VDOT
Virginia Department of Transportation

MAINTENANCE AND OPERATIONS COMPREHENSIVE REVIEW

2019

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Maintenance and Operations Comprehensive Review 2019

EXECUTIVE SUMMARY

VDOT conducted a comprehensive review of the Commonwealth's investment in transportation assets funded by VDOT's Maintenance & Operations and State of Good Repair Programs. The comprehensive review entailed the development of an investment strategy to achieve long-term sustainable performance targets for pavements, bridges, and Special Structures as well as to satisfy the requirements of the *Robert O. Norris Bridge and Special Structures Fund* legislation, (2019 Acts of Assembly, Enactment 2 of Chapters 83 and 349).[1][2][3] This effort is part of the Commissioner of Highways' vision to ensure VDOT is business focused.

As a result of the comprehensive review, the Commonwealth Transportation Board in December 2019 has:

- Adopted new performance targets for Pavements
- Adopted new performance measures and targets for Structures
- Supported development of a Special Structures health index and risk-based prioritization of projects
- Required an Annual Report that summarizes planned and actual achievement of performance targets
- Approved the 2019 Comprehensive Review Report

Projections of funding allocations to achieve the performance of the overall network, pavements, structures, Special Structures, and other aspects of this comprehensive review require an additional investment of $140-$186 million annually over the next 20 years.

Recognizing the full amount of funding may not be available, VDOT will prioritize the most critical projects on an annual basis to minimize risk.

1 VDOT Commissioner of Highways, "Comprehensive Review of Pavements and Structures," Presentation, September 17, 2019

2 VDOT Commissioner of Highways, "Comprehensive Review of Routine Maintenance," Presentation, October 16, 2019

3 VDOT Commissioner of Highways, "Comprehensive Review of Special Structures," Presentation, November 20, 2019

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PAVEMENTS

The Past – How We Got to Where We Are Today

The condition of the **Interstate System** (5,539 lane miles) is currently benefitting from the significant investment made between 2014 and 2016 using an infusion of construction funding.

The **Primary System** (22,653 lane miles) and **Secondary System** (100,578 lane miles) have benefited from sustained recent funding (2017-2019) to achieve a stable performance level.[1]

		INVESTMENT LEVELS		
	2014 SUFFICIENCY	FY2014-16	FY2017-19	2018 SUFFICIENCY
Interstate	85%	$172M	$87M	90%
Primary	83%	$143M	$193M	85%
Secondary	61%	$168M	$239M	60%

CRITICAL CONDITION INDEX (CCI)

Virginia's measure of pavement condition. The CCI has a 0 to 100 scale (0 being bad, 100 being good).

SUFFICIENCY

Percentage of lane miles at a CCI of 60 or better.

The Present – A Business Model Change

NEW PERFORMANCE TARGETS

Analysis of long-term pavement performance shows that planned investment levels, $425 million, will not enable existing pavement condition to be maintained.

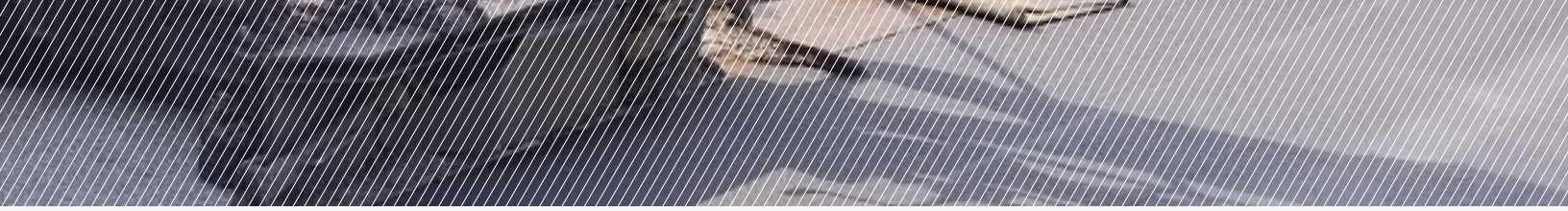
		ANNUAL SHORTFALL TO ACHIEVE PAST TARGET $2019	
	PAST SUFFICIENCY TARGET	YEARS 1-6	YEARS 7-30
Interstate	82%	($61M) PER YEAR	($82M) PER YEAR
Primary	82%		
Secondary	65%		

To achieve a long-term financially sustainable outcome that ensures acceptable pavement condition, VDOT proposes to:

- Manage a sustainable performance of the Interstate System to achieve the current performance target of 82 percent sufficiency.
- Maintain a performance target and condition of the least-trafficked part of the Primary System (routes with <3,500 vehicles per day).
- Improve the condition of the heavily-trafficked Secondary system (routes with ≥ 3,500 vehicles per day, which carry 60 percent of the vehicle miles travelled on the network) and maintain the remainder of the network at 60 percent sufficiency.

The new long-term sustainable performance targets (20 years) will reduce the investment shortfall to $38 million per year in the first six years of implementation, and $74 million per year thereafter instead of the shortfalls for sustaining past performance targets of $61 million and $82 million, respectively.

1 Virginia Department of Transportation (VDOT). Maintenance Division, "Mileage Tables," 2018.



The Future – Outcomes and Cost

	NEW PERFORMANCE MEASURES AND TARGETS SUFFICIENCY	INVESTMENT $2019	REQUIRED INVESTMENT $2019 YEARS 1-6	REQUIRED INVESTMENT $2019 YEARS 7-20	ANNUAL SHORTFALL $2019
Interstate	**82%**	**$425M** PER YEAR	**$463M** PER YEAR	**$499M** PER YEAR	**($38M-$74M)** PER YEAR
Primary	**82%** FOR ≥ 3,500 AADT **75%** FOR < 3,500 AADT				
Secondary	**82%** FOR ≥ 3,500 AADT **60%** FOR < 3,500 AADT				

IMPLEMENTATION REQUIREMENTS

To implement these changes, it is necessary for VDOT to address the following:

ALLOCATION BASED ON NEED

Allocation to Districts must be based on optimizing performance to achieve the revised performance targets.

MAINTAIN INDUSTRY STABILITY

Establish a floor and ceiling for each District allocation when undertaking a needs analysis to ensure sustainability of the local paving industry.

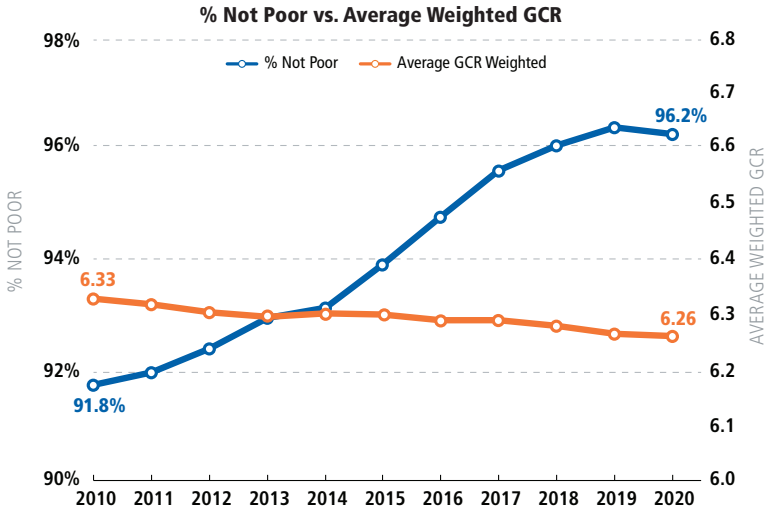
GRADUAL ACHIEVEMENT OF TARGETS

Manage gradual pavement condition declines over 6-10 years to ensure that once the new target is achieved it will be sustained for the long term.

STRUCTURES

The Past – How We Got to Where We Are Today

The agency has made progress in reducing the percentage of structurally deficient, or "poor," structures across the Commonwealth, by focusing on addressing the "worst of the worst." While we have worked to address "poor"-rated structures, the overall condition (measured by Average Weighted General Condition Rating) of the inventory as a whole has slowly deteriorated. The poor performance measure focused on 10 percent of the inventory instead of considering a long-term sustainable approach for the 21,173 bridges and culverts (structures).



GENERAL CONDITION RATING (GCR)	POOR RATING (OR STRUCTURALLY DEFICIENT)	AVERAGE WEIGHTED GCR	CUSP BRIDGES
A national (defined by FHWA) rating system (0-9 scale) for bridge components. (0-4 is poor condition, 5-6 is fair, 7-9 is good).	Is defined as a bridge or culvert having one of the components rated with a general condition rating of 4 or less or poor. Poor DOES NOT mean the structure is unsafe.	A method for utilizing GCR through first averaging the components of each bridge, providing a blended bridge GCR and then averaging this for all bridges (in a group, District, or across the Commonwealth) to calculate an average GCR across the system. The average GCR is weighted by an Importance Factor calculated for all bridges through the State of Good Repair process.	Bridges with a component GCR of 5, meaning they are one inspection rating from that component being rated poor and therefore the entire structure.

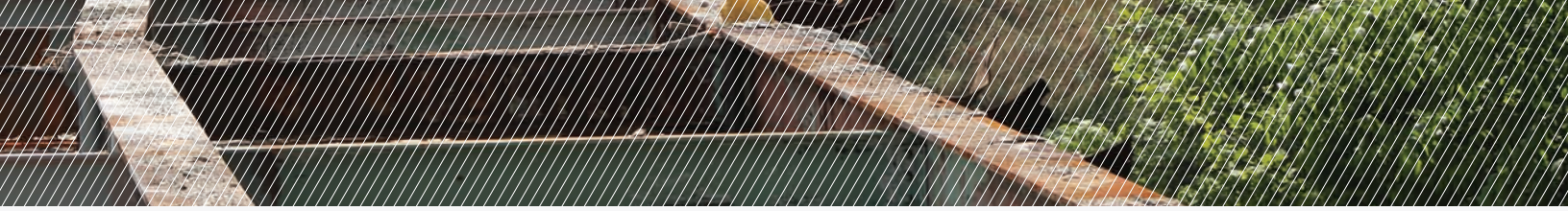
The Present – A Business Model Change

NEW PERFORMANCE FOCUS, PRESERVATION FIRST

VDOT's focus on 'poor' structures is not sustainable as these structures continue to age.

	PAST NON-POOR TARGET	ANNUAL SHORTFALL TO ACHIEVE PAST TARGET $2019 YEARS 1-50
Interstate	99%	($122M) PER YEAR
Primary	96%	
Secondary	94%	

To address the aging VDOT's structures while ensuring safety and network efficiency, VDOT's recommendation is to undertake a "preservation-first" approach that will seek to commit 75 percent of allocations to asset preservation (e.g. deck repair, superstructure repair, joints) and 25 percent to replacement (e.g. components such as deck replacement,



entire structure). Based on this approach, some structures may not get replaced as quickly. In changing the business practice, the agency will ensure no weight limit posting of structures on the Interstate System.

This new approach is expected to result in a minimal increase in the percentage of "poor" structures in the medium term (15-30 years). However, over the long term, this approach will enable VDOT to recover and stabilize the condition of all structures across the Commonwealth and not focus a subset of the inventory.

This 'preservation-first' approach will be measured using the primary performance indicator of Average Weighted GCR, which will provide a more holistic picture of condition across the entire VDOT structures inventory. Percentage of Non-poor structures will be a secondary measure. The past targets require an additional investment of $122 million annually; whereas, a "preservation first" approach allows VDOT to use existing resources and creates long-term sustainability (50 years).

The Future – Outcomes and Cost

	NEW PERFORMANCE MEASURES AND TARGETS SUFFICIENCY	INVESTMENT $2019	REQUIRED INVESTMENT $2019	ANNUAL SHORTFALL $2019
All Systems	AVERAGE WEIGHTED **GCR≥5.6**	**$384M** PER YEAR	**$384M** PER YEAR	**$0M** PER YEAR
Interstate	≥ **97%**			
Primary	≥ **93%**			
Secondary	≥ **90%**			

IMPLEMENTATION REQUIREMENTS

To implement these changes, it is necessary for VDOT to address the following:

FUNDING FOR CUSP STRUCTURES

Invest in structures before they become "poor" to extend their life and reduce overall costs. To achieve the new targets, VDOT will need to invest in the structures at optimal times to achieve the lowest life-cycle cost.

SPECIAL STRUCTURES

The Past – How We Got to Where We Are Today

Due to their complexity and size, many of the Special Structures required distinct funding sources (e.g., tolling). Examples include:

- **The Robert O. Norris Bridge** – originally built in 1957 and tolls removed in 1976.
- **Hampton Roads Bridge-Tunnel** – originally built in 1957 and tolls removed in 1976.
- **Berkley Bridge** – originally built in 1952 and tolls removed after bonds were paid.
- **George P. Coleman Memorial Bridge** – originally built in 1952 and toll removed in 1976. New bridge was built in 1996 and the tolls reinstated. These tolls are slated to be removed after the debt is repaid.

The maintenance and operations responsibility for most of these structures is now with VDOT to manage out of the Maintenance and Operations Program.


Hampton Roads Bridge Tunnel Toll Booth - 1957


Berkley Bridge – Toll Plaza

SPECIAL STRUCTURES

Previously referred to as "VITAL" Infrastructure, Special Structures includes tunnels, movable bridges, and large, complex fixed-span structures. They are considered "special" due to their complexity, maintenance and operations cost, level of risk, and importance. Determination of importance is based on factors including potential long detours, high traffic, economic significance (shipping and vehicular), and access to vital facilities, including military facilities and ports.

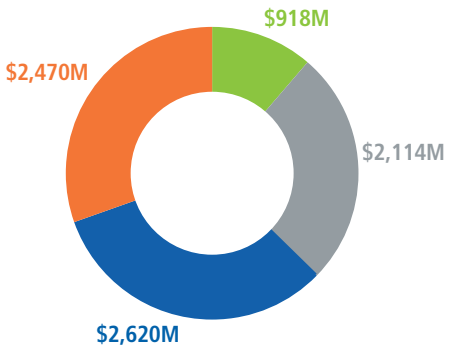
The Present – A Business Model Change

NEW 2019 LONG-TERM PLAN

A long-term plan (50 years) has been developed for each Special Structure that VDOT maintains and operates using a consistent life-cycle approach. The long-term plan provides a realistic perspective of the investment required to operate and maintain each Special Structure. Special Structures under concession agreements – the Pocahontas Parkway and Elizabeth River Tunnels (Midtown and Downtown) – will not be included in the plan until the concession agreements end, in years 2105 and 2069, respectively.

A funding gap exists between the current spending levels for Special Structures – $50 million per year (average over fiscal years 2016 through 2019) – and the investment that is required based on this analysis undertaken as a part of this comprehensive review. The analysis indicates an additional average annual investment of $102 million is required in the first four years, which is projected to increase to $112 million beginning in FY 2025 due to the completion, and operations requirements, of the new Hampton Roads Bridge-Tunnel.

Work Type

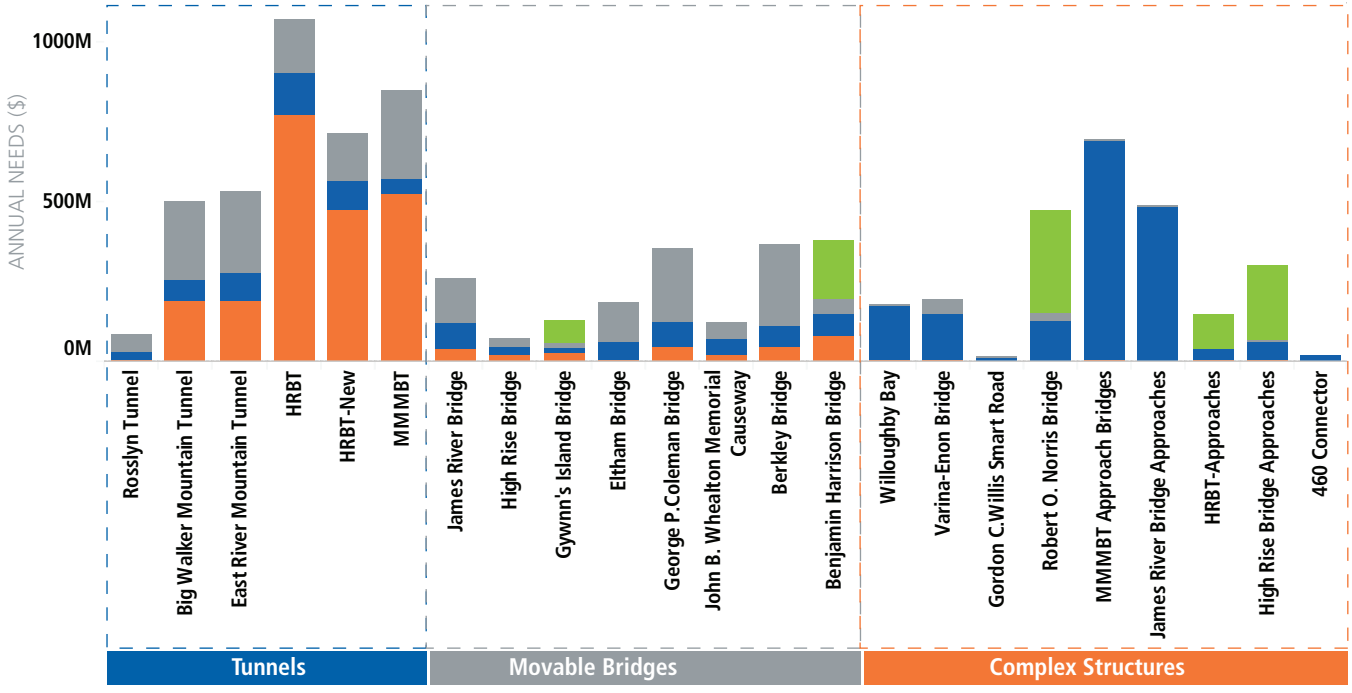


Work Category

Electrical	$704,115,500
Hydraulic	$625,000
Inspection	$200,878,000
Mechanical	$706,804,000
Structural	$3,505,749,000
Systems	$439,074,000
Utilities	$228,935,000
Materials	$71,100,000
Equipment	$250,225,000
Labor	$2,013,925,000
Grand Total	$8,121,430,500

Structure Replacement | Component Replacement | Maintenance | Operations

Spend Profile



The Future – Outcomes and Cost

	INVESTMENT $2019	REQUIRED INVESTMENT $2019		ANNUAL SHORTFALL $2019
		YEARS 1-4	YEARS 5-50	
Health Index and Risk-Based Prioritization performance measures to be developed	**$50M** PER YEAR	**$152M** PER YEAR	**$162M** PER YEAR	**($102M-$112M)** PER YEAR

IMPLEMENTATION REQUIREMENTS

To implement these changes, it is necessary for VDOT to address the following:

ANNUAL REVIEW OF LONG-TERM PLAN

Updated based on additional information (e.g. new technology, investment decisions)

EXECUTE THE LONG-TERM PLAN FOR EACH STRUCTURE

Based on the investment levels available.

ASSESS ALTERNATIVE DELIVERY MODELS

Commenced with current RFI process.

ROUTINE MAINTENANCE

The Past – How We Got to Where We Are Today

Routine maintenance includes work that extends the useful life of the asset (e.g. maintaining drainage and ditching to protect roads), as well as services that provide safe and efficient mobility (e.g. mowing, snow removal, and incident response).

From October 2018 to September 2019, over 197,000 service request calls were received by VDOT. An increased focus on reactive work to address service call requests has reduced the efficiency of maintenance delivery (less planned work).

SERVICE REQUEST INCREASE 2015-2019

VEGETATION	DRAINAGE	UNPAVED ROADS	SIGNS	SIGNALS
↑ 76%	↑ 48%	↑ 20%	↑ 114%	↑ 43%

The Present – A Business Model Change

NEW PERFORMANCE METRICS TO DRIVE A PROACTIVE APPROACH

VDOT is refocusing its routine maintenance efforts toward getting back to basics and implementing a more proactive approach (planned work) that will:

- Provide efficiencies and cost savings through a planned and systematic approach;
- Extend the life of assets and limit the unavailability of assets.

Performance metrics have been developed to enable VDOT to plan and work toward achieving clear targets and monitoring accomplishments against those targets.

2019 TARGET - PLANNED WORK FREQUENCY (ANNUAL)

TURF			TREES	PIPES	STORM WATER MANAGEMENT FACILITIES
Interstate 3 MOWINGS / YEAR	Primary 3 MOWINGS / YEAR	Secondary 2 MOWINGS / YEAR	6% OF INVENTORY	10% OF INVENTORY	2 TIMES / YEAR

DITCHES	UNPAVED ROADS	UNPAVED SHOULDERS	SIGNS	SIGNALS	PAVEMENT MARKINGS
5% OF INVENTORY	4 TIMES / YEAR	20% OF INVENTORY	5% OF INVENTORY	5 YEAR CYCLE	70% OF INVENTORY

The Future – Outcomes and Cost

	INVESTMENT $2019	REQUIRED INVESTMENT $2019	ANNUAL SHORTFALL $2019
Performance metrics (annual achievement) defined for ten key activities	**$725M** PER YEAR	**$725M** PER YEAR	**$0M** PER YEAR

IMPLEMENTATION REQUIREMENTS

To implement these changes, it is necessary for VDOT to address the following:

BUILD UNDERSTANDING OF INVENTORY AND SERVICES

VDOT maintains a variety of assets (e.g., trails) while providing services to ensure the mobility of the traveling public. VDOT will investigate and catalogue the assets and services within its purview.

ANNUAL PERFORMANCE REVIEW

VDOT will report annually.

1 INTRODUCTION

The Virginia Department of Transportation (VDOT) is responsible for designing, building, maintaining, and operating the Commonwealth's roads, structures, tunnel systems, and other roadway assets. VDOT also provides services to ensure a transportation system that is safe, enables easy movement of people and goods, enhances the economy, and improves our quality of life. This report summarizes the 2019 comprehensive review conducted to ensure the investment strategy of VDOT's Maintenance & Operations and State of Good Repair (SGR) Programs achieve the long-term performance sustainability of assets (e.g., pavements, structures, Special Structures).

1.1 PURPOSE OF REPORT

The purpose of this report is to summarize the findings of the comprehensive review of long-term investment strategies for VDOT's Maintenance and Operations and SGR responsibilities regarding roadway assets. This review was conducted during 2018 and 2019. This report also satisfies the requirements of Chapters 83 and 349 of the 2019 Acts of Assembly (the Robert O. Norris Bridge and Special Structures Fund legislation), which required the Commonwealth Transportation Board ("Board") to undertake a comprehensive review of the current and future conditions of pavements and structures as well as the consideration of current and future investment strategies for both the Highway Maintenance and Operating Fund ("HMOF") and the SGR Program and the recommendations regarding pavement and structure performance measures focused on 20-year sustainable performance.

While the legislation requested a review of the Highway Maintenance and Operating Fund, the Highway Maintenance and Operating Fund is legislatively distributed to other Commonwealth agencies and entities (e.g., cities, towns, State Police). In the Comprehensive Review, the focus was on the Highway Maintenance and Operations Program (VDOT's portion of the Highway Maintenance and Operating Fund).

Much of the review has centered on pavements and structures – the most visible and valuable assets for which VDOT is responsible. VDOT has been, and continues to be, a leader in condition assessment and performance targets for pavements and structures. A key component of effective condition and performance assessment is a periodic review to analyze the longevity of the funding programs (Maintenance and Operations and SGR Programs). As assets age, the costs of VDOT's Maintenance and Operations and SGR work continues to rise while resources remain limited when prioritized with other needs. While the number of structures added to VDOT's inventory annually is minimal, VDOT's pavement

inventory increases by over 200 to 300 lane miles annually (e.g., new subdivision roads, capacity building projects such as additional lanes on I-64). As a result, the Board and VDOT continuously work to improve the allocation of its resources to ensure easy movement of people and goods, enhancement of the economy, and improved quality of life across the Commonwealth.

1.2 CODE OF VIRGINIA REQUIREMENTS

Enactment 2 of Chapters 83 and 349 of the 2019 Acts of Assembly (the *Robert O. Norris Bridge and Special Structures Fund* legislation) requires the - Board to "undertake a comprehensive review of the current and future condition of pavements and bridges (structures) in the Commonwealth," including consideration of conditions, performance targets, and investment strategies.[1] The Board is required to report the findings of its review no later than December 1, 2019.

