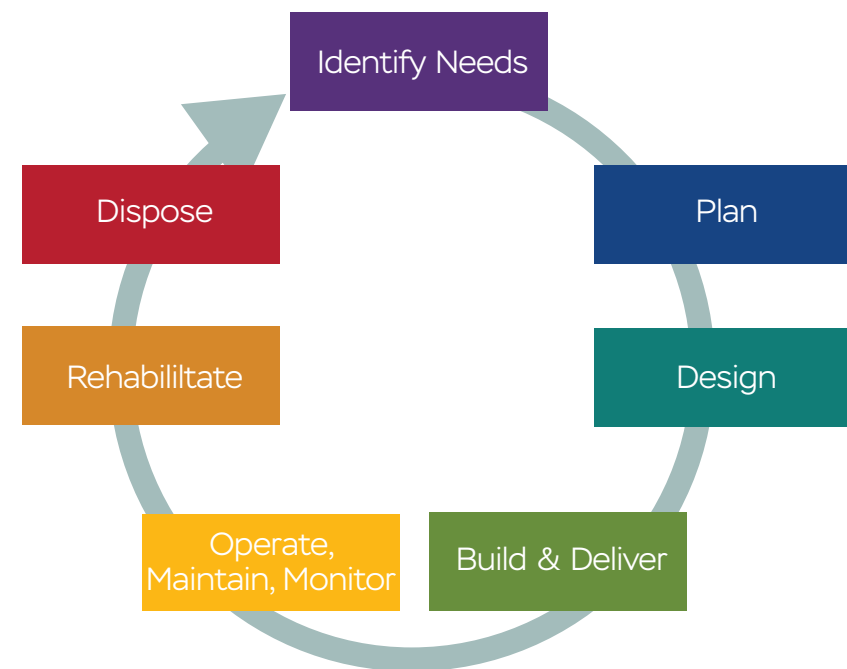


8 | Lifecycle Management



Lifecycle Approach

Lifecycle management and planning is a strategic and systematic process of operating, maintaining, and improving physical assets, applying engineering and economic analysis based on quality information to identify a structured sequence of actions to provide safe, cost-effective, and reliable service to current and future customers.



Lifecycle Management Planning

MDOT is in the process of developing full lifecycle management plans across all its asset classes. These apply asset management practices in each phase of an asset's lifecycle to maintain the value of the asset and minimize total lifecycle cost. Well-planned lifecycle management extends the useful life and ensures the reliability of MDOT assets.

Example Management Plan

1. Based on existing vehicle utilization and availability rates, staff identify a need for an additional vehicle to transport staff between facilities and conduct field work.
2. MDOT purchases a vehicle that will meet the identified need and can be maintained at low cost.
3. Staff create an inspection schedule for the vehicle: every 5,000 miles or every two years, whichever comes first.
4. An asset management software program alerts maintenance staff when either inspection threshold has been reached.
5. During each inspection, regular maintenance is performed to prolong the life of the vehicle.
6. During subsequent inspections, if there are needs for major repairs, maintenance staff will consider the cost of the repair and weigh this against the remaining useful life of the asset.
7. Because the asset has been regularly inspected and has comprehensive maintenance records, the capital planning team will be able to more accurately forecast the end of its useful life.

8. A replacement strategy is developed in advance of the end of its useful life, identifying how needs may have changed since the vehicle was purchased.
9. When the vehicle has reached the end of its useful life, the vehicle is disposed of strategically to minimize environmental impact and maximize financial return to the State.

Vehicle Fleet Maintenance at MDOT MTA

Preventative Maintenance

Regular maintenance activities are essential to prolonging the useful life of assets. MDOT MTA has established regular maintenance standard operating procedures for many of its major assets. The following table describes the typical maintenance schedule for a bus used to operate Core Bus service.