This document serves as a record of the comprehensive review undertaken, and satisfies the requirements stipulated in the enactment clauses of Chapters 83 and 349, which direct the Board to:

i. Consider current conditions and performance targets of pavements and structures;

ii. Consider current investment strategies of the HMOF as well as the SGR Program;

iii. Recommend new performance targets for pavements and structures with sustainable performance over a 20-year period; and

iv. Develop an investment strategy for the HMOF and the SGR Program to achieve those sustainable performance targets, including a plan to address the funding needs of large and unique bridges and tunnel structures in the Commonwealth.

The comprehensive review described herein has included analyses of current and predicted performance, data collection, and performance measures, as well as evaluation of preliminary recommendations for revised performance targets. As the review progressed, the Board was presented findings and recommendations for various Maintenance and Operations categories throughout 2019. These presentations can be found at http://www.ctb.virginia.gov/public_meetings/agendas_and_meeting_minutes/default.asp.

Through these analyses and assessments, VDOT has developed an investment strategy to meet or exceed recommended pavement and structure performance targets while considering the long-term needs of Special Structures and routine maintenance work. In December 2019, the Board approved by resolution in Appendix A.

- New performance targets for Pavements
- New performance measures and targets for Structures
- Supported development of a Special Structures health index and risk-based prioritization of projects
- Requirement of an Annual Report that summarizes planned and actual achievement of performance targets
- The 2019 Comprehensive Review Report

In addition to the comprehensive review, Chapters 83 and 349 require the Board to allocate funds from the HMOF or SGR Fund to the Robert O. Norris Bridge and Statewide Special Structure Fund after July 1, 2020. The legislation also requires an evaluation of the feasibility of a public-private partnership ("P3") for the replacement of the Robert O. Norris Bridge and the Downing Bridge, the findings of which are attached as Appendix B.

1 Virginia Acts of Assembly – 2019 Session, "Chapter 83; Relating to the Robert O. Norris Bridge and Statewide Special Structure Fund"

The findings from a Request for Information to the P3 industry are attached as Appendix C of this report.

1.3 CURRENT ALLOCATIONS

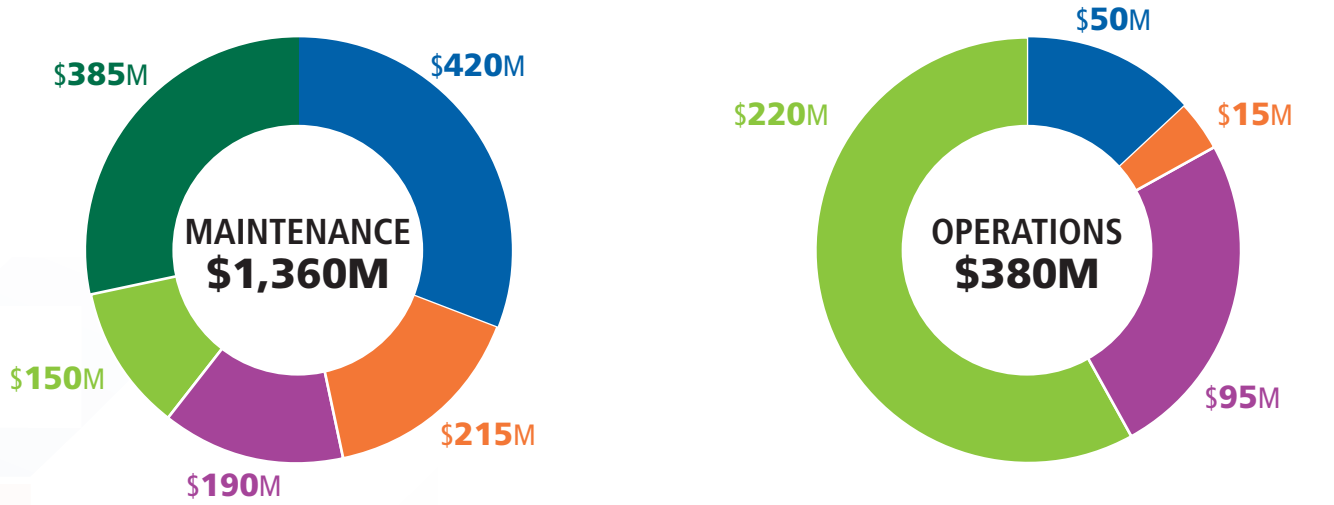
Section 33.2-358 of the *Code of Virginia* requires the Board to allocate each year from all funds available for highway purposes such amount as it deems reasonable and necessary for the maintenance of roadways. The funding is budgeted and allocated to VDOT's Highway Maintenance and Operations Program. Effective July 1, 2020, the Board after the maintenance allocation and certain other required program allocations, allocates 45% of Construction Program allocations to the SGR Program.

Maintenance and Operations Program Allocation

For VDOT's Maintenance and Operations Program, the Board has allocated on average $1.7 billion since FY 2016. VDOT's Maintenance and Operations Program is executed by a combination of VDOT employees and contractors, and includes the activities listed in Figure 1.

It is important to note that the Board allocates at a summary level so that VDOT can maintain flexibility in the Maintenance and Operations Program to react to various needs and conditions. For example, resources need to be available for emergencies, including snow and ice, flooding, debris, and unexpected events. Unexpected events, including sinkholes, pipe failures, and traffic crashes, also require the agency to respond rapidly and commit the resources needed to address such events.

FIGURE 1 VDOT Activities and Average Spending in the Maintenance and Operations Program, Based on Averages of FY 2016 – FY 2018 (numbers rounded to nearest $5M)



- **Pavements**
- **Bridges**
- **Routine Maintenance** (e.g. Roadside: drainage, slopes, mowing)
- **Traffic Items: signs, signals**
- **Other Maintenance** (e.g. Rest Areas, Pavement Patching, Equipment, Incidental Maintenance, Management and Direction or Program Oversight)
- **Special Structures Operations**
- **Ferries**
- **Traffic Operations Centers & Safety Service Patrol**
- **Snow and Ice Removal**

State of Good Repair Program Allocation

In 2015, recognizing the aging infrastructure, the General Assembly established the State of Good Repair Program (Chapter 684 of the 2015 Acts of Assembly). The Board allocates funding to the State of Good Repair Program pursuant to §33.2-358(D)(1) of the *Code of Virginia*. Beginning in FY 2021, once the maintenance allocations as described above are made, along with those to certain other required programs, the Board is to allocate 45 percent of the remaining highway funding to this Program. Prior to FY 2021, the Appropriations Act directed allocations to the SGR Program.

Unlike the VDOT Maintenance and Operations Program that funds a wide array of maintenance and operation activities, the SGR Program as defined in the *Code of Virginia*, 33.2-369, is limited to the reconstruction and replacement of structurally deficient ('poor') state and locally owned bridges (structures) and reconstruction and rehabilitation of pavement on the Interstate System and Primary state highway system (VDOT and municipality-maintained) determined by the Board to be deteriorated. The *Code* requires that the Board allocate funds around the Commonwealth with no construction district receiving less than 5.5 percent or more than 17.5 percent of SGR allocations in a given year. The *Code* does provide two waivers. The Board may, by a duly adopted resolution, waive the cap provided in this section for a fiscal year only when it determines that due to an extraordinary circumstance or need the cap inhibits the ability of the Department (VDOT) to address a key pavement or bridge need. Also, the Board may allocate up to 20 percent of the SGR Program to the Secondary System across all nine highway construction districts to improve conditions system-wide if VDOT has not met its established Secondary System performance target.

1.4 COMPREHENSIVE REVIEW PROCESS

In 2018, VDOT formed a working group comprised of VDOT staff and supported by consultant expertise as part of undertaking this comprehensive review. The charge of this group was to conduct independent analyses for the following asset areas:

- Pavements
- Structures (Bridges and Large Culverts)
- Routine Maintenance
- Special Structures

These asset areas were selected because of legislative requirements but also because they comprise over 90 percent of the Maintenance and Operations Program activities and all the State of Good Repair Program parameters. Through this comprehensive review, VDOT has developed updated performance measures and targets to create long-term, sustainable programs.

These efforts tie into the Commissioner of Highways' Business Plan for maintaining infrastructure, being transparent (performance measures), ensuring sustainable programs and project pipelines, operating systems efficiently, and being business focused by delivering on the actions the agency identifies.

Beginning January 1, 2020, VDOT will begin the implementation of the performance targets and allocation investment strategies. As required by the Board, VDOT will report on its accomplishments each year. The intent of this comprehensive review is that it will serve as a foundation for continual assessment. A key element of success will be the communication tools and processes used to establish the expectations and measure outcomes.

1.5 INTENDED AUDIENCE

This report is designed to provide an overview of the comprehensive review process and a record of the outcomes. It is intended to inform the following internal and external stakeholders:

- The General Assembly of Virginia
- The Commonwealth Transportation Board
- VDOT Leadership
- External Stakeholders
- The Public

1.6 CONTENTS OF THIS REPORT

This document has been divided into several sections:

- **Executive Summary:** Provides an overview of the project, background up to today, changes in performance management, and future outcomes and costs.
- **Introduction (this section):** Outlines the purpose, background, and intended outcomes of the report.
- **Pavements:** Describes the current condition and past performance targets for these assets. Summarizes the analysis undertaken and presents the performance measures and targets adopted by the Board that will be implemented beginning January 1, 2020.
- **Structures:** Describes the current condition and past performance targets for these assets. Summarizes the analysis undertaken and presents the performance measures and targets adopted by the Board that will be implemented beginning January 1, 2020.
- **Special Structures:** Examines the specific needs of these structures, outlines the 50-Year Long-Term Plan for addressing these needs, defines the intended use of the Robert O. Norris Bridge and Statewide Special Structure Fund, and outlines the funding requirements.
- **Routine Maintenance:** Presents the past focus and future focus for Routine Maintenance. Describes the newly adopted performance metrics and the approach to be taken beginning January 1, 2020.
- **Summary of Outcomes:** A summary of the Maintenance and Operations and State of Good Repair Programs long-term sustainable investment approach, and key considerations that will form part of the implementation of the investment strategy.

READING THIS REPORT

Throughout this document there are several highlighted sections. These are intended to illustrate some of the details of the analysis undertaken in assessing investment scenarios through the comprehensive review process. Further details and assumptions are included as appendices.

1.7 OTHER REFERENCE DOCUMENTS

Each year, VDOT receives requests from the General Assembly to produce reports that describe the condition and management of the Commonwealth's transportation system. These reports deal with a variety of transportation and operational issues impacting VDOT and the Commonwealth. The following documents provide relevant context for the comprehensive review described in this report:

- **State of Pavements Report:** This report describes the condition and ride quality on Virginia's 128,770 lane miles of roadway based on data collected, processed, and analyzed by VDOT. It also provides trend analysis over the last five years. The information in this report is used to understand variations in pavement condition and ride quality by pavement type, highway system, maintenance district, and county.[2]
- **State of Structures and Bridges Report:** This annual report summarize conditions; VDOT's structure maintenance activities, along with the construction and inspection program; and accomplishments for the Commonwealth's bridges, large culverts, and ancillary structures (e.g. poles for traffic control devices) for the given fiscal year.[3]
- **Biennial Report:** This report provides information required by §33.2-232 of the *Code of Virginia*, which directs the Commissioner of Highways to provide the Governor, the General Assembly, and the Commonwealth Transportation Board a biennial report. The report explains the basis for investment in the surface transportation system maintained by VDOT.[4]

2 Virginia Department of Transportation. Maintenance Division, "State of the Pavement - 2018," 2018.
3 Virginia Department of Transportation. Structure & Bridge Division, "State of the Structures and Bridges – FY 2018," 2018.
4 Virginia Department of Transportation. "VDOT Biennial Report - 2018," 2018.

2 PAVEMENTS

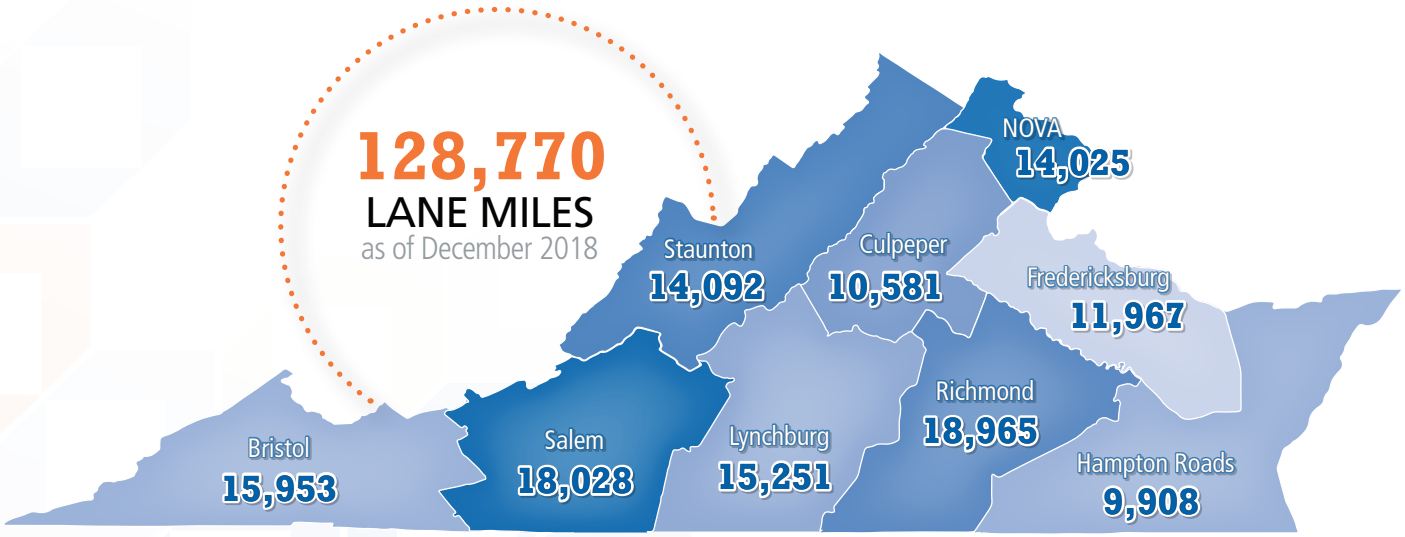
Pavements are the largest and one of the most visible assets, in terms of both size and funding, that VDOT maintains.

2.1 PAVEMENT INVENTORY

As of December 2018, VDOT maintained an inventory of 128,770 total lane miles across three systems (see Figure 2), as defined by the *Code of Virginia*,[5] as follows:

System	Lane Miles	Pavement Type Definition
Interstate	5,539	"Interstate System" includes highways or highway segments in the Commonwealth that constitute a part of the Dwight D. Eisenhower National System of Interstate and Defense Highways as authorized and designated in accordance with § 7 of the Federal-Aid Highway Act of 1944 and § 108(a) of the Federal-Aid Highway Act of 1956 and are declared by resolution of the Commonwealth Transportation Board to be portions of the Interstate System.
Primary	22,653	"Primary state highway system" consists of all highways and bridges under the jurisdiction and control of the Commonwealth Transportation Board and the Commissioner of Highways and not in the secondary state highway system.
Secondary	100,578	"Secondary state highway system" consists of all public highways, causeways, bridges, landings, and wharves in the counties of the Commonwealth not included in the primary state highway system and that have been accepted by the Department of Transportation for supervision and maintenance.

FIGURE 2 Map of VDOT Pavements Inventory (Lane Miles)



5 Virginia Law Library. *Code of Virginia*, "Title 33.2 Highways and Other Surface Transportation Systems, § 33.2-100. Definitions," 2019.

2.2 DATA COLLECTION OVERVIEW

VDOT has a detailed process for rating pavements and analyzing those ratings to prioritize maintenance and rehabilitation needs. VDOT assesses 100 percent of the Interstate and Primary Systems and 20 percent of the Secondary System each year. The condition of pavements, expressed in terms of Critical Condition Index (CCI) – an indicator of overall pavement condition, Virginia's measure of pavements, is determined based on the data collected and a subsequent assessment. The CCI has a 0 to 100 scale with a score of less than 60 (categorized as "poor" or "very poor" condition) considered to be deteriorated (see Figure 3). VDOT then utilizes this data to conduct further analysis to make objective and data-driven investment decisions.

VDOT reports a sufficiency percentage which is the percentage of lane miles on the network at a CCI of 60 or better (Excellent, Good or Fair) condition.

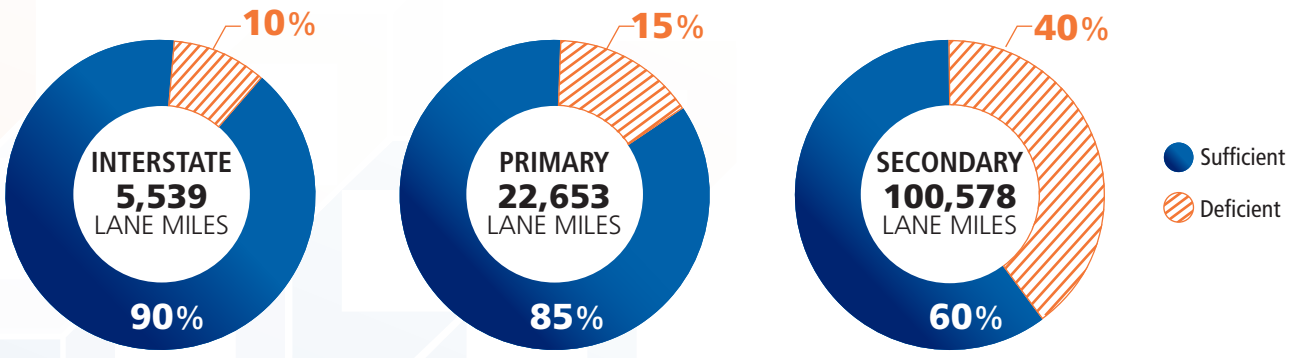
FIGURE 3 Critical Condition Index (CCI) Grading Overview

CCI Score	Rating	
90 - 100	Excellent	Sufficient (CCI≥60)
70 – 89	Good	
60 – 69	Fair	
50 – 59	Poor	
0 – 49	Very Poor	

2.3 CURRENT PERFORMANCE

Data collected on the Commonwealth's pavements allows VDOT to display the condition of pavements on network maps by system – Interstate, Primary, and Secondary. Figures 4 - 7 reflect the pavement condition, based on 2018 data.

FIGURE 4 State of the Pavement – Sufficiency Percentage, 2018



Note: Sufficient = Lane Miles at or above 60 CCI.

FIGURE 5 2018 Pavement Condition- Interstate

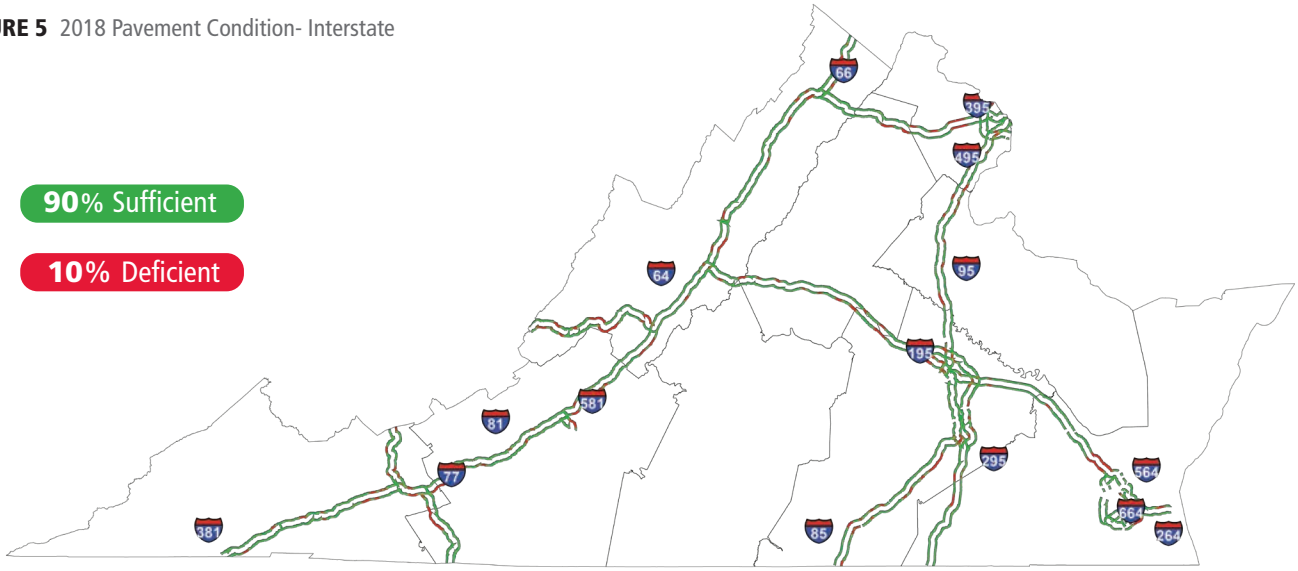


FIGURE 6 2018 Pavement Condition – Primary

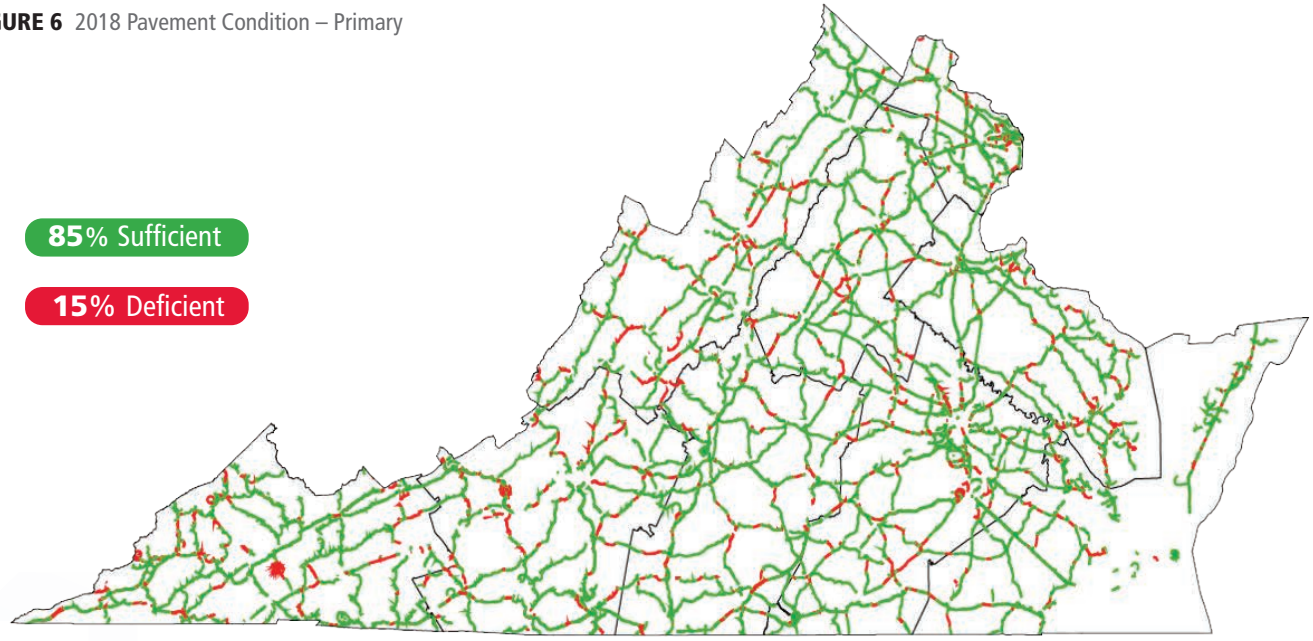
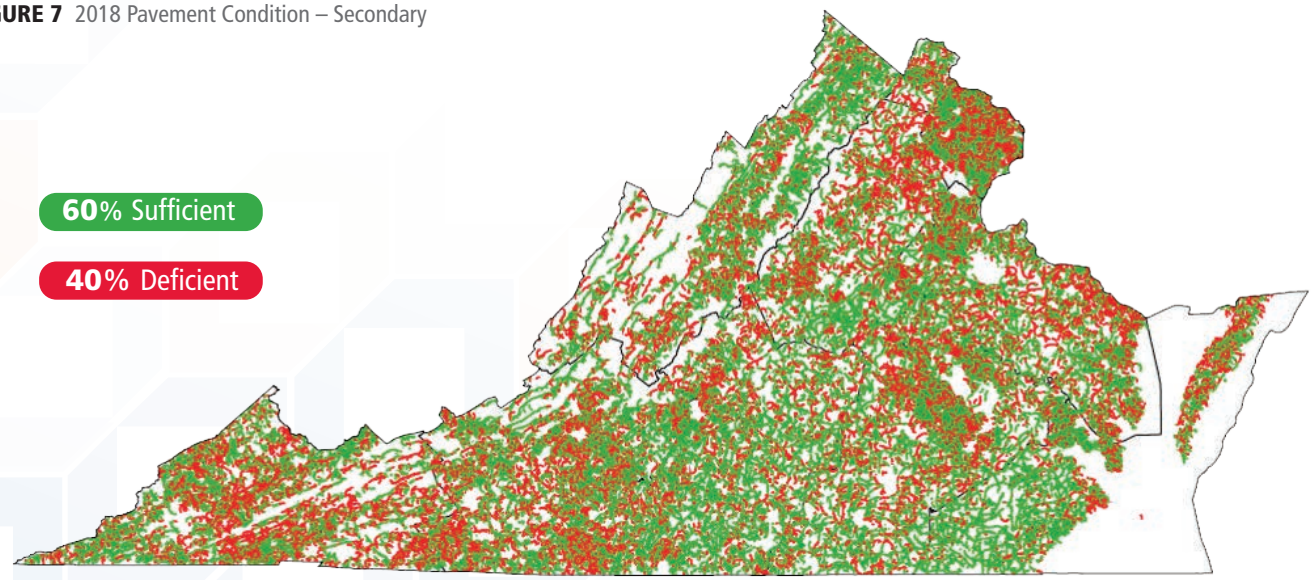


FIGURE 7 2018 Pavement Condition – Secondary



2.4 TARGETS BASED ON 2007 BOARD POLICY

VDOT pavement targets are defined for each of the Interstate, Primary, and Secondary Systems, as outlined in the Figure 8. The Board established these targets in 2007 with the Interstate and Primary systems both set at 82 percent sufficiency. Both systems achieved ratings above the current targets in 2018, 90 percent and 85 percent, respectively. The overall condition of the Secondary System did not reach its target of 65 percent, based on 2018 data, falling 5 percentage points below the target.