Asset Type	Maintenance Activity	Interval
Revenue Bus	Brake inspection, oil change, and grease job	6,000 miles
	Major inspection including steam cleaning	12,000 miles
	Brake inspection, oil change, grease job, brake job, and hydraulics	30,000 miles
	Major inspection, hydraulics, and transmission maintenance	60,000 miles
	Interior cleaning	30 days
	Steam cleaning of the engine compartment	30 days
	HVAC system check	120 days

Rehabilitation and Replacement

Rehabilitation, also called an overhaul, reconditions or replaces selected components to help extend the useful life of assets. When an asset finally reaches the end of its useful life, it must be replaced. The following table summarizes the rehabilitation and replacement cycles for MDOT MTA vehicles.

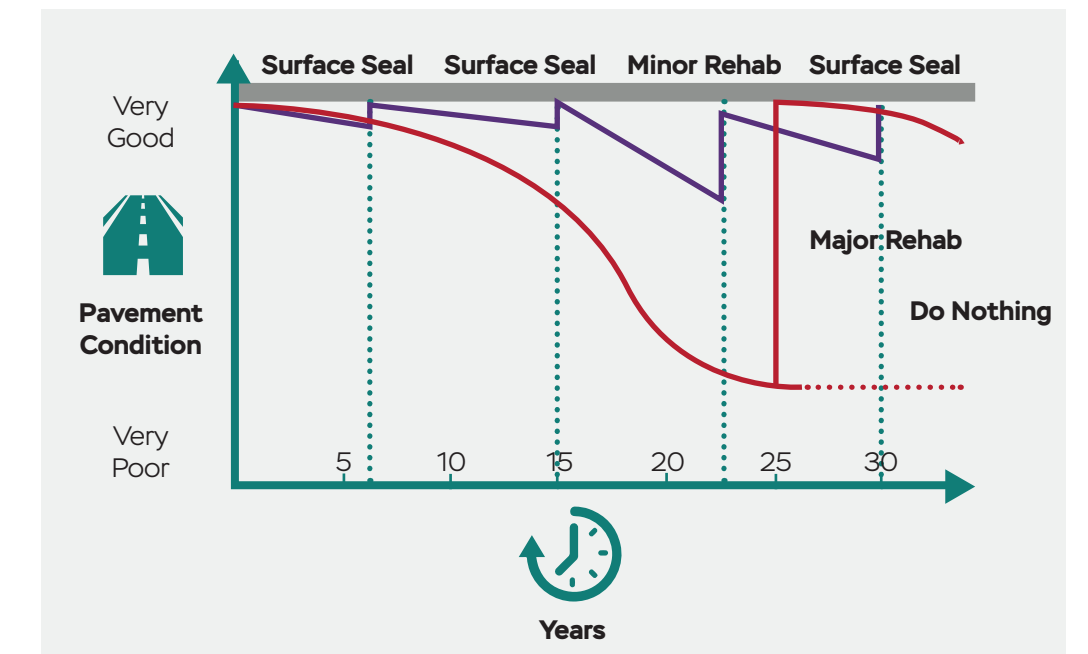
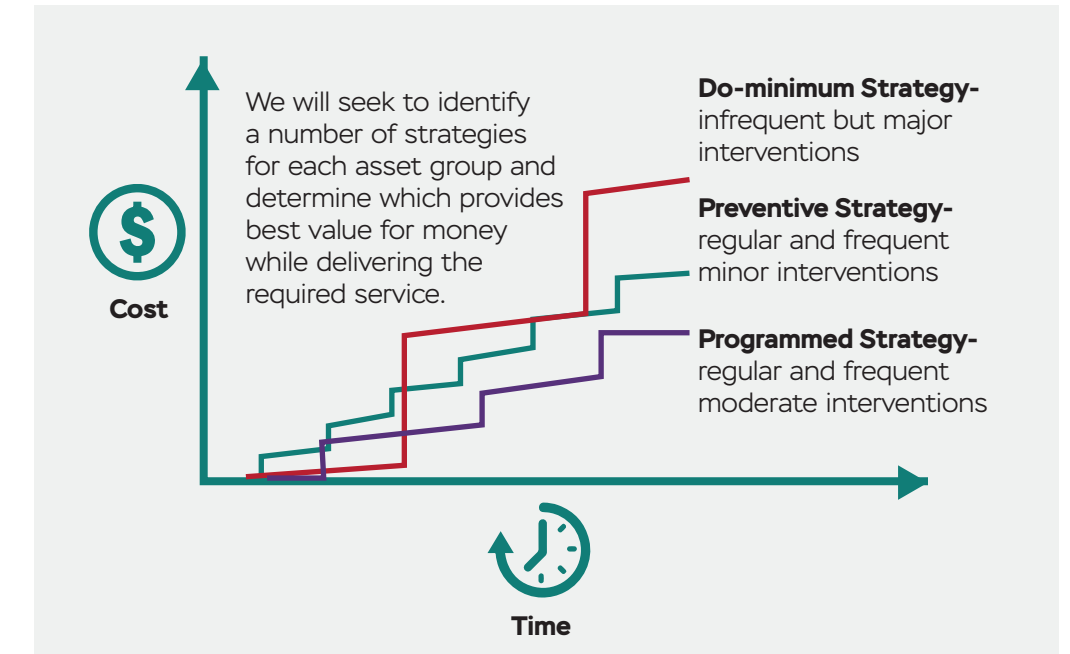
Mode	Asset Class	Rehab or Replacement	Interval
Metro Subway	Revenue Vehicles	<ul style="list-style-type: none"> • Rehab • Replacement 	<ul style="list-style-type: none"> • 5-year mini-overhaul and midlife overhaul • 30-year replacement
Light Rail	Revenue Vehicles	<ul style="list-style-type: none"> • 3 mini-overhauls • Midlife overhaul • Replacement 	<ul style="list-style-type: none"> • Completed at: 5-, 8-, 10-years, and midlife • 35-year replacement
Core Bus	Revenue Vehicles	<ul style="list-style-type: none"> • Replacement 	<ul style="list-style-type: none"> • 12-year replacement
MARC Train	Revenue Vehicles	<ul style="list-style-type: none"> • Midlife overhaul • Replacement 	<ul style="list-style-type: none"> • 25-year useful life prior to first mid-life overhaul (vehicles will typically go through two mid-life overhauls over complete lifespan before replacement)
Mobility	Revenue Vehicles	<ul style="list-style-type: none"> • Replacement 	<ul style="list-style-type: none"> • 5-year replacement for automobiles • 7-year replacement for light-duty vans • 8-year replacement for medium-duty vans



Improving Pavement Maintenance at MDOT MPA

In 2020, MDOT MPA has begun implementing a pavement management program for its first time. This newly introduced program involves a more thorough review of pavement specifications and exploring rehabilitation techniques, rather than the more traditional approach of simply repaving pavement in kind.

This more proactive approach to preventive maintenance can result in cost savings over the long-term. Although initial costs may be greater in the short-term, a proactive preventive maintenance program can prolong the life of pavement, reduce the need for expensive major rehab, and maintain a more consistent SGR standards throughout the asset's lifespan.



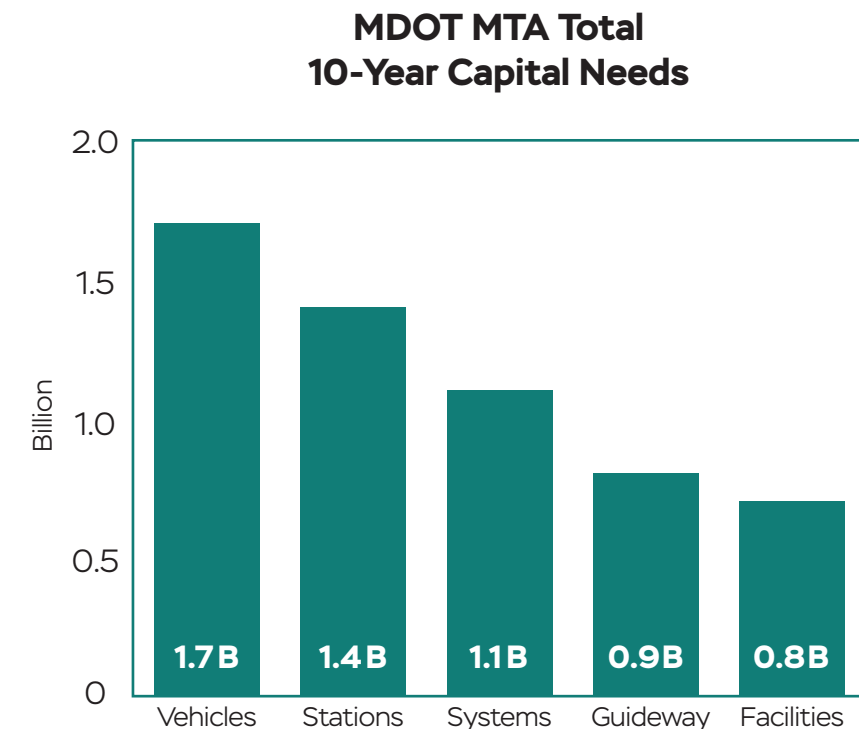
9 | Capital Renewal Plan, Financial Forecast, and Funding Strategy