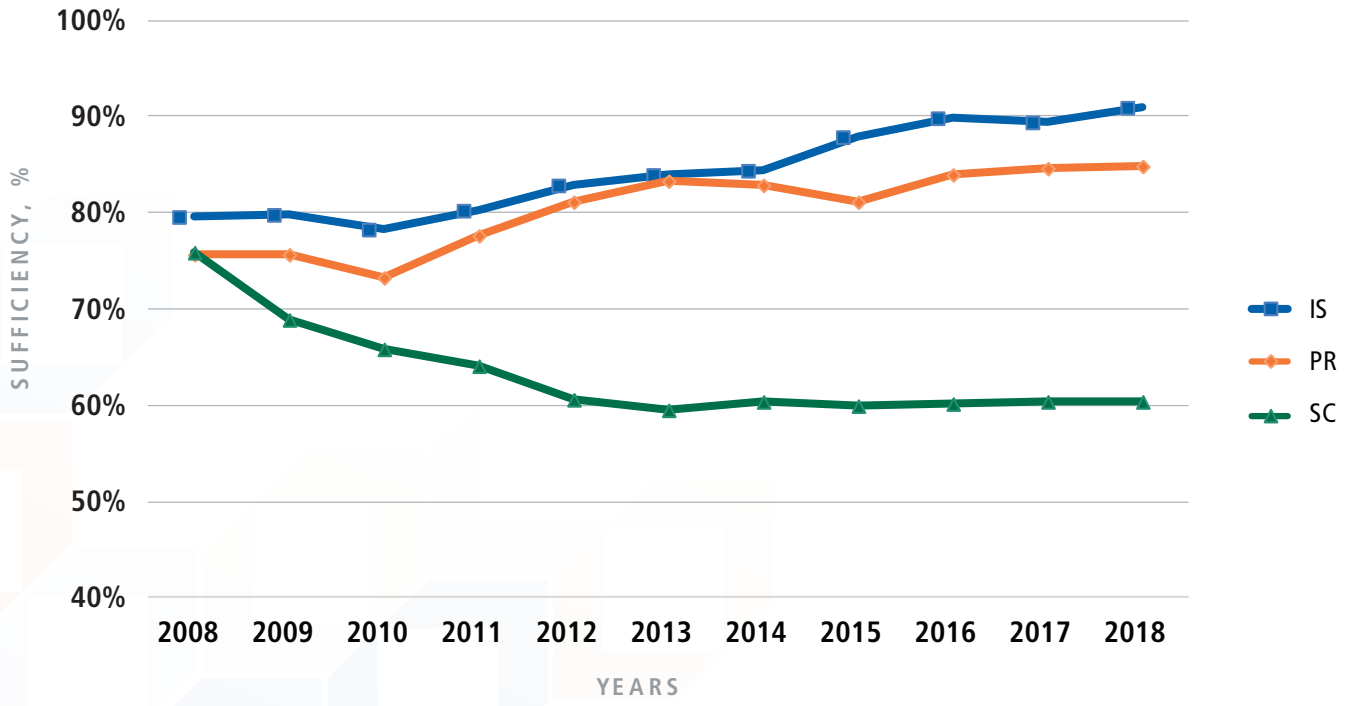
FIGURE 8 Pavements –Target (Policy) and Performance (as of 2018)

Pavement System	Target Based on Past Board Policy (% Sufficiency)	2018 Performance (% Sufficiency)
Interstate	82%	90%
Primary	82%	85%
Secondary	65%	60%

2.5 PREVIOUS PERFORMANCE

Since 2010, VDOT has managed to improve the condition of Interstate and Primary System pavements, while Secondary pavements have declined keeping in mind most lane miles added to VDOT's inventory are in Secondary pavements (see Figure 9). During this time the rehabilitation and replacement of pavements, primarily on the Interstate System, received Board allocations from the highway Construction Program.

FIGURE 9 Historical Performance (Sufficiency Rating) Across All Systems



2.6 PAVEMENT ANALYSIS UNDERTAKEN

The comprehensive review included evaluation of various investment strategies and performance targets to consider alternative treatment approaches, funding levels, and performance targets. The analysis considered development of solutions that create a long-term sustainable program.

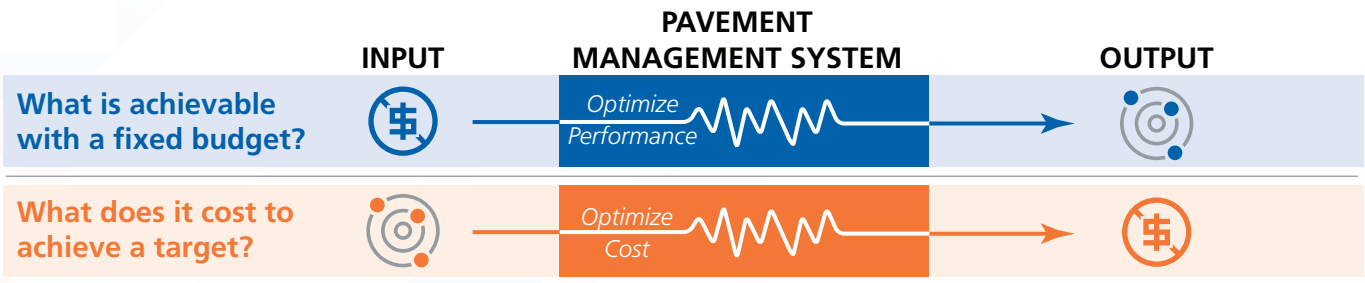
The analysis undertaken to define a sustainable, long-term approach included:

- **Considering Historical Performance:** *What has VDOT spent? How did that influence performance?*
- **Evaluation of Time Periods:** *What is the best analysis period to understand the full lifecycle of an asset?*
- **Assessment of Varying Maintenance Strategies:** *What are the assumptions used in modeling and how is pavement performance affected if assumptions change?*
- **Cost to Maintain Performance:** *What it would take to sustain our pavement condition as last measured in 2018?*
- **Cost to Achieve Current Targets:** *What would be the cost difference of lowering sufficiency level (where it exceeds targets) to meet the current performance target?*
- **Impact of Different Investment Levels:** *What can be achieved with different investment levels, based on 2020 investment levels and increasing or decreasing funding?*
- **Impact of Tiered Targets:** *What if tiered performance targets were considered for each of the systems?*

A key assumption in this analysis is that the pavement allocations will be made and executed based on needs to optimize the overall network performance. In recent years, VDOT has strayed from the Pavement Management System outputs to address areas of immediate concern. To achieve the outcomes described in this report, it will be necessary to utilize a needs-based allocation process with accountability for its implementation (a data driven process while accounting for business practices).

The Pavement Management System optimized outcomes in two ways, as illustrated in the Figure 10.

FIGURE 10 Pavement Management System Optimization Approaches



2.7 INVESTMENT SCENARIOS – COSTS, OUTCOMES, AND PROPOSED TARGETS

VDOT has modeled and analyzed a series of investment scenarios and evaluated potential outcomes in pavement performance. The following sections provide an overview of the analysis undertaken and its findings. The results presented here are shown over a 20-year period. Analysis was also undertaken for a 30- to 50-year period to ensure rehabilitation and the greater cost of associated treatments (i.e. 2 to 5 times the cost of corrective maintenance) were considered.

Two of the shortlisted investment options are presented in the figures shown on the following pages for Interstate, Primary, and Secondary Systems. There are three key elements to the figures:

- The blue bars and line indicate the past expenditure and condition performance.
- The orange bars and lines represent the predicted outcomes based on the FY 2020 level of investment. The outcome is presented as a band of performance to reflect a range of possible solutions based on a variety of assumptions for potential treatment types. Actual performance is expected to fall within this band.
- The green bars and line indicate required funding levels to maintain the pavement condition at the pavement performance targets.

INTERSTATE SYSTEM INVESTMENT

The condition of the Interstate System is currently benefitting from the significant investment (average $172 million per year) made in 2014-2016 when there was an infusion of Construction Program funding (see Figure 11). This investment raised pavement conditions and enabled these levels to be maintained with reduced investment in the following years. However, as investment levels decline, pavement condition is expected to gradually fall. With an 82 percent Interstate System sufficiency performance target and assuming a $60 million annual investment in Interstate System pavements, Interstate System performance will decline to 66 to 73 percent by year 10 (2029).

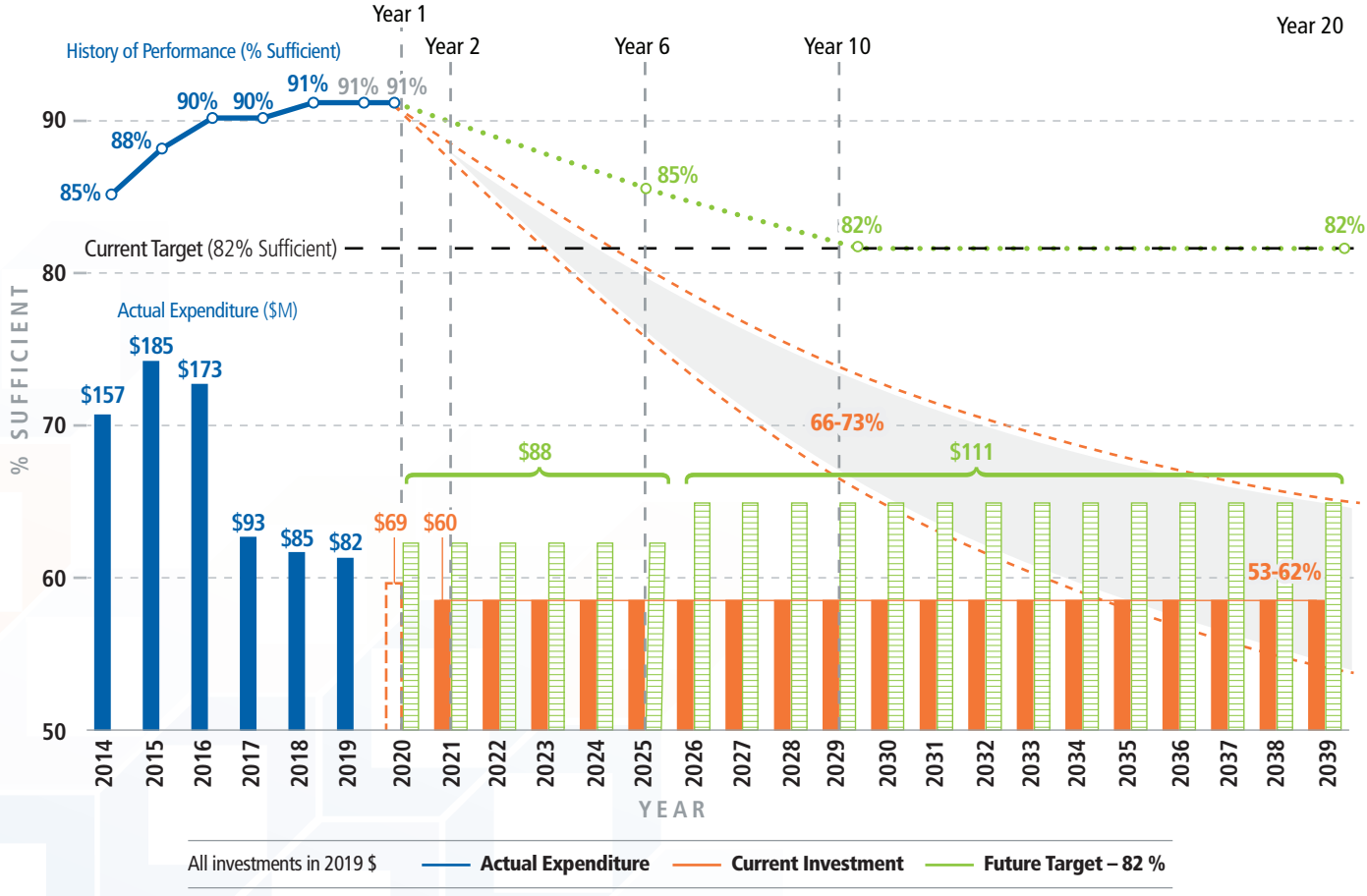
In order for the 82 percent performance target to be achieved each year, the annual investment for the Interstate System will need to be $88 million in years 1-6 and $111 million in years 7-20.

This investment strategy provides a sustainable approach to managing the pavement performance sufficiency on the Interstate System at the existing 82 percent performance target.

ANALYSIS DETAILS: INTERSTATE MINIMUM CCI LEVEL

A fundamental aspect for the Interstate System pavement management strategy is that any pavements measuring below a CCI of 35 are scheduled for repair or reconstruction. This is commonly referred to as "No CCI<35." VDOT enacted this practice to reduce the risk of Interstate pavement failure, meaning the roadway is no longer open to traffic for an extended period. This strategy was considered by the working group and has been retained in this review. VDOT intends to investigate this issue further to ensure that this criterion is the most efficient approach to measure risk of failure.

FIGURE 11 20-Year Outlook for Interstate System: Estimated Investment Needed for Meeting Sufficiency Target



ANALYSIS DETAILS: TIERED APPROACH

The Primary and Secondary Systems comprise 96 percent of the Commonwealth's roadway network lane miles and are diverse in their function. The Secondary System alone comprises 78 percent of the lanes miles managed by VDOT.

The working group considered whether the same pavement performance target was necessary for the roadways with the 3,500 vehicles per day (Average Annual Daily Traffic, AADT) (see Figures 12 – 13). Significant discussion occurred on whether a roadway user has different expectations of pavement condition depending on the roadway system (Primary and Secondary Systems) on which they are traveling. Based on practical business acumen the conclusion was the expectation by the traveling public does not exist. Therefore, the Commissioner of Highways presented and recommended to the Board that the 82 percent pavement performance target be continued for sections of the Primary System with AADT of 3,500 or more and adopted for sections of the Secondary System with the same AADT. For those pavements with less than 3,500 AADT, the recommendation was that a 75 percent target be established for the Primary System and 60 percent for the Secondary System. The Board adopted these recommendations as policy in December 2019.

Busiest Part of Secondary System:

- Carries on average more than 3,500 vehicles per day
- Makes up only 5% of the total number of Secondary lane miles
- Carries 75% of all Secondary truck traffic
- Carries 59% of the Secondary vehicle trips in Vehicle Miles Travelled (VMT)

FIGURE 12 Primary System Condition and Traffic as of 2018

AADT	Current % Sufficiency	% Primary Network (Lane Miles)	% Primary Truck VMT	% Primary VMT
Above or equal to 3,500	85.1%	68%	94%	95%
Below 3,500	85.1%	32%	6%	5%

FIGURE 13 Secondary System Condition and Traffic as of 2018

AADT	Current % Sufficiency	% Secondary Network (Lane Miles)	% Secondary Truck VMT	% Secondary VMT
Above or equal to 3,500	54.8%	5%	75%	59%
Below 3,500	60.3%	95%	25%	41%

Paving Operations, Henrico County – VDOT, 2012

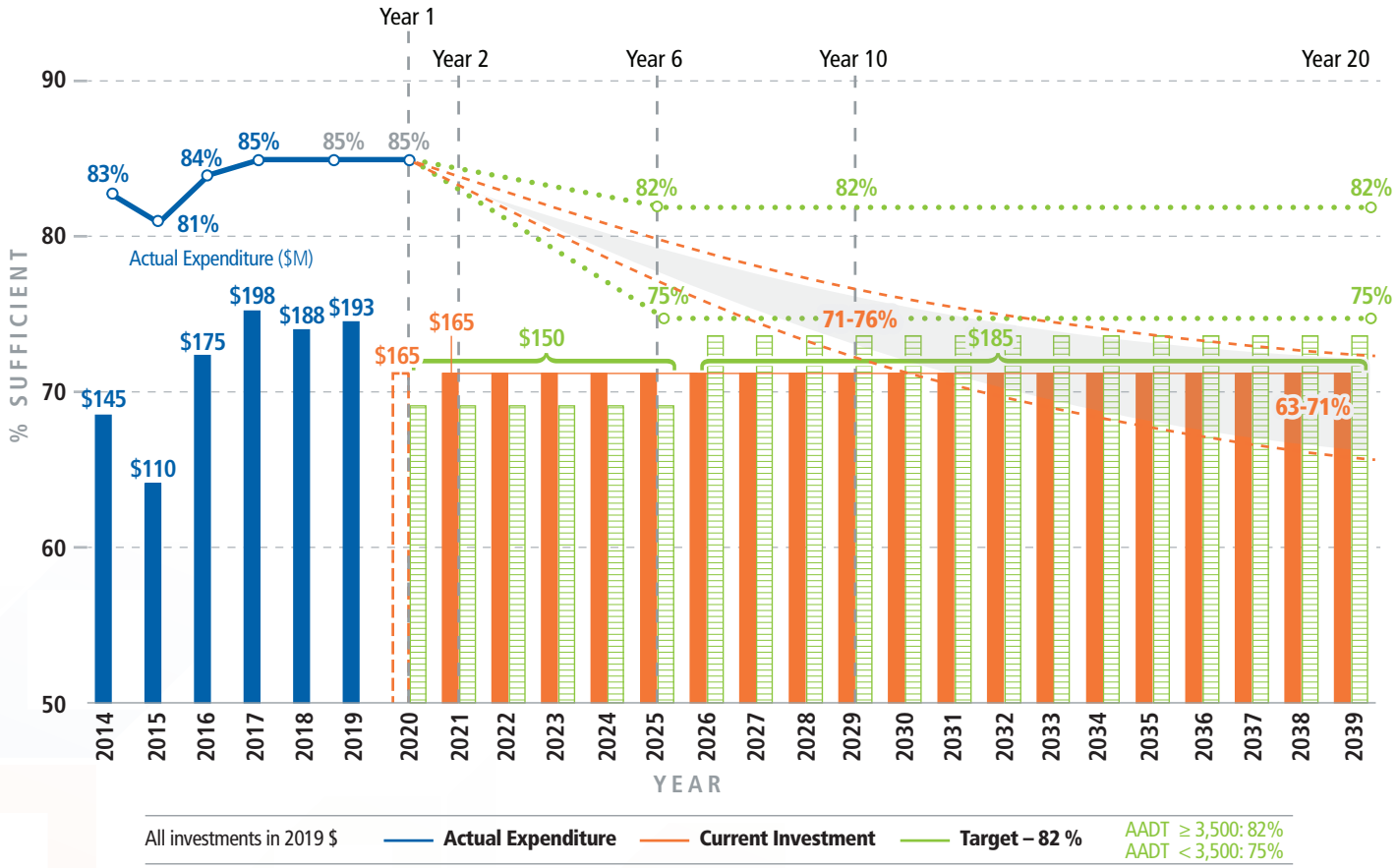
PRIMARY SYSTEM INVESTMENT

Spending levels averaging $193 million have enabled the condition of the Primary network to achieve a stable 85 percent sufficiency - performance above the Board's 82 percent performance target. In order for the 82 percent performance target to be achieved each year, the annual investment for the Primary System will need to be $171 million in years 1-6 and $193 million in years 7-20.

Without the adoption of an 82/75 percent tiered Primary System sufficiency performance targets and the 3,500 AADT tiered approach and assuming a $165 million annual investment in Primary System pavement, Primary System pavement performance will decline to 71 to 76 percent by year 10 (2029). This is shown in the Figure 14.

In order for the 82/75 percent performance targets to be achieved each year, the annual investment for the Primary System will need to be $150 million in years 1-6 and $185 million in years 7-20. The savings in years 1-6 would be used on other pavement systems (e.g., Secondary System) to assist with performance.

FIGURE 14 20-Year Outlook for Primary System: Estimated Investment Needed for Meeting Sufficiency Target



SECONDARY SYSTEM INVESTMENT

Since 2010, the Secondary System pavement performance has not achieved the Board's performance target (CCI ≥ 65). With average spending levels of $239 million per year pavement condition has remained stable at 60 percent sufficient since 2012. The working group examined whether the Board's 65 percent sufficiency performance target was achievable and sustainable. In order for the 65 percent performance target to be achieved each year, the annual investment for the Secondary System will need to be $227 million in years 1-6 and $203 million in years 7-20 as well as following an optimized needs approach. At the same time, the working group acknowledged a need for higher pavement sufficiency on sections of the Secondary System with 3,500 AADT and above (see Figure 15). These changes were adopted by the Board in December 2019.