MDOT MTA 10-Year Capital Needs Inventory

Long-Term Funding Needs

Among MDOT TBUs, MDOT MTA has completed the most comprehensive financial forecast of its assets. In July 2019, it published the 10-year Capital Needs Inventory (CNI), which estimated and prioritized SGR and enhancement needs of \$5.7 billion from 2019 to 2028, including \$1.5 billion in deferred capital investment.



Costs to bring MDOT MTA's current asset inventory into a SGR drive 81% of total funding needs. Enhancement needs to meet system performance goals and serve current and future demand make up the remaining 19%.

Backlog

MDOT MTA has identified an estimated \$4.6 billion in SGR needs over the next 10 years, including \$1.5 billion in deferred capital maintenance, also known as the backlog. For context, MDOT MTA is not alone in addressing its backlog; the U.S. Department of Transportation estimates national transit SGR backlog to be \$90 billion.

Funding Forecast and Gap

At current funding levels, MDOT MTA is unable to fully address its 10-year capital investment needs. Based on the FY19-FY24 Consolidated Transportation Program (CTP), MDOT MTA forecasts \$3.6 billion in SGR funding between 2019 and 2028. With \$4.6 billion in SGR needs, MDOT MTA estimates a funding gap of \$1 billion over the 10-year period.

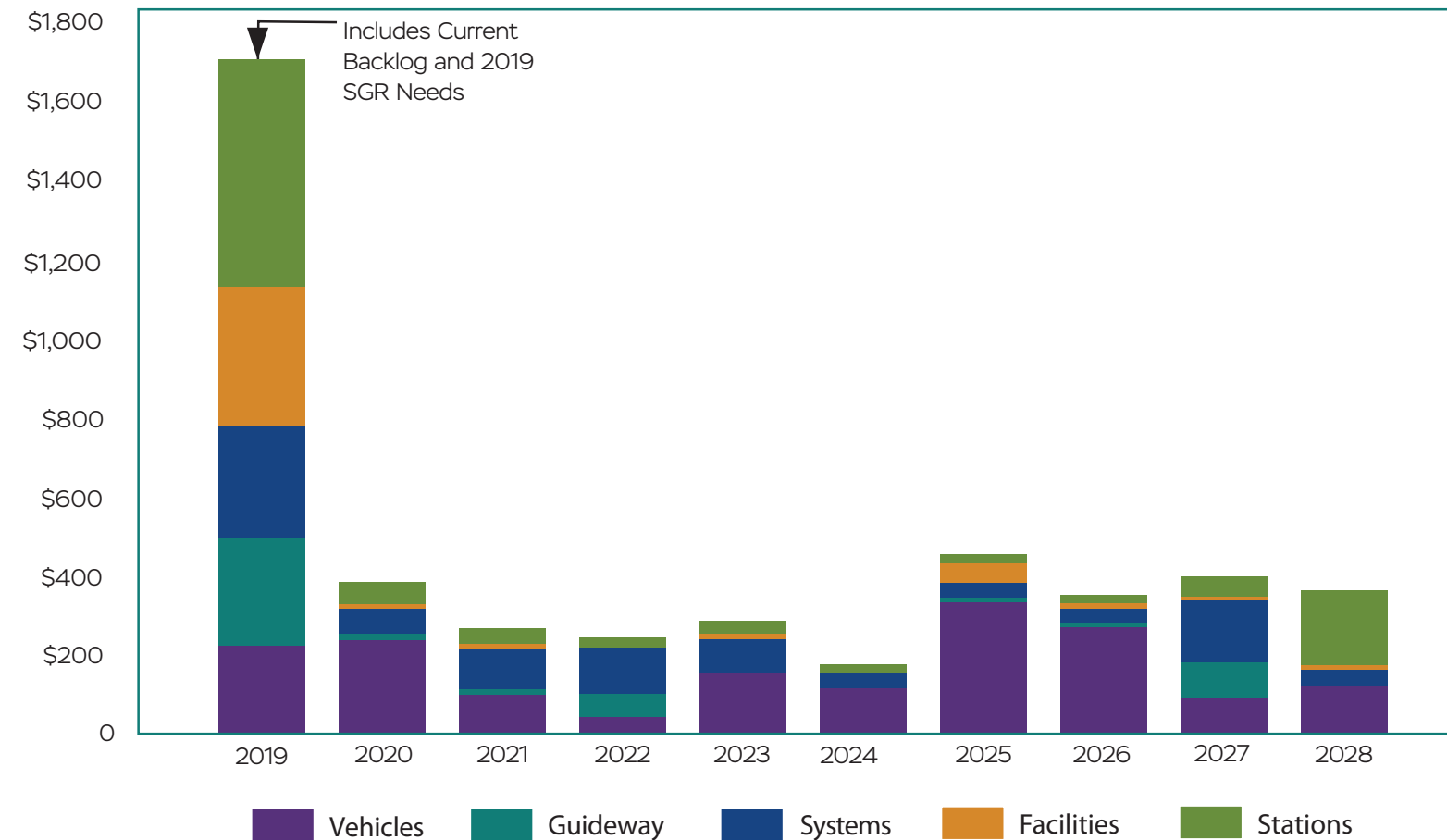
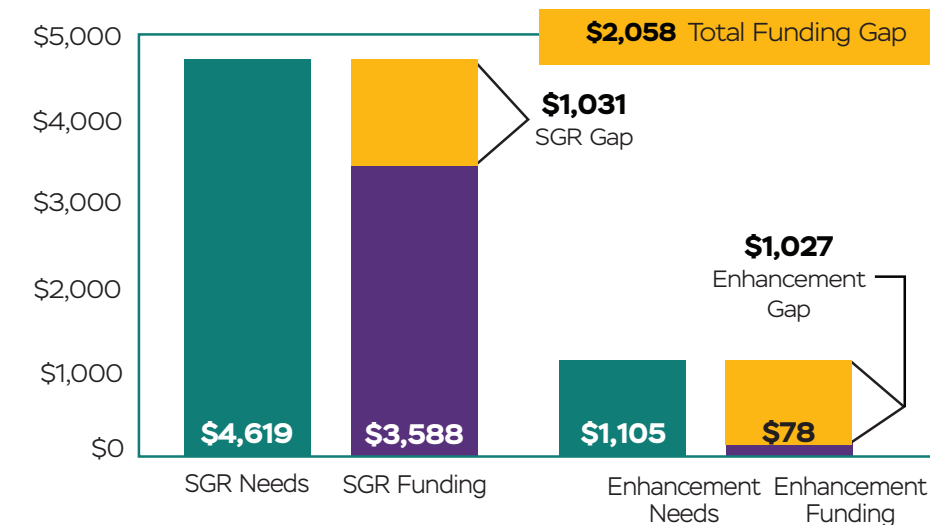
Adding in identified enhancement needs, total 10-year total needs reach \$5.7 billion. However, total capital funding is forecasted to be only \$3.7 billion. Thus, an estimated funding gap of \$2 billion remains to meet all SGR and enhancement needs.

Funding Strategies

Governor Hogan has already helped address many recent SGR and enhancement needs including a commitment of full funding for the BWI MARC Station renovation, the Camden MARC Station replacement, and the numerous assets delivered through the BaltimoreLink and North Avenue Rising programs. In addition, MDOT MTA continues to explore innovative ways to address its capital needs. These include leveraging all available federal funding and discretionary grant opportunities, shared mobility strategies and partnerships, innovative finance, and alternative delivery methodologies.

Recent successes include over \$66 million in federal discretionary grant awards over the last five years, including full funding for the North Avenue Rising project and numerous system safety enhancements. MDOT MTA is also exploring the use of shared mobility solutions for paratransit to increase system performance while reducing operating costs and researching alternative funding and project delivery arrangements for future capital projects.

Through these efforts, MDOT MTA will continue providing safe transit service to communities across Maryland; however, further investment is needed to realize its vision and achieve system performance goals.



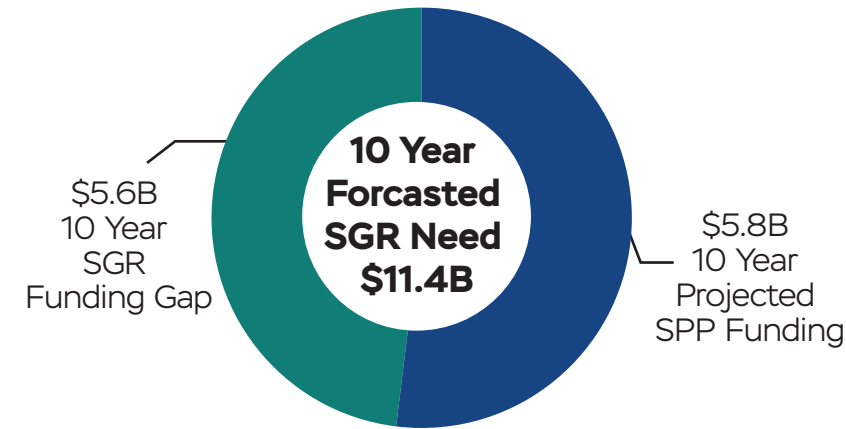
MDOT SHA System Preservation Program Financial Forecast

MDOT SHA optimizes system performance and asset condition goals while managing their largest risks—within the prescribed level of funding. Applying appropriate lifecycle maintenance strategies also helps to ensure minimum practical cost. The 2021 MDOT SHA capital needs analysis, developed from the FY2021-2026 Consolidated Transportation Program (CTP), estimates the 10-year funding needed to achieve and then maintain all assets in a State of Good Repair (SGR) is approximately \$11.4 billion, of which MDOT SHA projects only 51% is funded through existing sources.