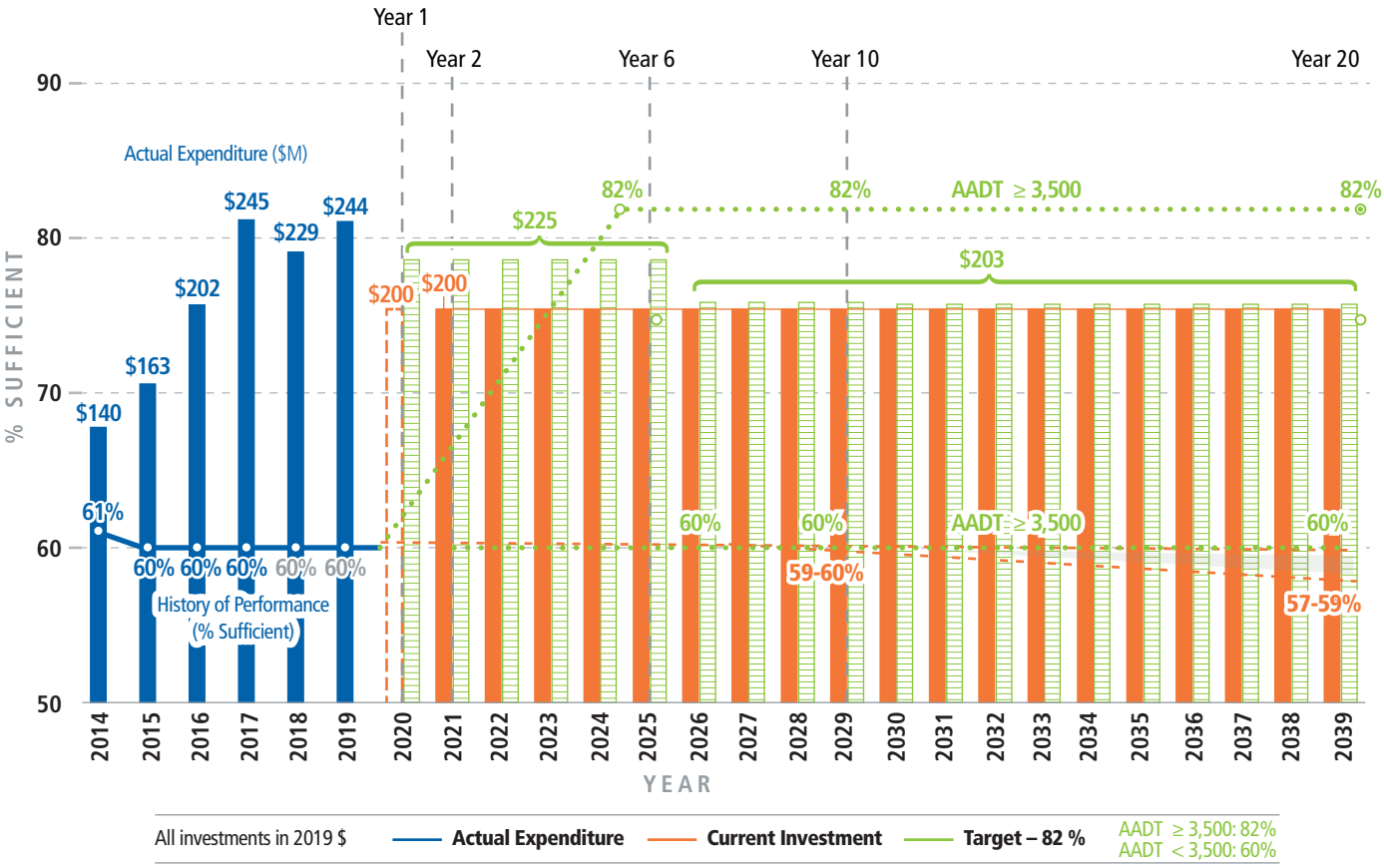
FIGURE 15 Secondary System Targets and Investment (Tiered Approach)

% Sufficiency for ≥ 3,500 AADT	% Sufficiency for < 3,500 AADT	Estimated Average Total Cost
82%	60%	$225M
75%		$221M
70%		$219M
65%		$215M
60% (current level)		$200M

Similar to the 20-year outlook for the Primary System, the analysis in Figure 16 illustrates the outcome of projecting the current $200 million annual investment. In addition, the analysis shows the projected amount of investment needed to achieve the proposed target of 82 percent for routes with AADT ≥ 3,500, and to maintain the current 60 percent sufficiency level where AADT < 3,500. As previously noted, the Secondary System at 100,578 lane miles is the largest system in the pavement inventory. The working group recommended the higher volume Secondary System lanes miles, with AADT ≥ 3,500 and 5% of the Secondary System inventory (approximately 5,000 lane miles), have the same performance or user experience as the Primary System.

In order for the 60 percent performance target and the 3,500 AADT tiered approach (82 percent performance target) to be achieved each year, the annual investment for the Secondary System will need to be $225 million in years 1-6 and $203 million in years 7-20. The $25 million additional investment in the first 6 years will assist in increasing performance to 82 percent sufficient on the Secondary System where AADT ≥ 3,500 (approximately 5,000 lane miles).

FIGURE 16 20-Year Outlook for Secondary System: Estimated Investment Needed for Meeting Sufficiency Target



2.8 SUMMARY – PAVEMENTS

To implement the Board performance targets adopted in December 2019 and a sustainable long-term pavement program, the short-term Maintenance and Operations Program and State of Good Repair Program allocations for pavements will:

- Invest the allocation needed for the Interstate and Primary Systems to reach the target of 82 percent sufficiency.
- Shift $15 million in allocations to the Secondary System to improve the condition of the 3,500 AADT or higher routes and maintain the rest at 60 percent sufficiency.

In the long-term, achieving and maintaining the new performance targets would require an additional $38 million for the first 6 years of implementation (shown in parenthesis in Figure 17). The Interstate System is projected to meet or exceed the 82 percent performance target with no additional investment for the next 10 years (2029) and the Primary and Secondary Systems' pavement would be maintained or improved. For comparison, an additional annual investment of $61 million for the next 6 years would be required to meet the prior Board performance targets. To optimize the overall network performance, VDOT will take a statewide approach to pavement allocation based on assessed need, which differs from past practices that have directed funds to address specific parts of the system ("worst of the worst").

FIGURE 17 Difference Between Investment ($425M) vs. Cost to Achieve Current or Proposed Targets

Targets, % Sufficiency			Average Total Cost per Year, $ Millions					
			Years 1-6			Years 7-20		
Interstate (IS)	Primary (PR)	Secondary (SC)	IS	PR	SC	IS	PR	SC
Current Targets			88	171	227	111	193	203
82%	82%	65%		$486			$507	
		Cost differential to investment:		($61)			($82)	
Revised Targets			88	150	225	111	185	203
82%	82% for ≥ 3,500 AADT 75% for < 3,500 AADT	82% for ≥ 3,500 AADT 60% for < 3,500 AADT		$463			$499	
	Cost differential to current investment:			($38)			($74)	

Current Policy Proposed Targets ***All amounts in 2019 dollars**

2.9 IMPLEMENTATION CONSIDERATIONS

As these new targets are implemented, there are several specific items that VDOT will implement and consider.

ALLOCATION BASED ON NEED

To optimize overall pavement performance, VDOT will take a statewide approach to pavement allocation based on assessed need.

MAINTAINING INDUSTRY

When considering a needs-based process to allocations, VDOT will evaluate inclusion of a floor and/or ceiling of funding levels to the nine construction districts. These may be used so that the sustainability of the local paving industry can be assured. This aligns with similar requirements in the distribution of the SGR Program.

GRADUAL ACHIEVEMENT OF TARGETS

For the Interstate and Primary Systems, achievement of the new targets, which are below current condition levels, are predicted to be realized gradually during the next decade. As this occurs, VDOT can continue to carefully consider the right asset management decisions to ensure that upon reaching the targets, the new condition levels can be maintained.

ANNUAL REPORTING

VDOT will report to the Board annually on the progress against the performance targets in this document.

Paving Operations, Virginia Beach – VDOT, 2012

2.10 FUTURE PROCESS ENHANCEMENTS

Following the comprehensive review process, there are other areas of continuous improvement that VDOT will continue to focus on, in addition to implementing the new targets.

REVIEW OF NO CCI<35 CRITERIA FOR INTERSTATES

The working group will continue to analyze whether the no CCI less than 35 for Interstate System pavement is an effective and efficient measure for failure.

REVIEW OF FREQUENCY OF PAVEMENT RATING

The working group will also further consider the current process for collecting data on the Secondary System. VDOT currently measures 20 percent of the Secondary System each year, completing a full inventory assessment every 5 years.

CONTINUE TO RESEARCH INNOVATIVE PAVEMENT TECHNIQUES

The working group will continue to conduct and support studies of emerging methods and technologies to further improve the accuracy of estimation and predictions. VDOT is an active participant in several ongoing research activities in this area with various state and national transportation organizations, including Virginia Transportation Research Council (VTRC), Transportation Research Board (TRB), and AASHTO (America Association of State Highway and Transportation Officials). Recent research activities include assessing the potential of ground penetrating radar and traffic speed deflectometer as a tool for pavement structural evaluation for better assessment of overall pavement condition. Also, the working group will continue research in materials, techniques and applications that extend the life of pavements.

3 STRUCTURES

The aging of structures is a national concern and the greatest challenge facing VDOT's highway structures.

3.1 STRUCTURE INVENTORY

VDOT maintains an inventory of 21,173 bridges and large culverts, including 13,592 National Bridge Inventory (NBI) structures and 7,581 non-NBI structures across Virginia. The NBI bridges are longer than 20 feet and are required to be reported annually to the Federal Highway Administration (FHWA) by all states. In addition, VDOT maintains large culverts with waterway openings greater than 36 square feet and has incorporated these structures into the agency's structure inspection and safety program. Figures 18 and 19 below show the distribution of structures across the Commonwealth, and representative images of the types of structures VDOT operates and maintains.

FIGURE 18 Map of VDOT Structure Inventory

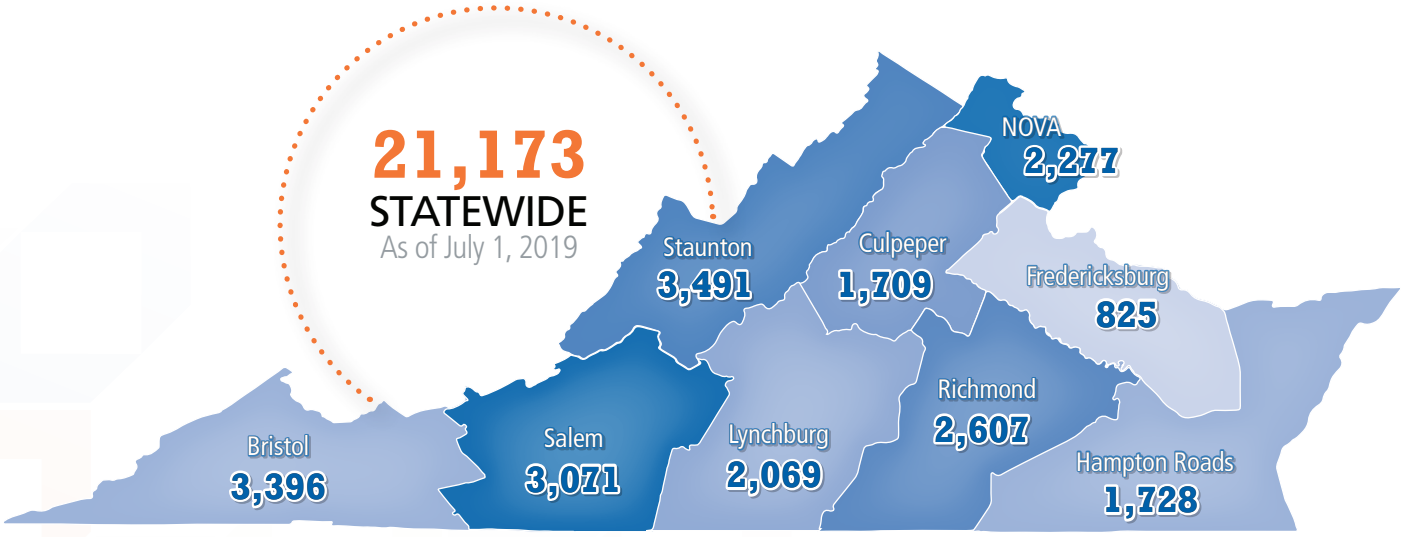


FIGURE 19 Structure Inventory – by Type

Bridge Work, Morgan Ford Road Bridge – VDOT, 2017

3.2 DATA COLLECTION OVERVIEW

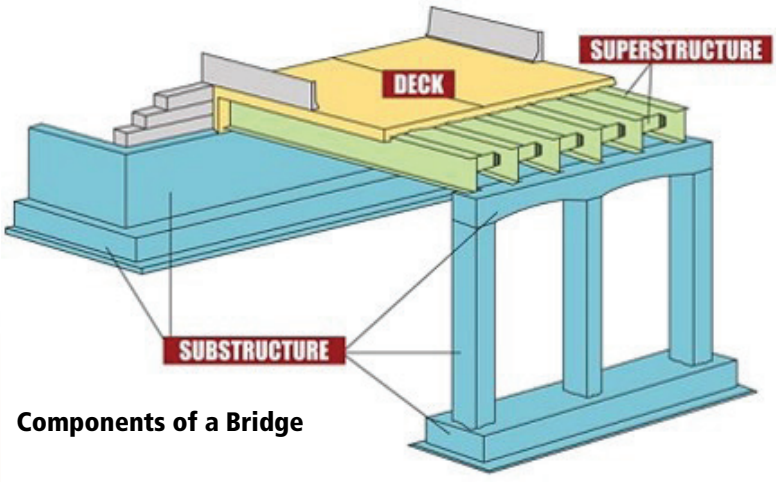
VDOT's structure inspection practices comply with federal requirements. Most structures are inspected on a 2-year cycle (biennially). Those with a rating of "poor" are inspected annually or more often. Inspections are performed in accordance with FHWA National Bridge Inspection Standards (NBIS). Under the NBIS, FHWA holds the Commonwealth responsible for the inspection of public highway structures to ensure the safety of the traveling public. When inspectors find safety issues or structural concerns, action is immediately taken to post weight limits, detour traffic, and repair these structures as appropriate.

Structure safety inspectors provide a General Condition Rating (GCR), shown in Figure 20 with example conditions pictured in Figure 21, for each component of a bridge, based on a rating scale from 0 to 9. A bridge has three components – the **deck, superstructure**, and **substructure** – while a culvert only has one component (the culvert).

"Poor" is defined as a bridge or culvert having one of the components rated with a general condition rating of 4 or less. *"Poor" DOES NOT mean the structure is unsafe,* it means it must be monitored, inspected and maintained. It may mean that the bridge may have restricted load capacity. Currently of the 21,173 structures, 20,380 are in fair or better condition (approximately 96 percent), and thus are not "poor."

FIGURE 20 Structure Rating Overview: General Condition Rating (GCR) and Components of a Bridge

Condition Category	General Condition Rating (GCR)	Description
Good	9	Excellent
	8	Very Good
	7	Good
Fair	6	Satisfactory
	5	Fair
Poor (Structurally Deficient)	4	Poor
	3	Serious
	2	Critical
	1	Imminent Failure
	0	Failed



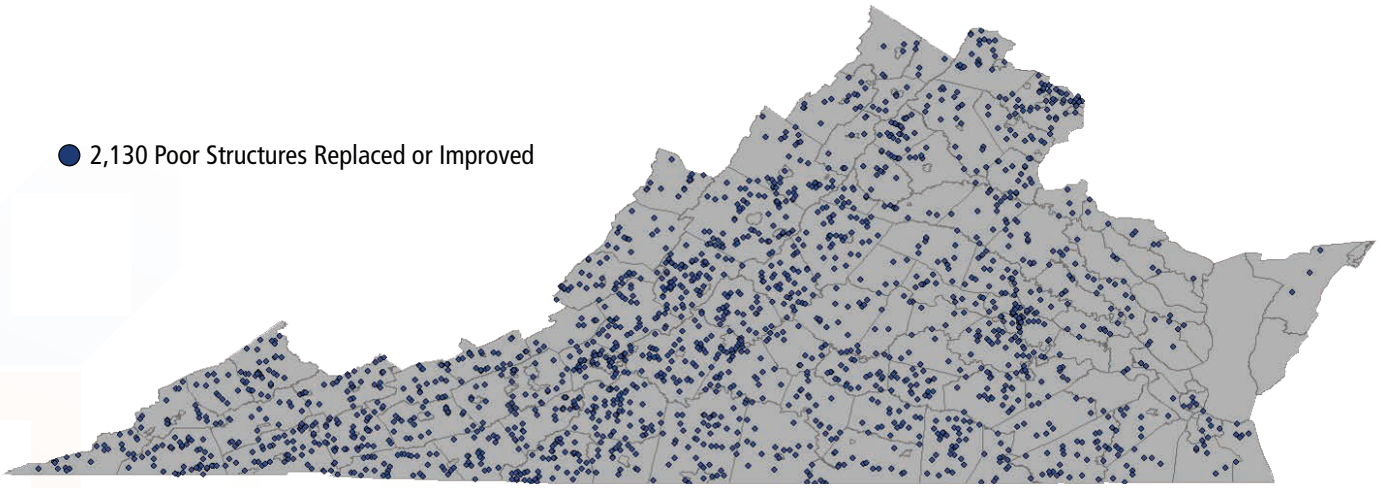
Components of a Bridge

FIGURE 21 Examples of Good, Fair, and Poor-Rated Structures

3.3 CURRENT PERFORMANCE

Since 2010, the Board has focused on improving "poor" structures and VDOT has rehabilitated or replaced 2,130 "poor" structures. The number of "poor" structures has reduced from 1,716 in 2010 to 793 today. The inventory of bridges and culverts across the Commonwealth has an annual attrition rate (structures becoming "poor") of approximately 0.6 percent (133 structures). In 2018 this was off-set by 174 "poor" structures being repaired. The locations of the structures rehabilitated or replaced since 2010 are shown as blue dots in Figure 22.

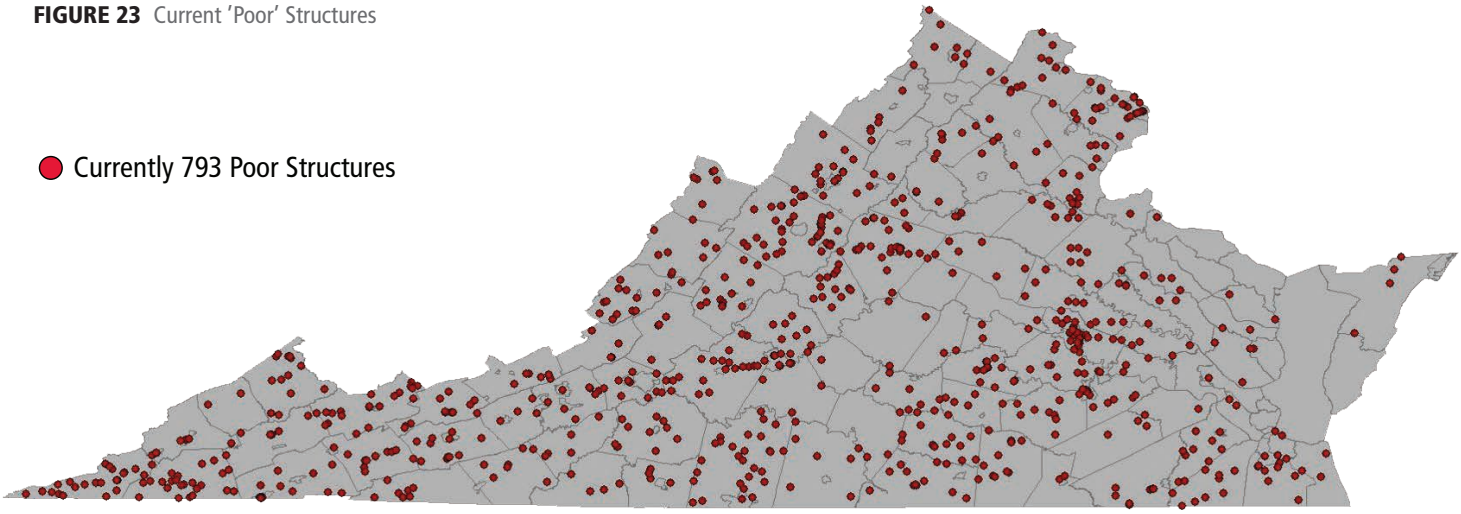
FIGURE 22 'Poor' Structures Improved Since 2010



2019 "POOR" STRUCTURES

Currently, Virginia has 793 structures rated in "poor" condition. Their distribution is as shown in Figure 23 as red dots. A majority of these structures are scheduled for future improvement.

FIGURE 23 Current 'Poor' Structures

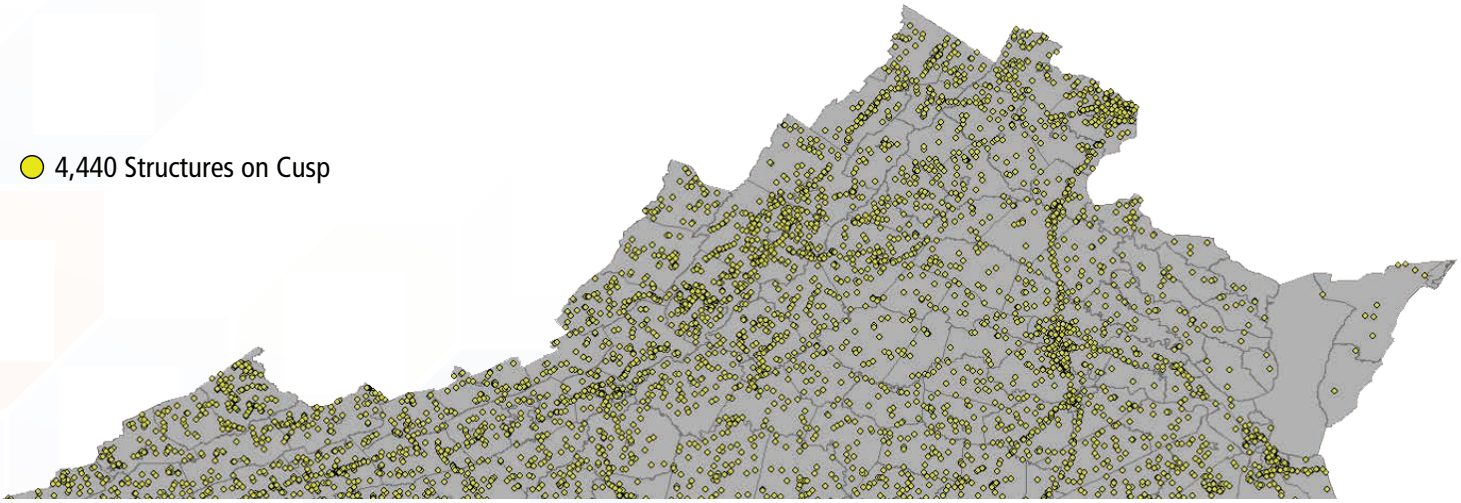


2019 STRUCTURES ON THE "CUSP"

There are currently 4,440 structures with one or more components with a GCR of 5, meaning they are one inspection rating from that component (and hence the entire structure) being rated "poor." These structures are shown as yellow-green dots in Figure 24. The map shows a concentration of dots along the Interstates, which indicates a need to focus resources on these structures.

The average age of these "cusp" structures is 62 years. Most structures within the "cusp" rating can be rehabilitated and preserved at approximately 15% of the cost of replacement. Investments in preservation of cusp structures has the ability to provide a higher condition rating and the potential for additional service life.

FIGURE 24 Current Structures on the "cusp" of 'Poor'



3.4 HISTORIC BOARD PERFORMANCE TARGETS

The performance measure for VDOT structures has historically been the percentage of structures in each roadway system (Interstate, Primary or Secondary) to be above a "poor" rating. The previous structure targets are 99 percent for Interstate System, 96 percent for Primary System, and 94 percent for Secondary System.

The Board also established a target of maintaining 95.5 percent of all NBI structures above the "poor" rating. The current performance of the systems exceeds current targets, as shown in Figure 25. The Primary and Secondary Systems both exceed current targets, while the Interstate System is just 0.1 percent below the target.

FIGURE 25 Previous Structures Targets and Current Performance Across Systems as of July 1, 2019

System	Board Performance Targets Until December 2019 (% Non-poor)	Current Condition (% Non-poor)
All Systems	95.5%	96.3 %
Interstate	99%	98.9 %
Primary	96%	96.9 %
Secondary	94%	95.7%

Boydton Plank Road (Route 1) Bridge Repairs, Dinwiddie – VDOT, 2017

ANALYSIS DETAILS: ALTERNATIVE PERFORMANCE MEASURES

The traditional metric for measuring structure condition has been to calculate the percentage of "poor" and report the percentage of the structures in each system that are non-poor. There are a number of advantages and disadvantages to this approach, including the consequence of incentivizing a "worst-first" approach. As part of this comprehensive review, the working group assessed other options for measuring structure condition.

DISADVANTAGES OF USING "POOR" TO MEASURE PERFORMANCE:

- The cost to replace bridges rather than rehabilitate exceeds available funding
- "Poor" are < 4% of the inventory. This performance reporting does not address the other 96% of bridges
- National trends are toward system preservation and using broader measurements

ADVANTAGES OF USING "POOR" TO MEASURE PERFORMANCE:

- Consistent with previous national conventions for bridge condition
- Easy for the public to understand
- Provides impetus to address bridges in worst condition

The working group focused on performance indicators that:

- Give an overall assessment of the entire structure inventory; and
- Incentivize the best value long-term (sustainable) approach.

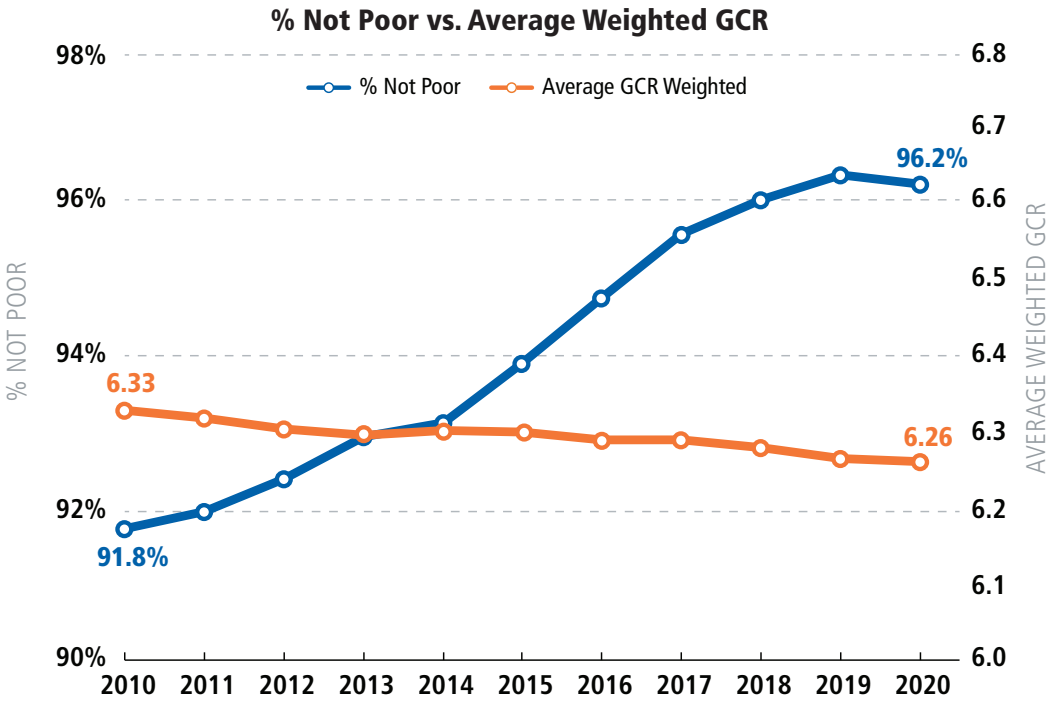
To enhance investment decision-making, the working group investigated the option of applying a weighting to each structure. Several weighting metrics were considered (such as traffic volume (AADT) and structure deck area).

The working group reviewed weighting metrics used in other related programs including the SGR Program. The SGR Program importance factor, developed by the Virginia Transportation Research Council, was recommended by the working group. This importance factor assigns a relative importance to each structure on a 0 to 1 scale based on a number of sub-factors.

3.5 PREVIOUS PERFORMANCE

As shown in the upcoming Figures 29 – 31, since 2014-2019, VDOT spent $2.4 billion total, or an average of $400 million annually, to maintain and preserve structures. A vast majority of the $2.4 billion applied to only 10 percent of its inventory, addressing the "worst of the worst." However, as VDOT has worked to address this 10 percent of "poor"-rated structures, the overall condition (measured by Average Weighted GCR) of the inventory as a whole has slowly deteriorated, as shown in Figure 26.

FIGURE 26 Structures Overall Inventory – Historical Condition



There are a number of costs that are required to manage these structures that do not contribute to maintaining or improving the condition of the asset (non-performance impacting costs). These costs are presented in Figure 27.

FIGURE 27 Overview of Current (FY 2020) Investment Needs and Non-performance impacting Costs of Structures in 2019 dollars

Current Investment	**Maintenance and Operations**	$215M
	State of Good Repair	$225M
	Total	$440M
Non-performance Impacting Costs	**Inspection (Federal Requirement)**	($38M)
	Routine Maintenance	($10M)
	Emergency Work	($8M)
	Total	($56M)
	TOTAL AVAILABLE	**$384M**

3.6 ANALYSIS UNDERTAKEN

Projections show that deterioration of most structures will accelerate as they age. The average age across VDOT's structures inventory is currently 50 years, which is the same number of years as the anticipated design service life for most structures as stated in Section 3.0. Therefore, the working group's analysis focused on a "preservation first" approach. The preservation first approach will assist in "recovering" the system, create an opportunity to improve the long-term outcome and have an impact on future generations. Accomplishing a preservation first approach is the appropriate business model and can be obtained at current levels of investment by using preventative technology and techniques.

During 2018-2019, the working group conducted a review of the overall condition of the structures inventory and analyzed options to define a sustainable, long-term approach to improving management and investment in the structure program. Major work components of this analysis included: replace, rehabilitate, repair, and preserve. The analysis included:

- **Historical Performance:** *What has VDOT spent? How did that influence performance?*
- **Evaluation of Time Periods:** *What is the best time period to understand the full lifecycle of an asset through to replacement?*
- **Cost to Maintain Performance:** *What it would take to sustain current performance levels?*
- **Alternative Preservation First Approach:** *What can be achieved with an optimized long-term solution?*

One assumption consistent across all analyses was the exclusion of Special Structures from the analysis. These structures are in Section 4.0 of this report.

3.7 INVESTMENT SCENARIOS – COSTS, OUTCOMES, AND TARGETS

Investment scenarios were considered in two phases as follows:

- **Current Investment vs. Required Investment to Maintain "Poor" Targets**
  These scenarios were presented over a 20-year outlook. They assumed the current approach to allocations, and a focus on "poor" structures continues.
- **Current Investment with Alternative Approaches**
  This 50-year outlook compares two work planning approaches (the current approach and a preservation first approach).

CURRENT INVESTMENT VS. REQUIRED INVESTMENT TO MAINTAIN "POOR" TARGETS

The 20-year projection (see Figures 29-31) for this approach predicts a decline in performance as current investment levels struggle to keep up with aging and deterioration.

There are three key elements to the figures:

- The blue bars and line indicate the past expenditure and performance outcomes.
- The orange bars and lines represent the predicted outcomes based on the FY 2020 level of investment. The outcome is presented as a band of performance to reflect a range of possible solutions based on a variety of assumptions for potential treatment types. Actual performance is expected to fall within this band.
- The green bars and line indicate required funding levels to maintain current "non-poor" targets.

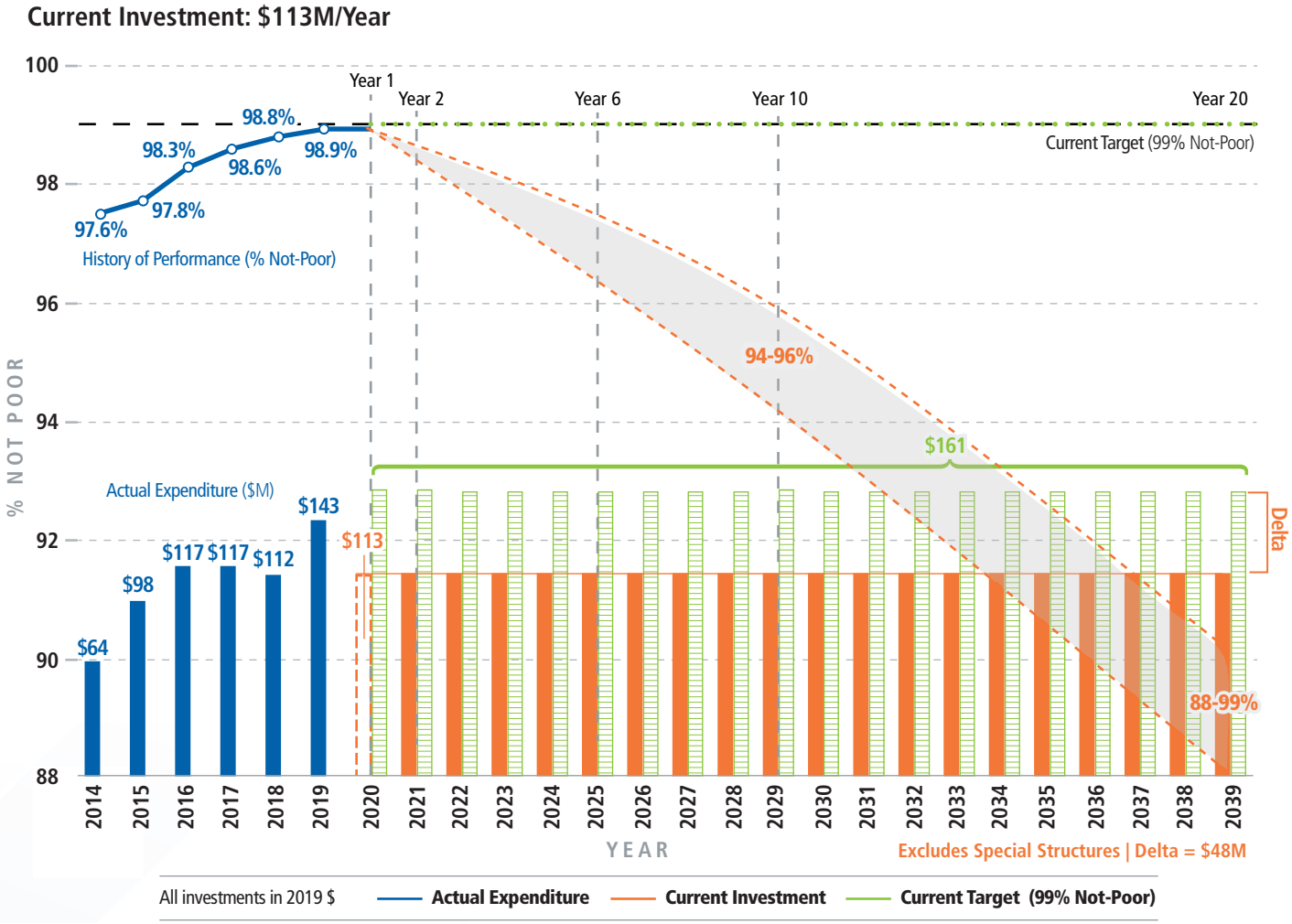
Route 360 Bridges – VDOT, 2015

INTERSTATE SYSTEM

The performance of the Interstate System is currently benefitting from a higher level of investment in FY 2016 – FY 2019 (see Figure 28). Current performance is 98.9 percent "non-poor."

The green bars and lines in the figure below show the projected amount of investment needed to achieve and sustain the current target of 99 percent for 20 years or a projected $161 million per year for Interstate System structures. This compares to a planned allocation of $113 million.

FIGURE 28 20-Year Outlook for Interstate System: Estimated Investment Needed for Meeting Sufficiency Target

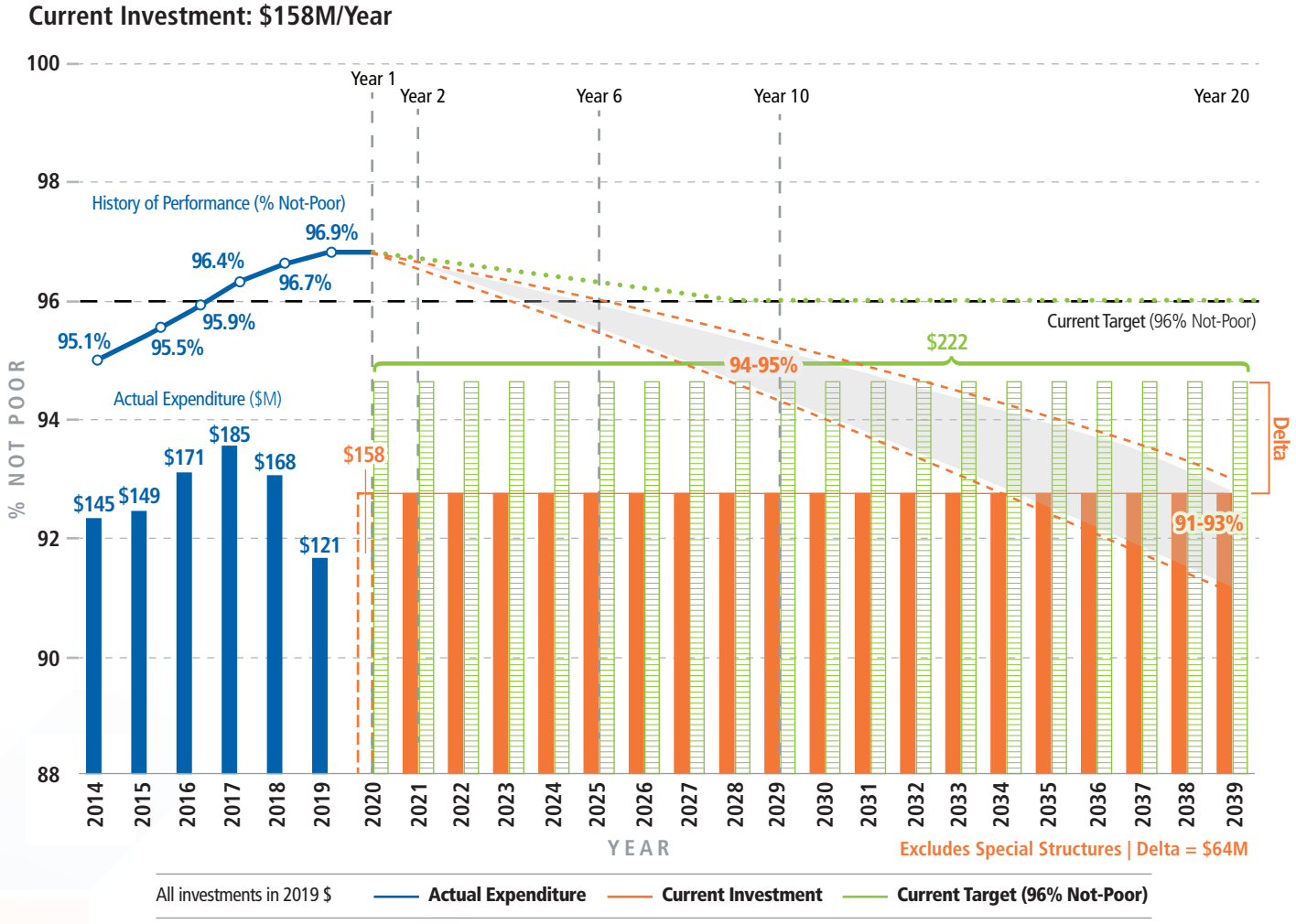


PRIMARY SYSTEM

Primary System structures performance has also benefitted from higher levels of investment in FY 2016 - FY 2019 (see Figure 29). This investment has steadily improved conditions and enabled the achievement of 96.9 percent performance on the Primary System.

The green bars and lines in the figure below show the projected amount of investment needed to sustain the current target of 96 percent using the approach of focusing on "poor" structures, which amounts to $222 million per year compared to a planned allocation of $158 million.

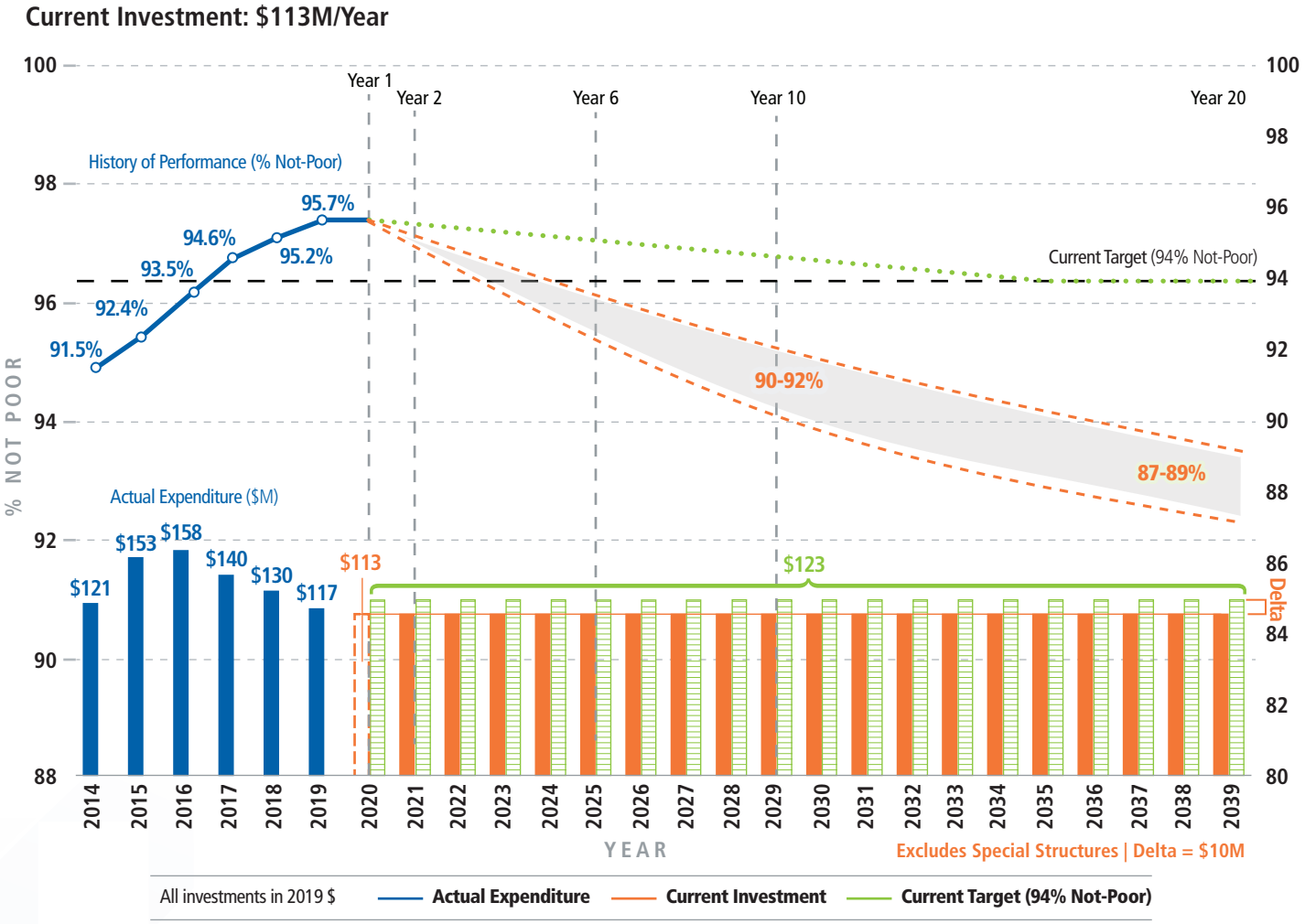
FIGURE 29 20-Year Outlook for Primary System: Estimated Investment Needed for Meeting Sufficiency Target



SECONDARY SYSTEM

The condition of the Secondary System has also continued to rise in recent years (see Figure 31). The green bars and lines in Figure 31 show the projected amount of investment needed to sustain the current target of 94 percent using the approach of focusing on "poor" structures, which amounts to $123 million per year compared to a planned allocation of $113 million.

FIGURE 30 20-Year Outlook for Secondary System: Estimated Investment Needed for Meeting Sufficiency Target



CURRENT INVESTMENT WITH ALTERNATIVE APPROACHES

The 50-year analysis considers that the average age of VDOT's structures will be approximately 91 to 99 years old by the end of this timeframe. In the 50-year modeling, the assumption was made that 75 percent of the allocations would be used for preservation activities while 25 percent would be allocated to replacement. The model output indicates that over the 50-year period, a recommended treatment can be implemented on 88 to 98 percent of structures. This is compared to 50 percent of structures being treated through the current approach.

With a 50-year investment plan implementing the preservation approach, VDOT can sustain an acceptable level of service for 50-years at current investment levels while extending the useful life of these structures and stabilize the structure conditions overtime to create long-term sustainability for generations to come. The preservation first approach assumes a quick implementation period and may need further refinement (and potentially additional investment) for delays as the window of opportunity to preserve or rehabilitate closes on these aging structures.

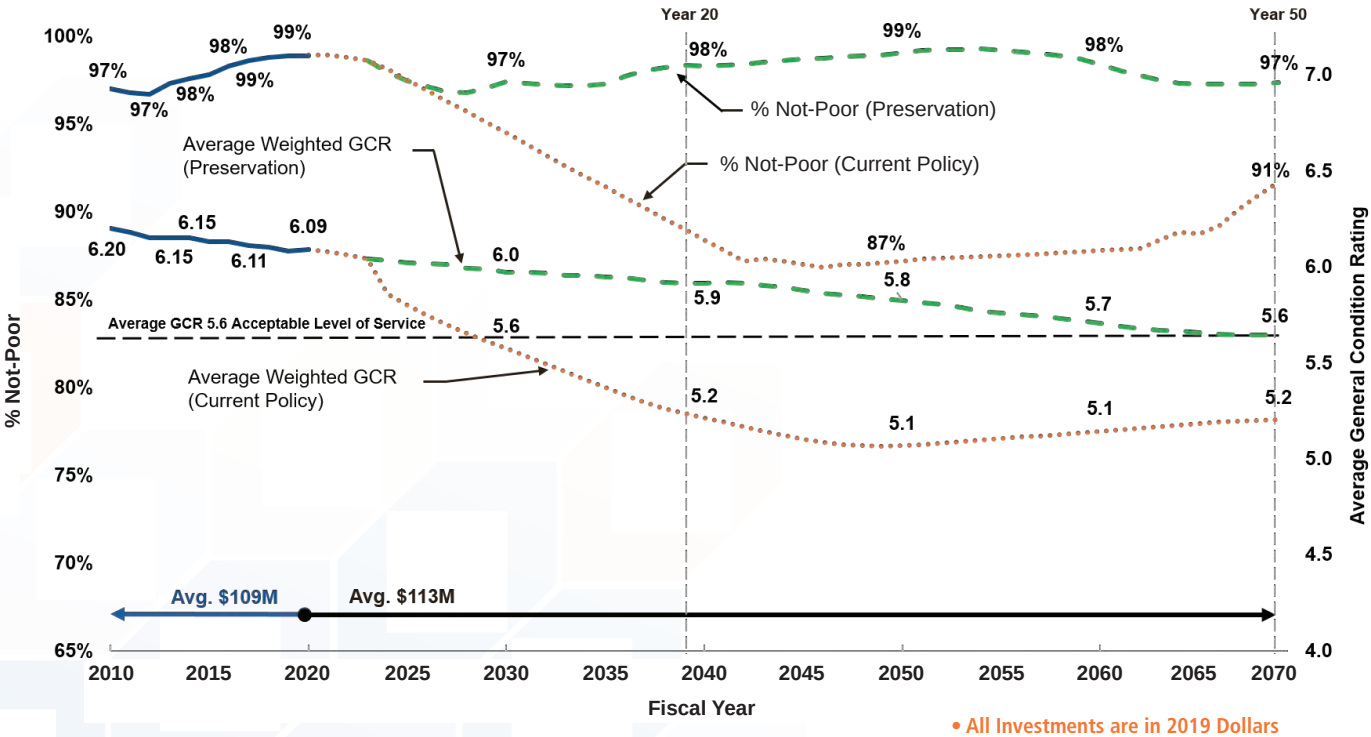
The findings of the 50-year outlook analyses across networks is shown on the figures in the following pages. Across all analyses, the current level of funding is assumed. There are three key elements to the Figures 31 - 33:

- The blue lines indicate the past condition outcomes.
- The orange lines represent the current approach ("worst first").
- The green lines show the "preservation approach" (75 percent preservation/rehabilitation, 25 percent replacement).