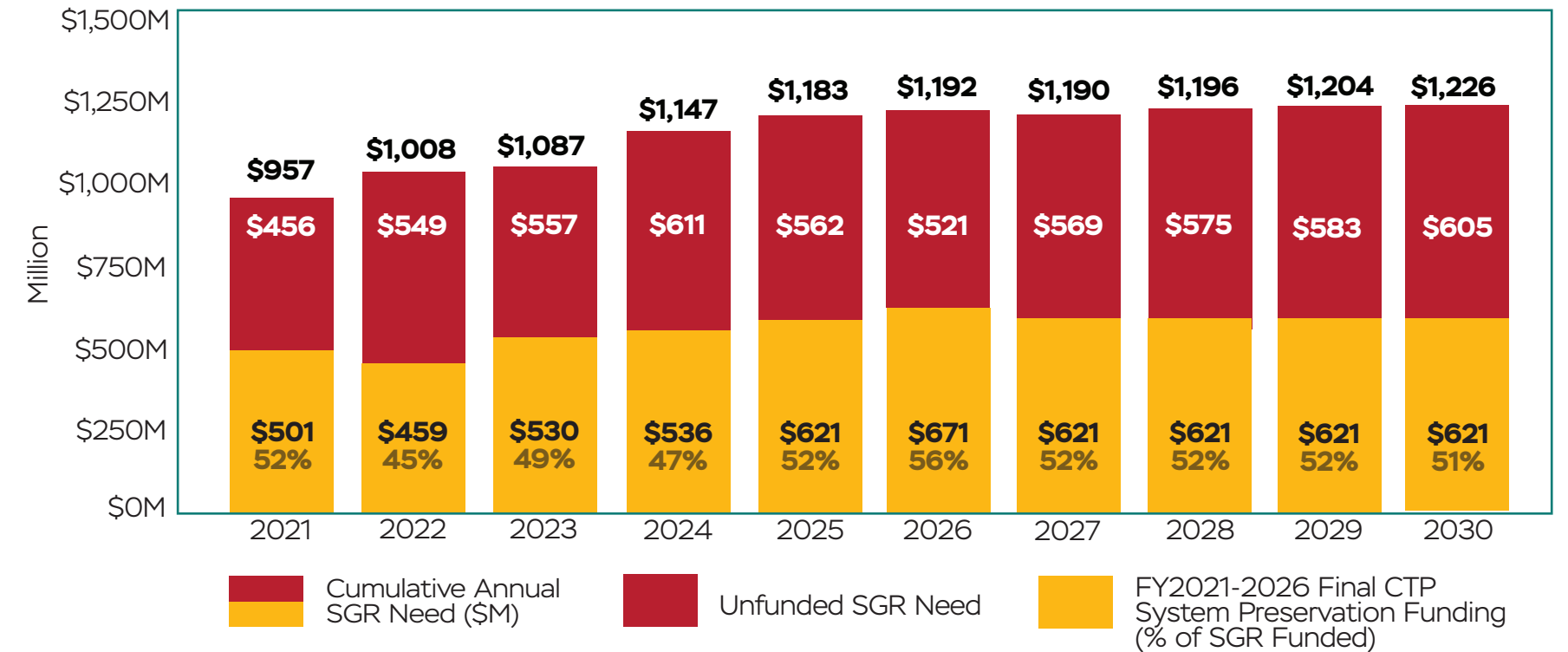
The SGR need and gap forecast compares the unconstrained (\$11.4 billion) maintenance, minor and major rehabilitation, and full replacement needs of the 14 critical asset classes to the 10-year constrained (\$5.8 billion) financial forecast equating to a gap of \$5.6 billion to meet the lifecycle needs of MDOT SHA assets.

The lifecycle and risk management strategies used by MDOT SHA help allocate available funds to infrastructure assets, projects, and programs that represent the largest risk and/or are expected to deliver the largest positive impact to level of service. The asset management program also applies triple bottom line (social, financial, and environmental impacts) and cost/benefit analysis to validate, justify, and support investments.

State of Good Repair (SGR) Funding Need, Projected System Preservation (SPP) Funding & Forecasted Funding Gap



State of Good Repair (SGR) Forecasted Need, Projected System Preservation (SPP) Funding, & Forecasted Funding Gap



Note: Analysis is based on December 2020 FY2021-2026 CTP funding estimates plus additional sources for asset classes not funded through the CTP.

Note: Available funding for years 7-10 is assumed to be equal to year 5 (FY2025) CTP estimates plus additional sources for asset classes not funded through the CTP.

10 | Improvement Activities and Monitoring



Opportunities for Improvement

MDOT's asset management program will continue to guide the Department in making wise investments to maintain its critical assets in a SGR. In addition to developing and updating its asset management plan on a regular basis, MDOT's TBUs have identified several key opportunities for improvement to more fully implement a proactive approach to asset management:

- Build staff capacity for asset management
- Improve systems for gathering, verifying, and analyzing asset data
- Optimize preventative maintenance of safety-critical assets
- Employ sustainability and resiliency strategies
- Complete pilot programs for new and expanded use of asset management applications
- Enhance financial forecasting capabilities

Reviewing Progress

Asset management is a dynamic process that requires continual evaluation to identify potential enhancements to agency policies and practices to improve efficiency, reduce risks, and address strategic priorities. To monitor progress, MDOT will:

- Continuously engage with stakeholders including customers, tenants, and employees
- Monitor gaps between LOS and customer expectations and recommend adjustments as needed
- Establish a regular cycle to update AMPs in conjunction with other relevant plans, including Maryland Transportation Plan (MTP) and Statewide Transportation Program (STIP)
- Review progress toward performance targets through KPIs and report results through the Excellerator



LARRY HOGAN
GOVERNOR

GREGORY SLATER
SECRETARY