INTERSTATE SYSTEM

FIGURE 31 50-Year Outlook for Interstate System: Estimated Investment Needed for Meeting Sufficiency Target, No Posted Structures

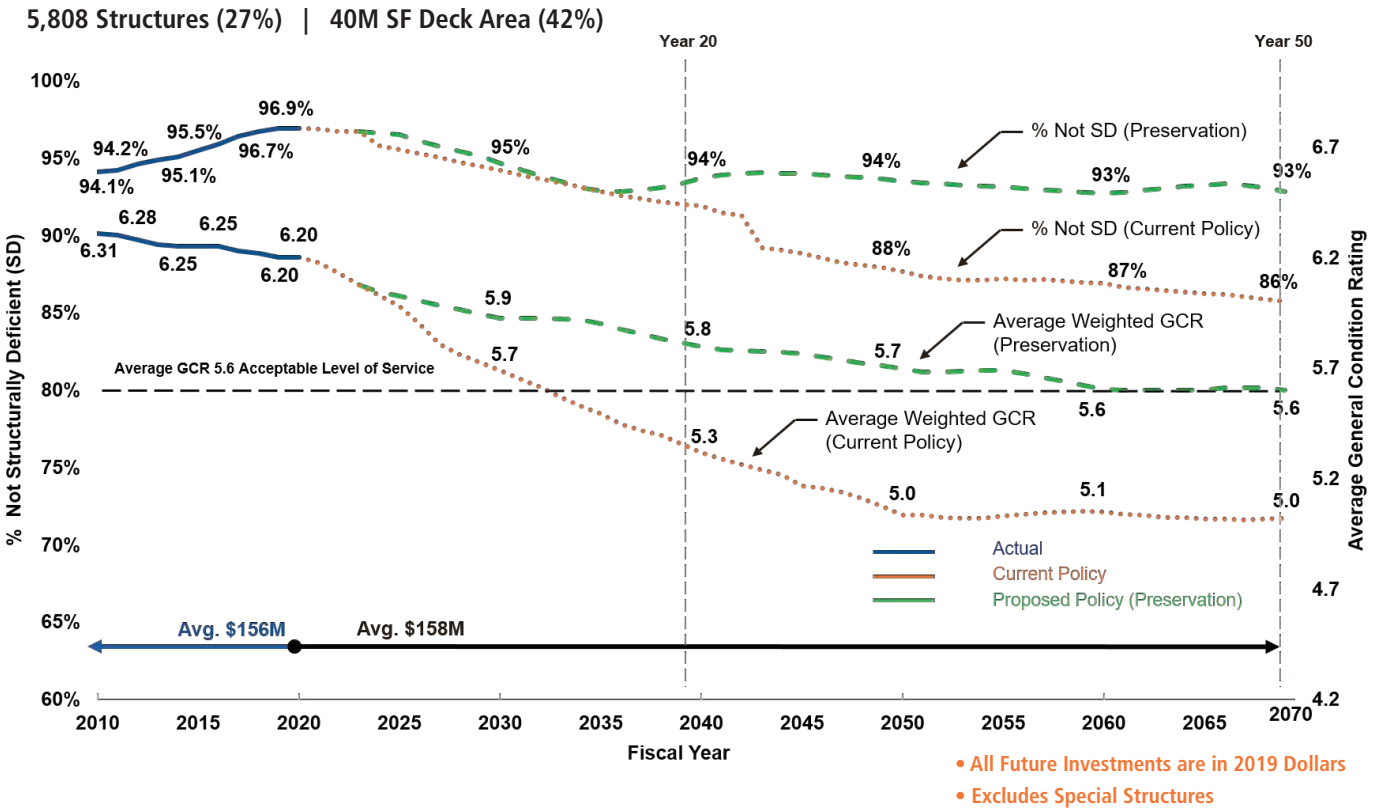
2,404 Structures (12%) | 26M SF Deck Area (28%)



- All Investments are in 2019 Dollars
- Excludes Special Structures

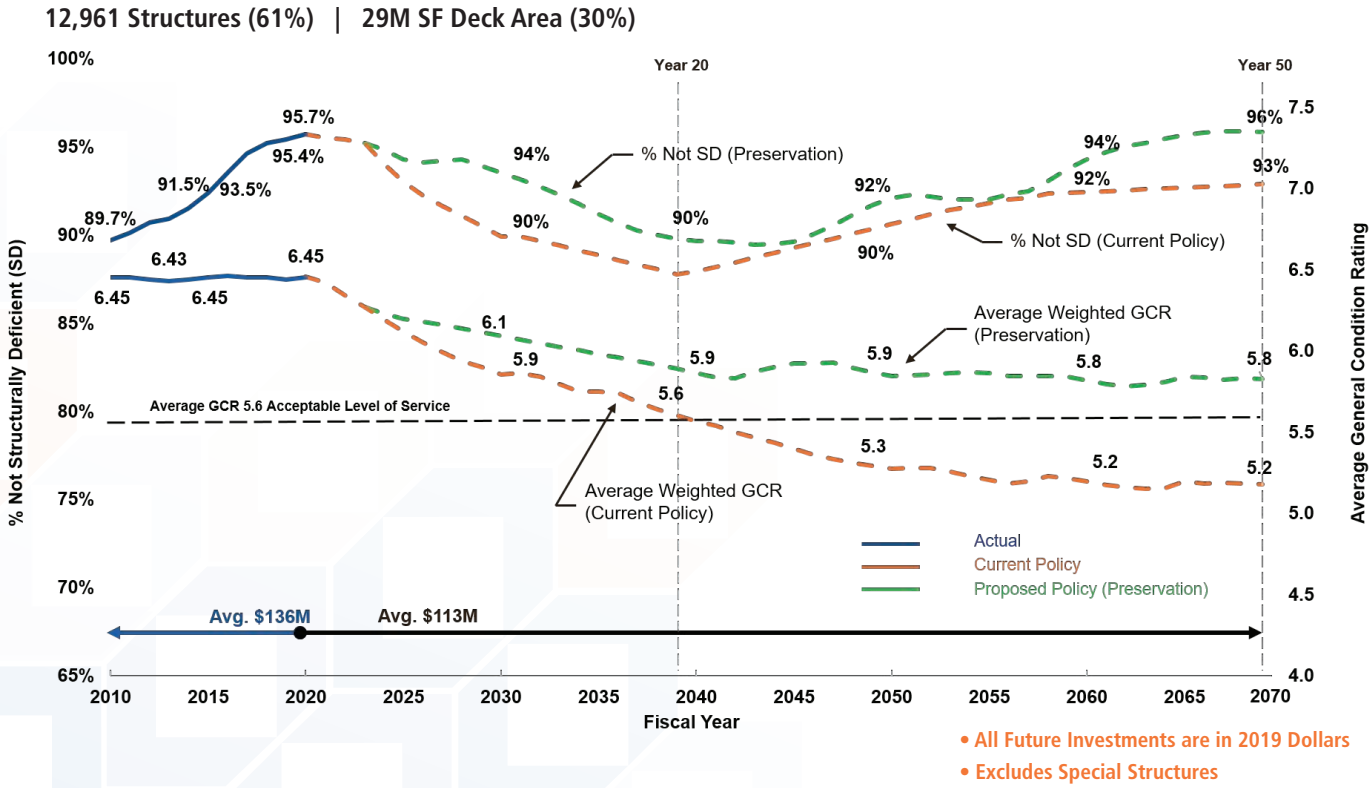
PRIMARY SYSTEM

FIGURE 32 50-Year Outlook for Primary System: Estimated Investment Needed for Meeting Sufficiency Target



SECONDARY SYSTEM

FIGURE 33 50-Year Outlook for Secondary System: Estimated Investment Needed for Meeting Sufficiency Target



In each scenario, the percentage of 'non-poor' structures reduces over the medium term (10-20 years). After this time, the benefits of the preservation first approach are realized as the percentage of "non-poor" increases without the need for additional investment.

For each system, the Average Weighted GCR decreases from current levels; however, with the preservation approach, it is minimized and stabilized. The analysis found that for each system, it is possible to keep the Average Weighted GCR rating above 5.6.

PRESERVATION FIRST – FOCUS ON CUSP

Currently, the SGR Program legislation require that the funding be used only for "poor" structures (on any systems) and deteriorated Interstate and Primary System pavements. As detailed in this report, Virginia can sustain its structures inventory over the long term with current funding levels if it makes significant changes in its approach. Specifically, the emphasis going forward should be on preservation of structures that are not yet "poor" over the partial or full replacement of structures after they become "poor." In order to execute this change, funding from the SGR Program would need to be available for work on structures that are well-positioned for preservation, repair, and rehabilitation. VDOT intends to request legislation no later than the 2021 General Assembly session to authorize this use of SGR Program on "cusp" bridges.

In general, the best candidate structures for rehabilitation and preservation as opposed to replacement are those that are on the "cusp" of structural deficiency. There is no single definition for cusp structures, but in general, they can be defined as structures with a minimum general condition rating of 5. This report references 4,440 cusp structures, which represents all structures in the inventory with a minimum general condition rating of 5, except for concrete culverts and Special Structures. Concrete culverts follow a different pattern of deterioration, as they can be sustained in fair condition (GCR 5) for decades. Accordingly, they have been precluded from the list of structures that can reasonably be considered as cusp. Special structures are addressed in Section 4.

3.8 SUMMARY – STRUCTURES

From FY 2014–FY 2019 (as shown in Figures 27 - 29), the average investment in structures was approximately $300 million per year. The projected investment available for maintaining and improving structures is $384 million. In evaluating how to create a long-term sustainable structure program, the working group concluded:

- Continuing to use current performance targets, a 20-year view, and a focus on "poor" structures would require an additional $122 million per year to sustain;
- A change to a preservation first approach and a 50-year view is projected to result in a medium-term drop in achieving performance targets (e.g. percentage "poor"); however, over the long term, structure condition and performance are stable with no change in allocation levels;
- A long-term approach focused on more efficient lifecycle maintenance based on Average Weighted GCR will provide an improved indicator of condition and ultimately improved condition for the entire VDOT structures inventory. The 50-Year target is to keep the Average Weighted GCR at or above 5.6.
- In order to achieve this outcome, it will be necessary for the percentage of "non-poor" structures to be managed to a lower level before it will rise again over time. New targets for percentage 'non-poor' will be:
  - *Interstate System – 97%, No structures will have weight limit postings.*
  - *Primary System – 93%*
  - *Secondary System – 90%*

Figure 34 provides a summary of the costs, targets, and projections associated with both the current approach and the revised "preservation first" approach.

FIGURE 34 Summary of the Cost to Achieve Current Targets and the New Preservation First Approach

Investment: $384M per year

***All amounts in 2019 dollars**

Performance Targets, % "Non-Poor" and Weighted Average GCR				Average Total Cost per Year, $ Millions		
				Years 1-50		
IS	PR	SC	Network Weighted Average GCR	IS	PR	SC
Current Targets and Approach				**$161**	**$222**	**$123**
99% Non-Poor	**96%**	**94%**	**N/A**		**$506**	
			Cost Differential to investment:		**($122)**	
Revised Performance Targets and Preservation First Approach				**$113**	**$158**	**$113**
≥97% No Postings	**≥93%**	**≥90%**	**Average GCR ≥ 5.6**		**$384**	
			Cost Differential to investment:		**$0**	

3.9 IMPLEMENTATION CONSIDERATIONS

IDENTIFYING ALL PRESERVATION ACTIVITIES

The move to a "preservation approach" requires further consideration of how these preservation activities will be tracked. VDOT will define this process and monitor the outcomes annually to ensure that it is achieving the intended results.

FUNDING FOR CUSP (GCR 5) STRUCTURES

Currently, the SGR Program legislation require that the funding be used only for "poor" structures (all systems) and deteriorated Interstate and Primary system pavements. As detailed in this report, Virginia can sustain its structure inventory over the long term with current funding levels if it makes significant changes in its approach. Specifically, the emphasis going forward should be on preservation of structures that are not yet "poor" over the partial or full replacement of structures after they become "poor." But in order to execute this change, funding from the SGR Program would need to be available for work on structures that are well-positioned for preservation, repair, and rehabilitation. VDOT intends to request legislation no later than the 2021 General Assembly session to authorize this use of SGR Program on "cusp" bridges.

ANNUAL REPORTING

VDOT will report annually on progress against the performance targets in this document.

4 SPECIAL STRUCTURES

VDOT's assets include Special Structures which include tunnels, movable bridges, and complex structures. Special Structures have been the subject of a series of concerted efforts and reports over the past several years. VDOT's Business Plans have included provisions for the study, prioritization, risk assessment, and needs determinations for the Special Structures.

In December 2018, VDOT published a report to satisfy requirements of Chapter 2 of the 2018 General Assembly Item 450, H, which required the Board to report on the overall condition, funding needs, and recommendations for addressing funding within the SGR Program and other options with respect to Virginia's large and unique bridge and tunnel structures.[6] The report identified 25 structures that comprise the VITAL Infrastructure ("Very large, Indispensable, Transportation Asset List," now referred to as "Special Structures") and their conditions, and presented a 30-Year Plan. These structures were identified to proactively plan for their rehabilitation and replacement, many of which are approaching the latter years of their service life.

The Report concluded that the magnitude of the identified needs would adversely impact the SGR Program by effectively depleting the SGR Program and nearly eliminating the ability of the SGR Program to address deteriorated pavements and deficient structures — and in turn, the ability of the SGR Program to accomplish its intended purpose.

The Comprehensive Review working group developed a 50-year Long-Term Plan to determine the allocations needed defined by §33.2-1532 of the *Code of Virginia*, known as the *Robert O. Norris Bridge and Statewide Special Structure Fund ("the Fund")*.[7] The Fund is for the maintenance and replacement of Special Structures (unique structures), as determined by the Board.

As part of the comprehensive review conducted this year, VDOT also commenced a feasibility assessment of potential public-private partnerships (P3) using the Public-Private Transportation Act of 1995 (§33.2-1800 et seq. of the *Code of Virginia*) to design, build, operate, maintain, and replace the existing Special Structures, including the Robert O. Norris and Downing Bridges, as required by the legislation.

Also, a Request for Information (RFI) was issued to seek input from the industry on opportunities to repair, replace, maintain, and operate seventeen Special Structures. This RFI is currently being explored under the Public-Private Partnership Transportation Act of 1995. The RFI responses were received on November 18 with 13 responses which are under review.

6 Virginia Department of Transportation, "2018 Appropriations Act, Item 450, H. – Final Report," December 2018.

7 General Assembly of Virginia. Virginia Acts of Assembly – 2019 Session, "Chapter 83; Relating to the Robert O. Norris Bridge and Statewide Special Structure Fund," March 12, 2019.

4.1 OVERVIEW AND INVENTORY

Of the 25 Special Structures (see Figure 35), 24 are on the National Highway System (NHS). Three Special Structures are maintained and operated by concessionaires. In 2025, the new tunnel constructed by the Hampton Road Bridge-Tunnel (HRBT) Expansion Project will also become a maintenance and operations responsibility for VDOT. As of 2019, VDOT maintained and operated 22 Special Structures, and may add these types of structures to its inventory, such as the new tunnel with the HRBT Expansion Project.

Special Structures (see Figure 36), include tunnels, movable bridges, and large complex fixed-span structures, as defined in the 2018 VITAL Infrastructure Report.[8] They are considered "special" due to their complexity, operations and maintenance costs, level of risk, and deemed importance. Determination of importance is based on factors including long detours, high traffic, economic significance (shipping and vehicular), and access to vital facilities including military facilities and ports.

FIGURE 35 Map of VDOT Special Structures Inventory

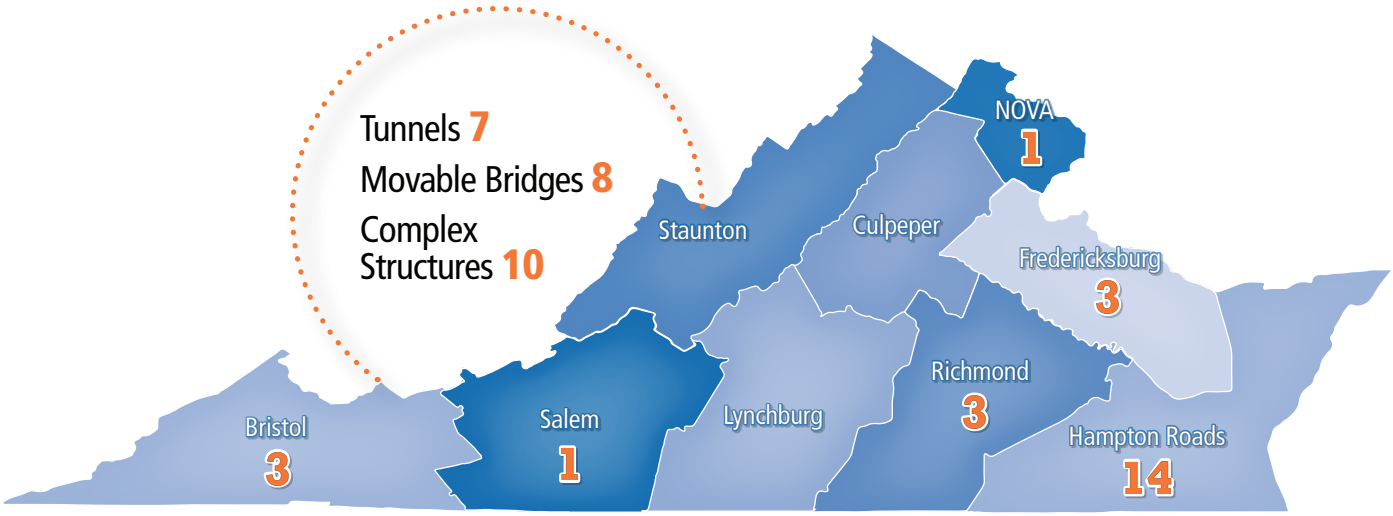
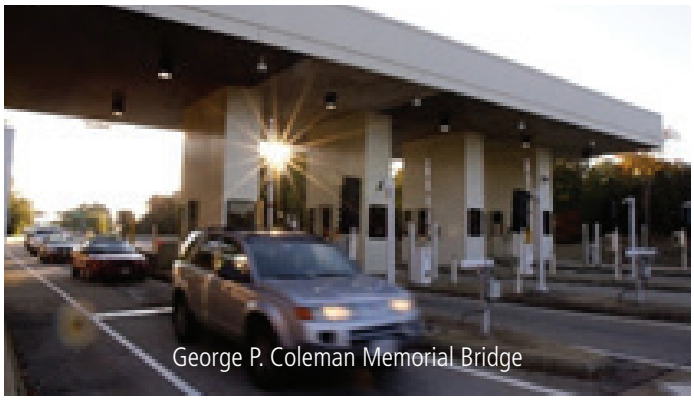


FIGURE 36 Special Structures Inventory

Complex Structures	Movable Bridges	Tunnels
Varina-Enon Bridge	John B. Whealton Memorial Causeway (Chincoteague Causeway)	Big Walker Mountain Tunnel
Robert O. Norris Bridge	High Rise Bridge	East River Mountain Tunnel
Hampton Roads Bridge-Tunnel Willoughby Bay	Berkley Bridge	Hampton Roads Bridge-Tunnel
Hampton Roads Bridge-Tunnel Approach Bridges	George P. Coleman Bridge	Monitor-Merrimac Memorial Bridge-Tunnel
Monitor-Merrimac Memorial Bridge-Tunnel Approach Bridges	James River Bridge	Elizabeth River Tunnel (Downtown)
James River Bridge Approach Spans	Benjamin Harrison Bridge	Elizabeth River Tunnel (Midtown)
High Rise Bridge Approach Spans	Eltham Bridge	Rosslyn Tunnel
Gordon C. Willis Smart Road	Gwynn's Island Bridge	
Pocahontas Parkway		
460 Connector		

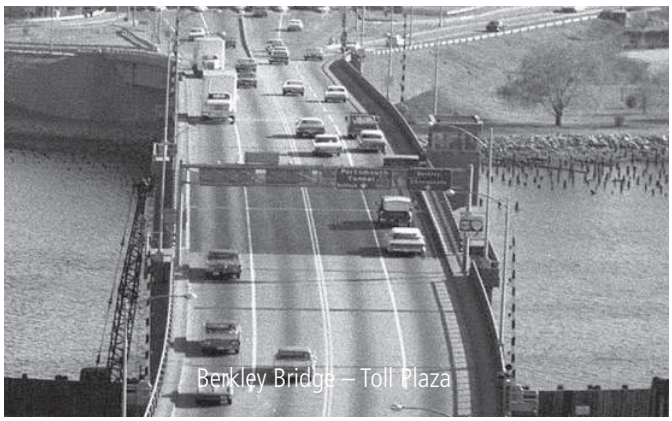
8 Virginia Department of Transportation, "2018 Appropriations Act, Item 450, H. – Final Report," December 2018.

Due to their complexity and size, many of these structures initially required special funding sources, such as tolling, for their construction and maintenance. Such examples include the George P. Coleman Bridge, Hampton Roads Bridge-Tunnel, Robert O. Norris Bridge, and Berkley Bridge.


George P. Coleman Memorial Bridge


Hampton Roads Bridge-Tunnel


Hampton Roads Bridge Tunnel Toll Booth


Berkley Bridge – Toll Plaza

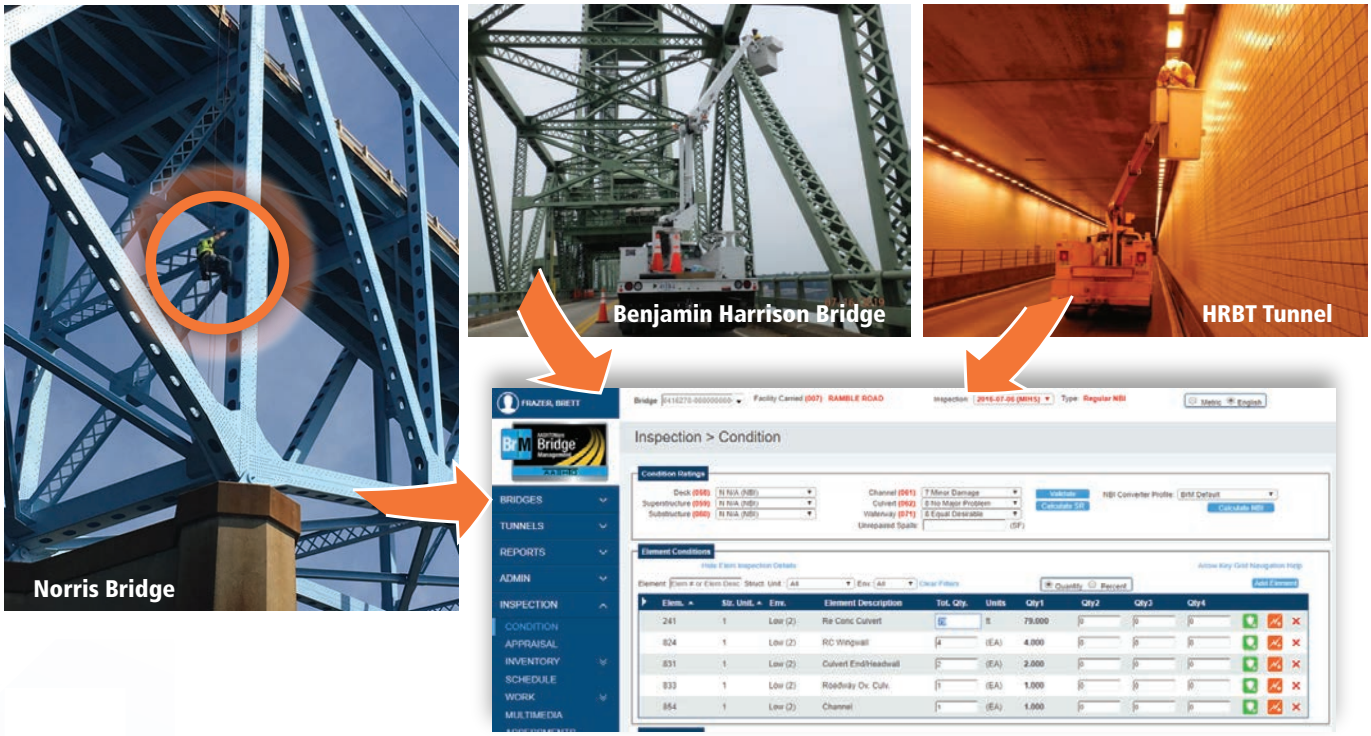
4.2 DATA COLLECTION OVERVIEW

VDOT inspects structures every two years based on federal requirements (see Figure 37). Complex Structures are inspected and assessed using GCR consistent with the process used for inspection of conventional bridges.

While some aspects of movable structures are inspected in a manner similar to conventional bridges, operational components of the movable structures do not have federal performance measures. VDOT includes all components in its inspection and assessment process.

Federal tunnel inspection requirements were not established until 2015. However, VDOT ensures inspections are conducted annually.

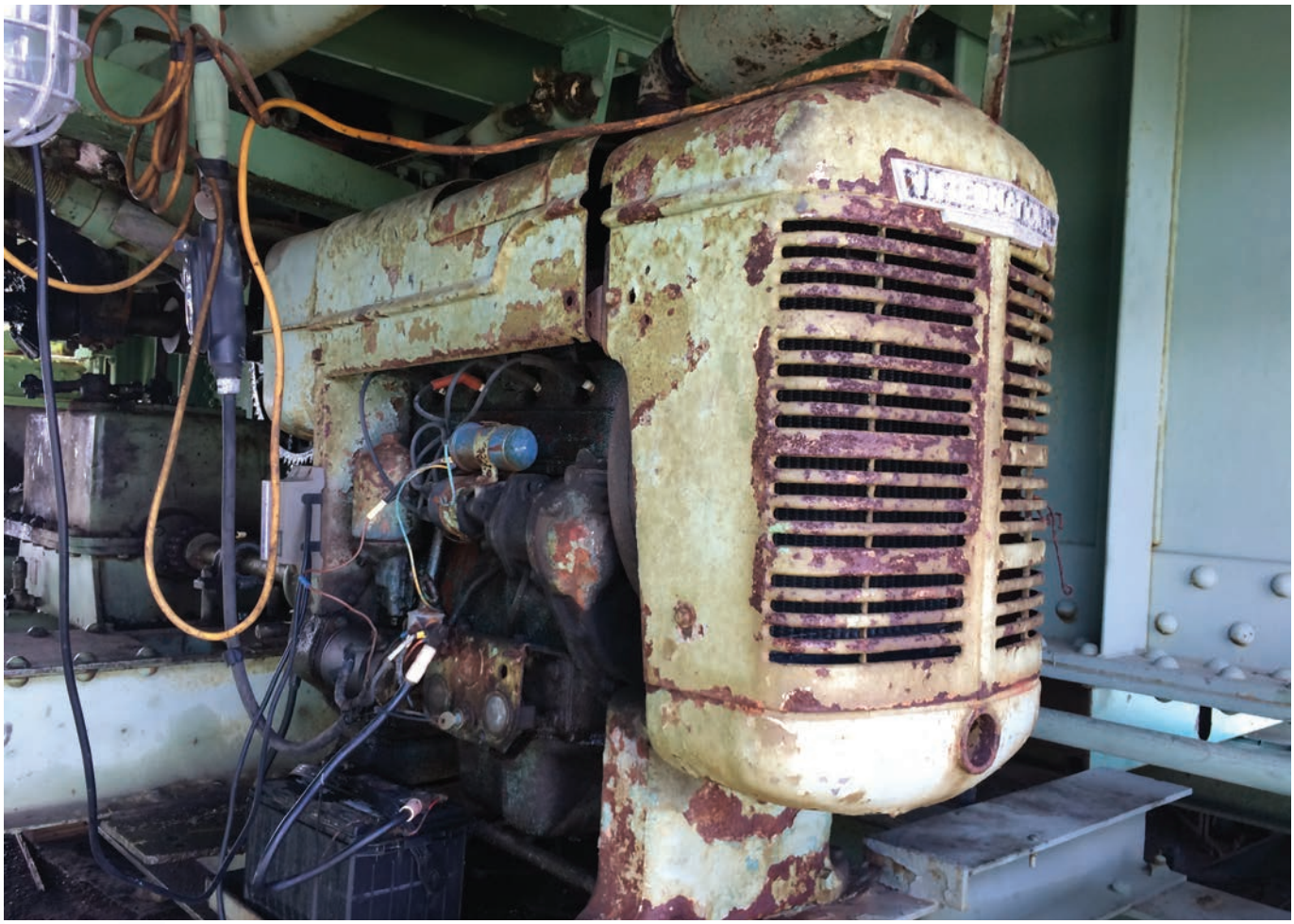
FIGURE 37 Special Structures Inspection



4.3 PREVIOUS EXPENDITURE AND FUTURE COST ASSUMPTIONS

VDOT has been spending an average of $50 million each year for the Special Structures inventory. Spending at this level has resulted in deferred work (see Figure 38, Gwynn's Island Generator) that needs to be completed to address maintenance, obsolescence, and operational needs.

FIGURE 38 Existing Gwynn's Island Generator



Three facilities are managed under a concession agreement: Pocahontas Parkway (Route 895) through 2105 and the Midtown and Downtown Elizabeth River Tunnels through 2069. While these three structures are not maintained and operated by VDOT currently, the concession agreement is a lease and thus once the term is over, the assets are returned to VDOT for maintenance and operation. This will require that the maintenance work and allocations required for these facilities be incorporated into the Special Structures 50-Year Long-Term Plan. At present, required funding for these three structures is not included in the 2019 50-Year Long-Term Plan as the dates are outside of the plan's time horizon.

The HRBT expansion project did not include work on the existing tunnel as such the 2019 Long-Term Plan includes a 50 year plan for the existing HRBT tunnel. The Special Structures 2019 50-Year Long-Term Plan has also considered the maintenance and operational needs for the new HRBT tunnel that is currently being designed and constructed. It is assumed that the responsibility for this structure will transfer to VDOT in FY 2025.

4.4 DEVELOPMENT OF THE SPECIAL STRUCTURES 2019 50-YEAR LONG-TERM PLAN

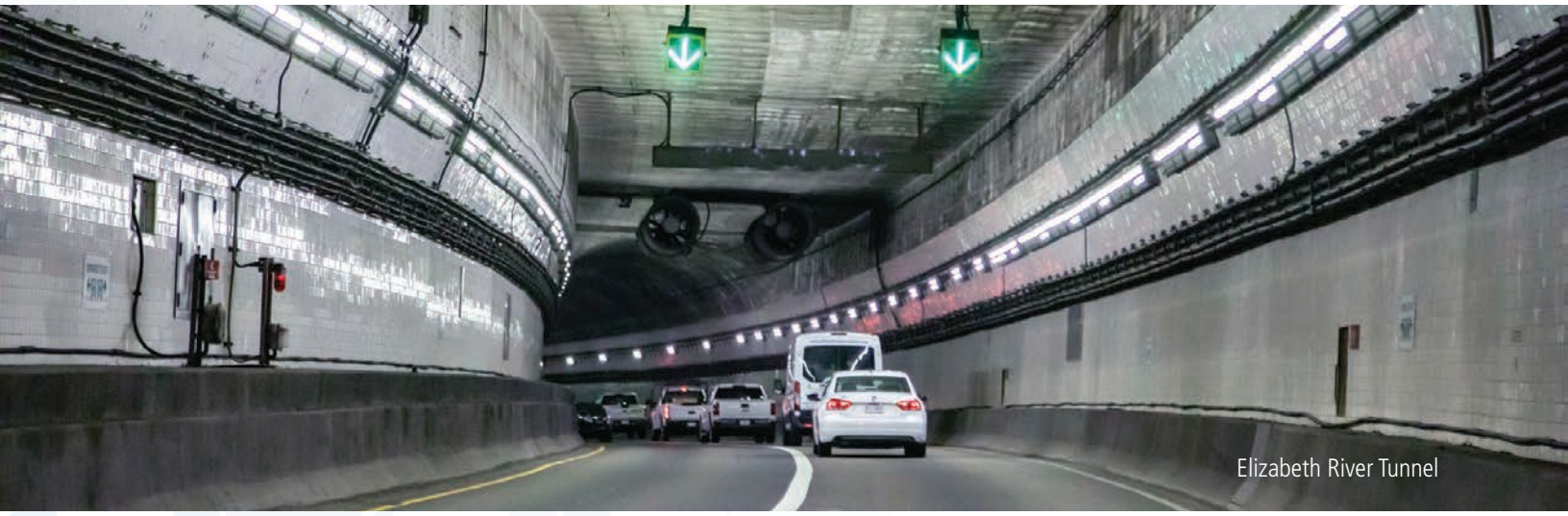
A statewide Special Structures 50-Year Long-Term Plan has been developed and includes each VDOT maintained and operated Special Structure. This 2019 50-Year Long-Term Plan provides a consistent life-cycle approach for each structure and fulfills the objectives of Goal 2.3 in VDOT's Calendar Year 2018 – 2021 Business Plan, which states VDOT is to "develop and implement a plan to address VITAL Infrastructure (Special Structures) long-term maintenance needs."[9] This includes identifying funding sources and a life-cycle based approach to investing in and maintaining each structure.

VDOT has worked closely with the District Asset Owners and Facility Managers to develop this long-term plan using consistent terminology, work types, work categories, and life cycle to improve understanding across districts and facilities. This effort culminated in several workshops where facility managers for each asset, VDOT, and industry experts came together to confirm a Long-Term Plan that was:

- **Comprehensive:** Utilizing the combined knowledge of those responsible for tunnels, movables, and complex structures.
- **Consistent:** That assumptions regarding life-cycle (service life) and needs were consistent across all structures. Providing VDOT with a plan that utilized the right treatments at the right time.
- **Detailed Plan:** Each structure has detailed work items which were compiled to create the statewide 50-Year Long-Term Plan.

The 2019 Long-Term Plan differs from the information presented in the 2018 Special Structures Report in that it includes the following:

- Extension of the report from 30 years to 50 years – Special Structures have a similar life cycle to conventional structures
- Revised replacement costs for some structures (e.g. HRBT Approaches)
- Inclusion of routine maintenance required to support the achievable service life for structures and components of structures (e.g. inspections, washing, lubrication on movable bridges)
- Inclusion of Operational costs which are critical to provide mobility to the travelling public that these structures deliver ($2.47 billion over 50 years)
- Inclusion of maintenance on movable bridge approaches that are not otherwise considered Special Structures and captures the needs to keep each facility functioning.



Elizabeth River Tunnel

9 Virginia Department of Transportation, "Calendar Year 2018 – 2021 Business Plan," n.d.

4.5 INVESTMENT NEEDS – 2019 50-YEAR LONG-TERM PLAN

The 2019 50-Year Long-Term Plan focuses on the work types and categories related to maintaining and operating each Special Structure, as defined in the Figure 39.

FIGURE 39 Consistent Terminology for Work Types and Work Categories in 2019 Long-Term Plan

Work Types	**Structure Replacement:** complete replacement of the structure
	Component Replacement: replacement of parts of the structure (e.g. deck, generator)
	Maintenance: activities that sustain or improve the condition of the structure components
	Operations: day to day requirements to keep the facility operating (e.g. labor, daily utilities – power/water, materials, equipment)
Work Categories (Components, parts or activities)	
	Electrical: e.g. pumps, lighting, generators
	Inspection: NBI and NTIS inspections
	Mechanical: ventilation fans, tidal gates, drive system, balancing movable bridges
	Structural: fenders, deck, superstructure, substructure, painting, and other preservation work
	Systems: traffic control systems, bridge gauge signs, CCTV, tunnel control systems
	Utilities: power, water, communications
	Materials: materials for annual maintenance
	Equipment: equipment rental and replacement, septic maintenance
	Labor: VDOT staff, consultant and contractor services for operations (24 hours for some facilities) and maintenance, training

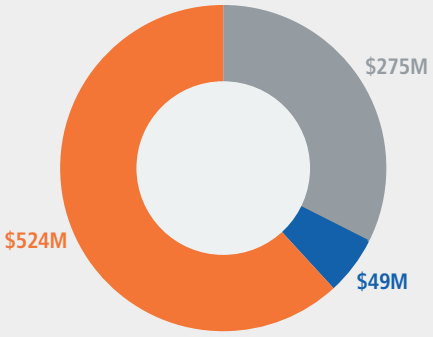
As a basis for developing the 50-year Long-Term Plan, a service life (or asset lifecycle) was agreed upon for key features. Each service life has been developed based on the assumption that all routine/preventative maintenance will be undertaken to enable the service life to be maximized.

Each Special Structure has a long-term work plan. An example of a Special Structure's 50-year Long-Term Plan is provided on the following page.

Robert O. Norris Bridge

DETAILED EXAMPLE - MONITOR-MERRIMAC BRIDGE-TUNNEL LONG-TERM PLAN

Work Type

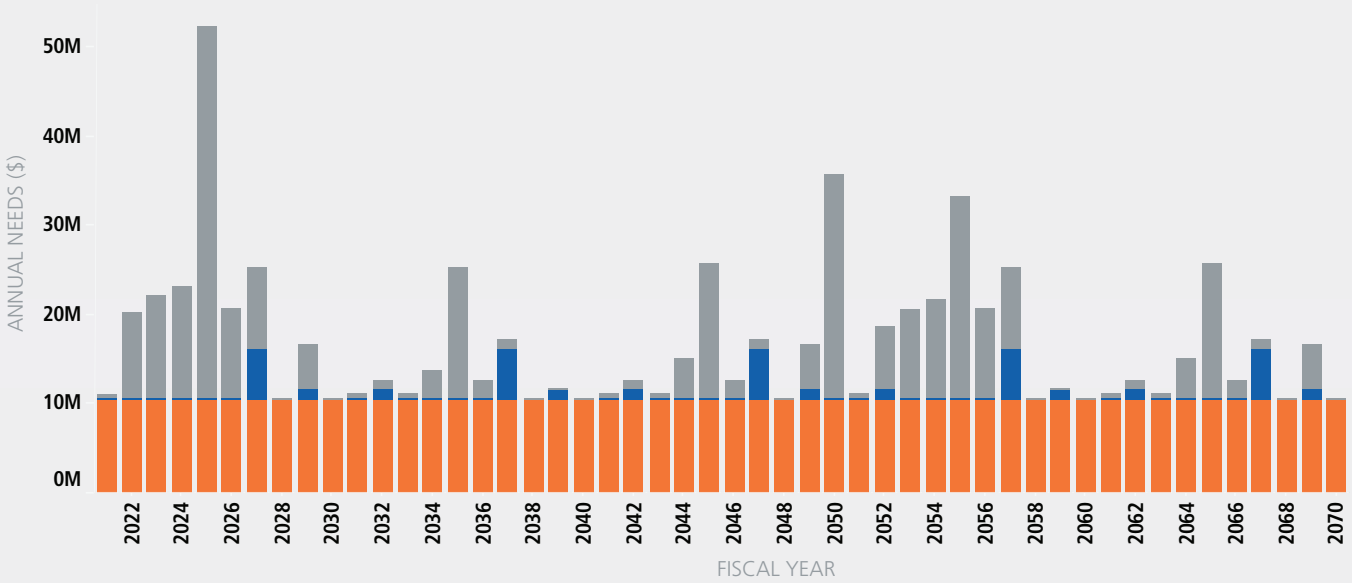


Component Replacement | Maintenance | Operations

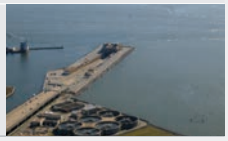
Work Category

Electrical	$135,580,000
Inspection	$12,000,000
Mechanical	$33,500,000
Structural	$34,380,000
Systems	$108,050,000
Utilities	$35,000,000
Materials	$15,000,000
Equipment	$63,750,000
Labor	$410,000,000
Grand Total	$847,260,000

Spend Profile



PROJECT EXAMPLES – 2019 DOLLARS:

Work Category	Project	Service Life	Project Cost	50-Year Costs	
Electrical	Utility Power, Switchgear and generator upgrade	30 Years	$40.5M	$81M	
Electrical	Replace Tunnel Lighting	25 years	$25M	$50M	
Labor	Operations and Maintenance Staffing	Annual	$8.2M	$410M	
Inspections	NTIS Inspections	Annual	$0.24M	$12M	

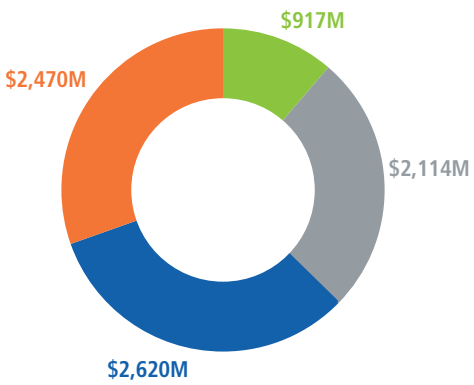
The figures (40 – 41) illustrate the 2019 50-Year Long-Term Plan for Special Structures across the Commonwealth.

Despite the backlog of projects, several projects are ready to construct while others will require additional time to prepare for construction due to their complexity. The 2019 50-Year Long-Term Plan will be refined in subsequent years to enable smoothing of the annual investment needed. This process will include development of an annualized prioritization process and formula for projects over the coming years and an averaging of costs to develop a consistent spend profile.

VDOT's work on analyzing costs for the next 50 years demonstrates that maintenance and operations costs are similar in size to construction and replacement costs. However, the agency is taking precautionary measures to ensure maintenance and operating costs are carefully considered and built into long-term budgets to provide the funding required to sustain the Special Structures throughout their useful life.

FIGURE 40 2019 50-Year Long-Term Plan: Combined Spend Plan for all Special Structures.

Work Type

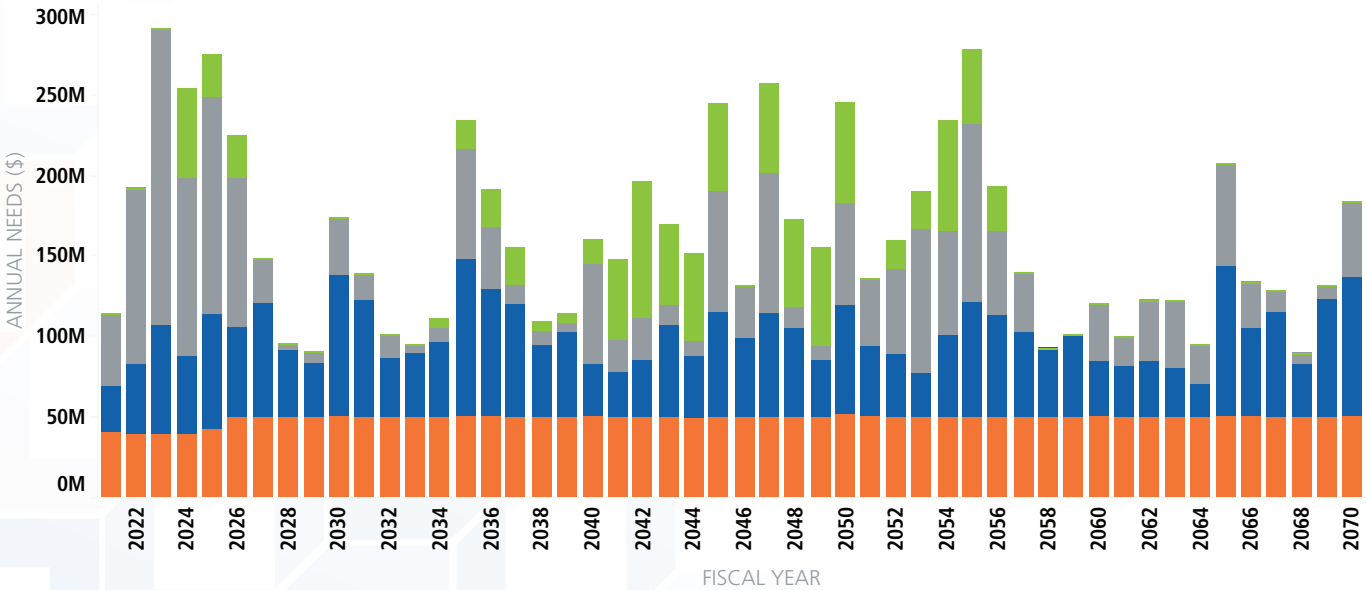


Work Category

Electrical	$704,116,000
Hydraulic	$625,000
Inspection	$200,878,000
Mechanical	$706,804,000
Structural	$3,505,749,000
Systems	$439,074,000
Utilities	$228,935,000
Materials	$71,100,000
Equipment	$250,225,000
Labor	$2,013,925,000
Grand Total	$8,121,431,000

Structure Replacement Component Replacement Maintenance Operations

Spend Profile

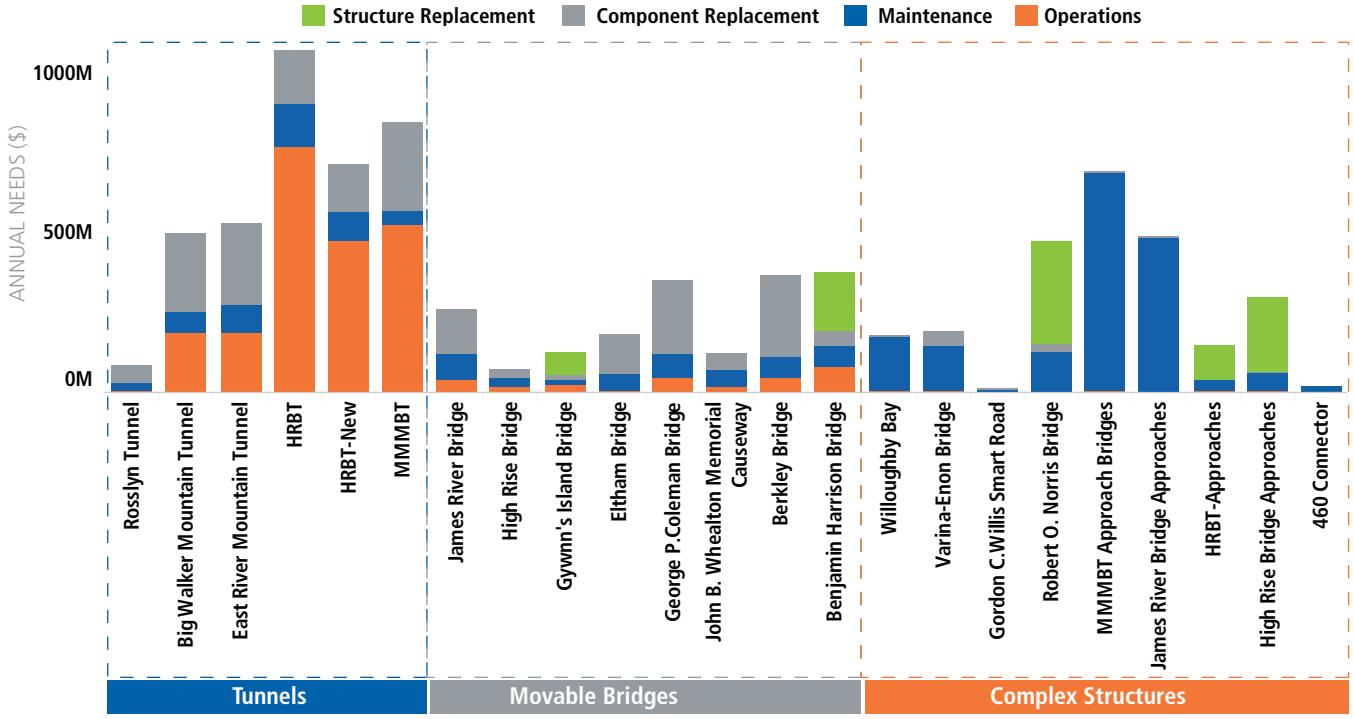


This plan will require annual updates and will be a living document. As projects are prioritized and developed further, this will be reported through an annual reporting process to the Board.

Figure 41 identifies the different work types for each special structure. It illustrates the significant operations cost associated with the tunnels and smaller operations requirement with movable bridges.

The figure also illustrates the cost associated with the new HRBT tunnel ($714M) over the life of the plan. This has been developed assuming the tunnel is operational and the responsibility of VDOT in FY 2025.

FIGURE 41 Special Structures – 50-Year Long-Term Plan: Summary by Special Structure



Figures 40 and 41 also illustrate several full structure replacements over the life of the plan. These are summarized in the Figure 42. These structures will be the focus of further analysis as to the when replacements should take place in the future. VDOT will identify potential savings if the funds were available to do proactive maintenance as opposed to full replacements.

FIGURE 42 Special Structures – 50-Year Long-Term Plan: Structure Replacements, Estimated Cost and Timing

Structure	Category	Estimated Replacement Cost (2019 Dollars)	Estimated Replacement Year
Hampton Roads Bridge-Tunnel Approaches (VDOT's responsibility)	Complex	$108.5M	2024-2026
Gwynn's Island	Movable	$71M	2034-2037
Robert O. Norris Bridge	Complex	$322M	2038-2045
High Rise Bridge (Approaches and Movable)	Complex and Movable	$234M	2047-2050
Benjamin Harrison Bridge	Movable	$182M	2052-2056

The average investment in Special Structures is $50 million per year, and this analysis indicates an annual investment need of $152 million for the years 1-4 of the plan, which is projected to increase to $162 million beginning in FY 2025 due to the completion of the Hampton Roads Bridge-Tunnel expansion project. This amounts to a funding gap of approximately $102 million annually for the first four years, and $112 million thereafter.

4.6 PERFORMANCE OUTCOMES

The continued, uninterrupted performance of its Special Structures is critical for the Commonwealth. They carry high volumes of traffic, and loss of service of these facilities will result in long and costly detours. The majority of Special Structures in VDOT's inventory are over 40 years old, which leads to increased maintenance needs. Additionally, due to the complexity of the structures, partial failures or failures of sub-components could lead to service disruptions of entire assets as parts are ordered and labor is coordinated (e.g. movable spans may be stuck opened or closed, or weight limits may be imposed).

While the Complex Structures will follow the preservation first approach similar to conventional structures, performance measures are under development for Movable and Tunnel structures. There are currently no federal performance requirements for these structures. The performance measures will be risk-based (looking at reliability, health index, remaining service life, and operational functionality) and consider the following factors shown in Figures 43 - 44:

FIGURE 43 VDOT Special Structures Performance Measures (Under Development)

Movable Bridges	Tunnels
Structural performance	Structural performance
Electrical/mechanical reliability	Mechanical – Mechanical, Electrical, Fire-Life-Safety, Ventilation
	Operational – Roadway, Traffic Control, Interior, Lighting, Drainage

FIGURE 44 Risk-Based Examples for Movable Bridges and Tunnels

MOVABLE BRIDGES

Description	Useful Life (Years)	Age (Years)	Risk
Generator	30	40	Lifting mechanism doesn't operate
Lifting Cables	30	45	

TUNNELS

Description	Useful Life (Years)	Age (Years)	Risk
Pumps	25	22	Flood
Ventilation	10	2	Fire (Life Safety)

4.7 SUMMARY – SPECIAL STRUCTURES

In December 2018, VDOT published a report to satisfy requirements of Chapter 2 of the 2018 General Assembly Item 450, H. The Commonwealth Transportation Board was required to develop a report that addresses the overall condition, funding needs, and recommendations for addressing funding, within the SGR Program and other options with respect to Virginia's large and unique bridge and tunnel structures.

VDOT developed the 2019 50-Year Long-Term Plan (shown in Figure 45) with a view to inform the development of a Statewide Special Structure Fund as defined by §33.2-1532 of the *Code of Virginia*, known as the *Robert O. Norris Bridge and Statewide Special Structure Fund*. The fund was created for the maintenance and replacement of Special Structures (unique structures), as determined by the Board.

FIGURE 45 2019 50-Year Long-Term Plan: Combined Spend Plan for all Special Structures.

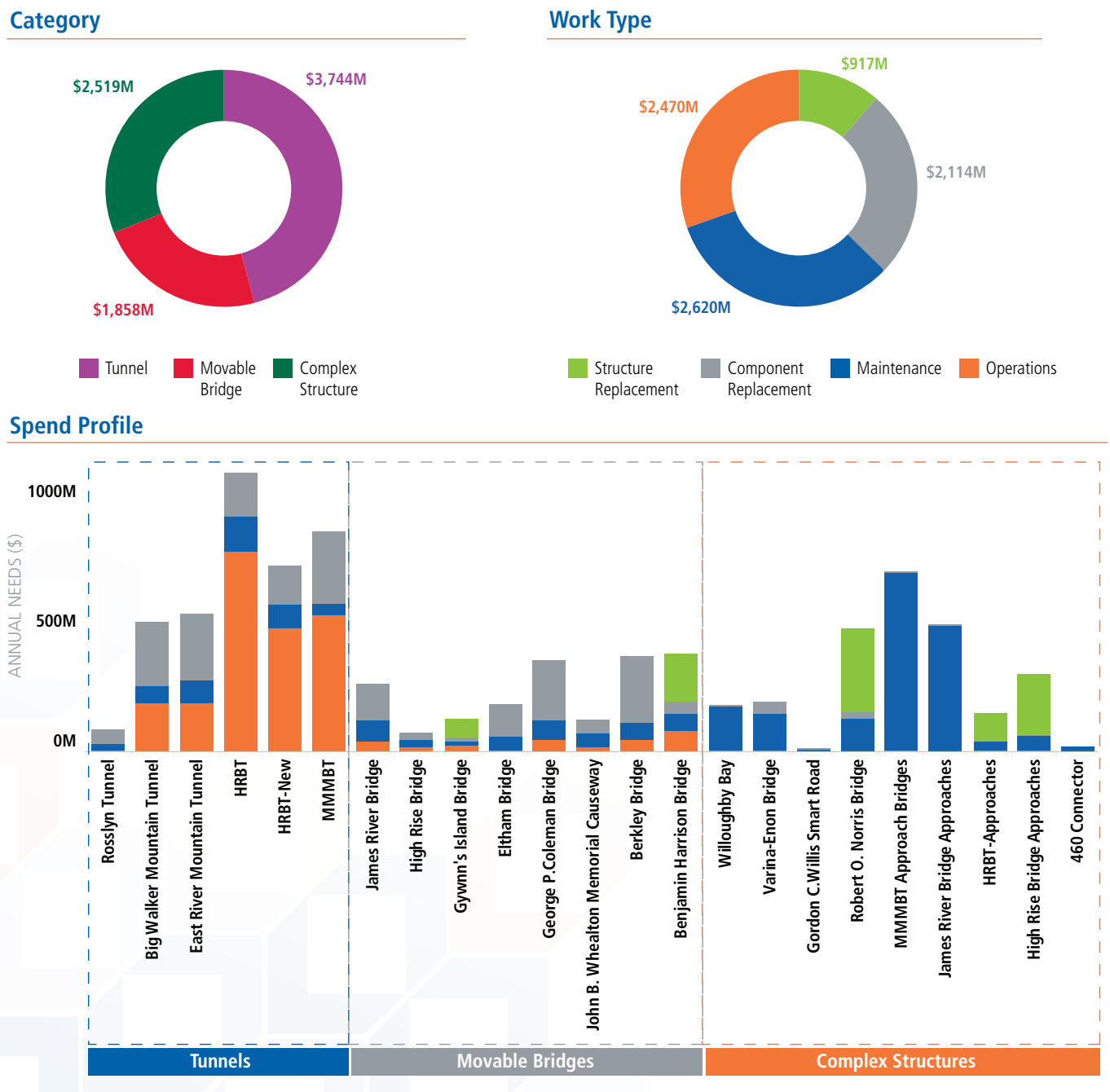


FIGURE 46 Summary – Special Structures Average Total Cost per Year (in 2019 dollars).

Special Structures			Average Total Cost per Year, $ Millions	
Complex Structures	Movable Bridges	Tunnels	Years 1-4	From Year 5
			$152	$162
		Cost Differential to Current Investment ($50M per year):	($102)	($112)

The 2019 50-Year Long Term Plan indicates an annual investment need of $152 million for the first four year and $162 million beginning in FY 2025 due to the completion of the HRBT Expansion Project. As shown in Figure 46, the average annual investment is $50 million and the funding gap is $102 million in year 1-4, and $112 million thereafter. Recognizing the full amount of funding may not be available, VDOT will prioritize the most critical projects on an annual basis to minimize risk.

The Special Structures 50-Year Long-Term Plan will continue to be developed to identify opportunities for efficiency, review of alternative project delivery mechanisms – including assessment of P3 viability, and new risk-based performance measures for tunnels and movable bridges.

High Rise Bridge

4.8 FUTURE PROCESS ENHANCEMENTS

As the Special Structures program is developed, there are several process enhancements that have been identified for review and possible implementation.

ASSESS OUTCOMES OF P3 ANALYSIS AND RFI PROCESS

The outcomes of the Special Structures P3 RFI and internal assessments of P3 viability are expected to be available in early 2020.

CREATION OF INTERNAL SPECIAL STRUCTURES COMMUNITY OF PRACTICE

The process of creating the 2019 50-Year Long-Term Plan has illustrated the benefit of gathering those responsible for managing the Special Structure facilities. Through these discussions, several opportunities for coordinating procurement and purchasing were identified that may help VDOT reduce costs and provide more consistent components improving the redundancy in replacements. Regular forums for these discussions will be put in place and will expand the capabilities of the subject matter resources and experts.

OWNER'S MANUAL DEVELOPMENT

VDOT is in the process of developing updated Owner's Manuals to expand on existing Maintenance and Operations plans for each Special Structure. These documents will provide consistent, high-level summaries of each structure and will describe the actions required to ensure each remains operational. This document will be the basis for informing future Long-Term Plans.

DEFINING LEVEL OF SERVICE – TUNNELS AND MOVABLES

Performance measures (condition and operations) are under development for movable and tunnel structures.

IMPLEMENTING A RISK-BASED PROJECT PRIORITIZATION PROCESS

The backlog of needs for Special Structures cannot be addressed immediately, and the required funding may not be available. VDOT is in the process of developing a prioritization process to enable selection of the most critical (risk-based) projects as funding allows.

STRUCTURE-SPECIFIC ASSET MANAGEMENT PLANS

VDOT is currently producing an Asset Management Plan for the Varina-Enon Bridge. Whereas the 2019 Long-Term Plan presents one approach to maintaining each facility, the Varina-Enon Asset Management Plan will consider multiple combinations of maintenance and replacement over the life of the asset. The least life-cycle cost can then be selected and implemented. While aspects of this type of analysis exist across all structures, VDOT will develop more complete Asset Management Plans for each special structure and will update each to reflect the results of annual or biennial inspections.

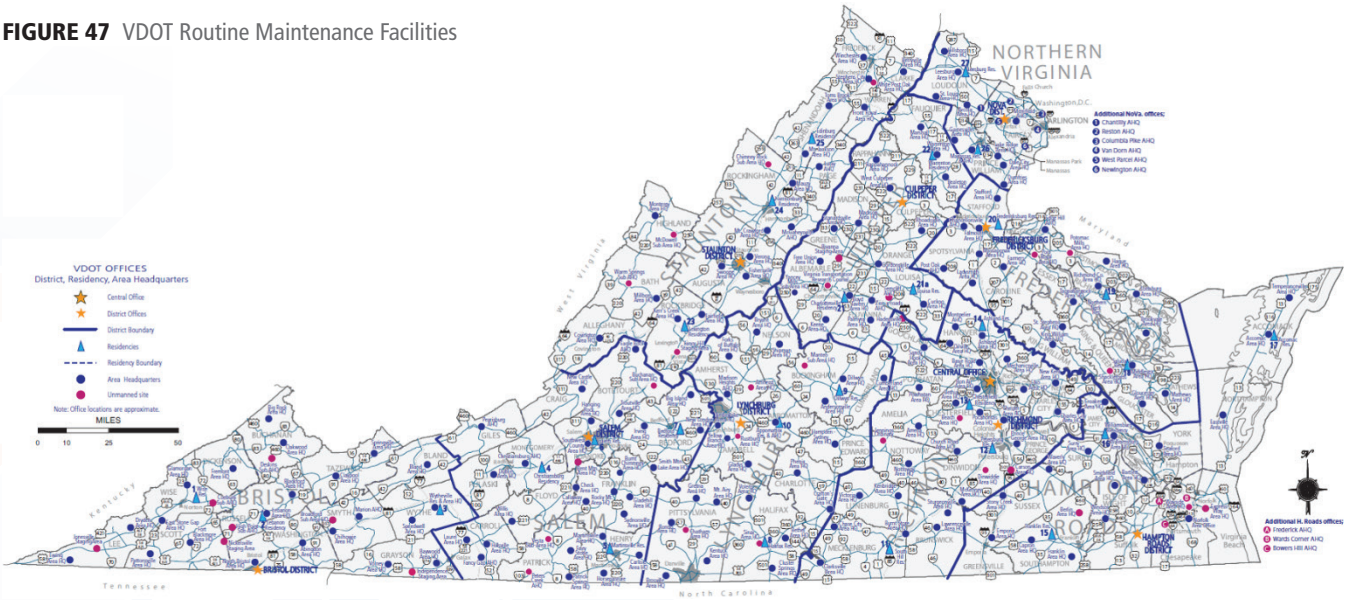
5 ROUTINE MAINTENANCE

VDOT's routine maintenance and operations program includes investment in work that extends the useful life of the asset (ex. ditching and drainage activities, paving roads), as well as services that do not change the physical condition of the asset (ex. mowing, snow removal, and incident response).

5.1 NON-PAVEMENT/STRUCTURE ASSETS OVERVIEW AND INVENTORY

The management and implementation of VDOT's routine maintenance and operations program is deployed throughout its organizational structure including the nine construction Districts, 31 Residencies, and 194 Area Headquarters (see Figure 47). An "Area Headquarter" covers at most one county. Most of the routine maintenance work is managed by the Residencies and Area Headquarters. In the comprehensive review, VDOT analyzed all the routine maintenance items including roadside maintenance (drainage, slopes, mowing); traffic items (signs and signals); and other maintenance (such as rest areas, patching, sweeping, equipment, and permitting).

FIGURE 47 VDOT Routine Maintenance Facilities



VDOT routine maintenance teams are responsible for a significant range and scale of assets, including those listed in the Figure 48.

FIGURE 48 Current Non-Pavement/Structure Assets Inventory (Estimated*)

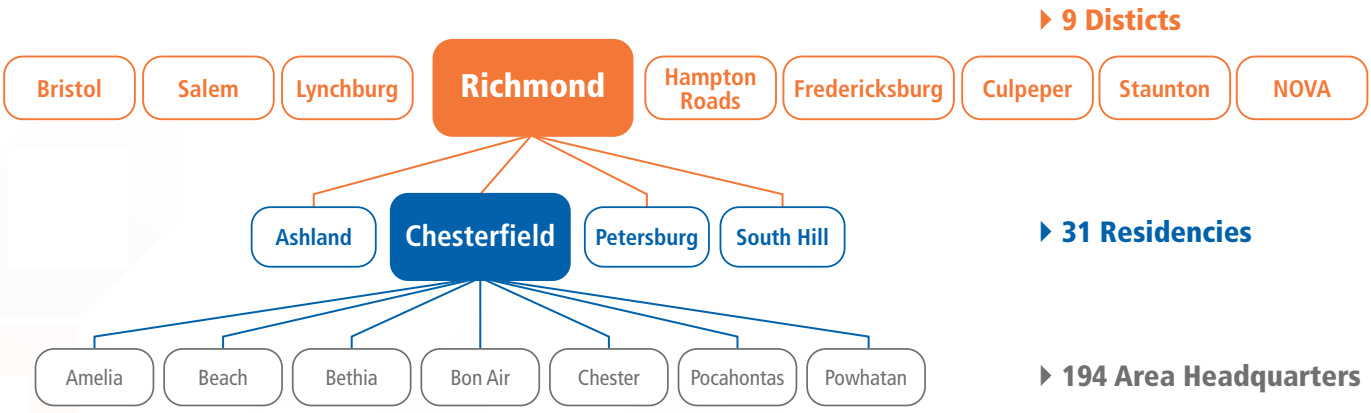
Asset	Inventory	Inventory Source
Unpaved Roads	6,000 miles	2017 Mileage Tables
Turf (Mowing)	149,000 acres	2011 Annual Needs Report
Pipes	338,000 each	2011 Annual Needs Report
SWM Facilities	2,000 each	Highway Maintenance Management System
Ditches	94,000 ditch miles	Pavement Management System
Trees	131,000 shoulder miles	2011 Annual Needs Report
Unpaved Shoulders	76,000 shoulder miles	Pavement Management System
Signals	3,000 each	Traffic Engineering
Pavement Marking	73,000 miles	Traffic Engineering
Signs	947,000 each	Traffic Engineering

Note: *Inventory for these assets is not collected as regularly and consistently as it is for pavements and structures. This is a process that VDOT is improving.

5.2 PREVIOUS EXPENDITURE

Approximately $700 million in Maintenance and Operations Program allocations are budgeted to the routine maintenance areas across the Commonwealth's nine construction Districts, and in turn, to Residencies and Area Headquarters (Figure 49).

FIGURE 49 VDOT Distribution Example



Examples of routine and other maintenance activities are shown in Figure 50, with average expenditures between the two major components of VDOT's routine maintenance program.

FIGURE 50 Routine Maintenance Examples, 2016 - 2018 Average

Routine Maintenance Examples	
Roadside: drainage, slopes, mowing	$190M
Traffic Items: signs, signals	$150M
Other Maintenance Examples	
Rest Areas	$23M
Equipment	$85M
Incidental Maintenance	$50M
Management and Direction or Program Oversight	$75M

Notes: 1. Materials cost comprises approximately 13% of routine maintenance cost.
2. The routine maintenance and operations budget also includes allocation of funds for area headquarters (salaries, equipment, and $20,000 per month on average for materials cost).

Pothole Repairs, Route 60 – VDOT, 2014

DETAILED ANALYSIS: MAINTENANCE & OPERATIONS WORKFORCE

Of the total VDOT workforce, approximately 4,800 (62 percent) are maintenance and operations staff. Labor and benefits account for 23 percent of the average annual budget. In general, staff within the maintenance and operations program are the agency's lowest paid staff. There has been a 20 percent increase in labor and benefits over the past six years (FY 2014 – FY 2019), associated with salaries, health insurance premiums, and retirement contributions. An increase of $23 million for salary increases across 4,800 staff (over 5 years) equates to approximately $920/year per individual.

Past Change

Since 2002, VDOT's staff has been reduced from approximately 10,000 to the approximately 7,700 people who comprise the workforce today. Between 1957 and 2008, the literature shows that approximately twenty studies have been completed and published focused on the organization, administration, financing, service levels and operations of the Virginia Department of Transportation. Such a continuing effort toward improvement is indicative not only of the importance of this agency in the lives of the citizens of the Commonwealth, but also of the fact that the environment, which affects the delivery of transportation service, is one of constant change. To harness the talent that already exists within the agency, VDOT is pursuing a current initiative focused on training staff to become the work force of tomorrow.

Current Initiative: Work Force of Tomorrow

The Work Force of Tomorrow initiative is an organizational transformation project for the agency that has focused on preparing VDOT for the future. Its focus includes:

- Strengthening employee skills
- Updating methods and processes
- Empowering innovation

The VDOT teams delivering routine maintenance need to balance planned and unplanned work on a daily basis. Planned work includes proactive maintenance tasks while unplanned work is considered reactive. This distinction is important because planned work is more efficient. Reactive work can be raised through identification by VDOT, weather events, or by service calls received from the public.

The reduction in cost for planned or proactive work is due to mobilization costs. With planned work, area headquarters and residencies are able to take a corridor approach instead of spot work. Also, planned work can allow for systematic analysis that enables the agency to understand what the root cause of an issue versus repeatedly fixing the same issue.

DETAILED ANALYSIS: SERVICE CALL REQUESTS

From October 2018 to September 2019, over 197,000 service calls were received by VDOT. Of these calls, 17 percent were emergencies and 15 percent were for potholes (approximately 30,000 calls). Other service request calls relevant to routine maintenance were for vegetation (15 percent), drainage (15 percent), unpaved Roads (6.5 percent), signs (4 percent), and signals (4 percent). The table below provides a summary of service calls, how the number has changed since 2015, and related activity examples (Figure 51).

FIGURE 51 Routine Maintenance Overview – Service Calls and Activity Examples.

Asset	Service Request Calls 2015	Service Request Calls 2019	Service Request Increase since 2015	Activity Example
Vegetation	17,300	30,400	76%	Removing vegetation impeding visibility, mowing, trees
Drainage	20,000	29,500	48%	Clearing standing water or blocked pipes, cleaning
Unpaved Roads	10,700	12,800	20%	Address rutting or water damage
Signs	3,500	7,500	114%	Replace damaged sign
Signals	4,900	7,000	43%	Attend to outages, malfunctions

An increased focus on reactive work has meant VDOT has needed to defer planned work in recent years, including:

- Maintenance of sound walls and fences
- Night-time sign inspection
- Daylighting (vegetation clearing) of signs
- Ditching
- Maintenance of closed drainage facilities

5.3 FUTURE STRATEGIES AND TARGETS: ANALYSIS UNDERTAKEN

To refocus VDOT's efforts toward a more proactive approach, VDOT assembled a working group to review maintenance activities currently being delivered. The expectation was that returning to a more proactive approach or "back to basics," would:

- Provide efficiencies and cost savings through a planned and systematic approach
- Extend life of assets and limit the unavailability of assets
- Extend life of other assets, as most assets are interdependent

Analysis of the routine maintenance program included a review of asset inventory information, the activities currently undertaken to maintain those assets, and consideration of recommended maintenance best practices. The activities selected for the analysis were based on:

- Safety items
- Most publicly visible activities

- Highest expenditures
- Activities that extend the life of other assets
- Service requests

From this, the working group defined performance metrics and targets through the lens of a long-term sustainability objective.

5.4 INVESTMENT STRATEGIES - PERFORMANCE METRICS

Performance metrics have been developed to enable VDOT to plan and work toward achieving a target and monitor accomplishments against that target. Those targets are outlined in Figure 52. It was determined that targets are to be considered as benchmarks or may be aspirational. As such, they may not be immediately achievable. The intention was to set a target that would be a stretch to achieve with current resources (i.e. no additional funding).

VDOT began measuring to these targets in June 2019. In 2020, the agency will review the work accomplished, develop a report on what has been achieved, and provide revised recommendations for targets, or priorities within these targets, as needed.

FIGURE 52 VDOT Routine Maintenance – 2019 Performance Metrics

Asset	Best Practice Frequency	Current Frequency Average / Year	2019 Target Frequency
Turf (Mowing)	3 times / year	IS: 3.1 times / year PR: 3.1 times / year SC: 2.3 times / year	IS: 3 times / year PR: 3 times / year SC: 2 times / year
Trees	10% of inventory	5% of inventory	6% of inventory
Pipes	20% of inventory	8% of inventory	10% of inventory
Storm Water Management Facilities	2 times / year	1.7 times / year	2 times / year
Ditches	20% of inventory	3% of inventory	5% of inventory
Unpaved Roads	4 times / year	5 times / year	4 times / year
Unpaved Shoulders	20% of inventory	16% of inventory	20% of inventory
Signs	7% of inventory	4% of inventory	5% of inventory
Signals	5-year cycle	4% of inventory	5-year cycle
Pavement Marking	Material dependent	64% of inventory	70% of inventory

Through setting targets, monitoring accomplishments against those targets, and communicating areas of prioritization and expected outcomes, VDOT will put itself in place to provide a more proactive and planned approach to routine maintenance. In turn, it is anticipated that a more proactive approach will reduce the volume of service calls that are placed.

DETAILED ANALYSIS: FLEXIBILITY AND RESPONSIVENESS

A key element of VDOT's approach to sustainable investment strategies is flexibility. VDOT must have flexibility in the Maintenance and Operations Program to react to both dynamic maintenance needs and unforeseen emergencies. While performance targets are needed to provide a framework for agency benchmarks, a level of flexibility must remain for VDOT address with unknowns as they arise to allow the agency to do what it does best: *keep Virginia moving.*

In good years, VDOT will have funds to invest in infrastructure and in challenging years the agency may have to shrink planned work. By retaining flexibility, VDOT is more equipped to manage dynamic maintenance needs and emergencies which include:

- Dynamic Maintenance Needs
  - » Annual inventory additions (e.g. lane miles, trails)
  - » Unfunded mandates (Federal or other requirements to provide more information, inspections, analysis)
- Emergencies
  - » Extreme weather events (e.g. snow and ice, hurricanes, floods (2018 was the wettest year on record), debris)
  - » Unexpected Events (e.g. structure hits, sinkholes, pipe failures, traffic accidents)

Tornado Aftermath in Waverly, Hampton Roads – VDOT, 2016

5.5 SUMMARY – ROUTINE MAINTENANCE

To refocus VDOT's routine maintenance efforts toward a more proactive approach, VDOT assembled a working group to review maintenance activities currently being delivered. The expectation was that returning to a more proactive approach, would:

- Provide efficiencies through a planned and systematic approach
- Extend life of assets and limit the unavailability of assets
- Extend life of other assets, as most assets are interdependent.

Performance metrics have been developed to enable VDOT to plan and work toward achieving a target and monitor accomplishments against that target. It was determined that targets are to be considered as benchmarks or may be aspirational. As such, they may not be immediately achievable. The routine maintenance planed work targets for 2019 are listed in Figure 53.

FIGURE 53 VDOT Routine Maintenance – 2019 Performance Metrics (Planned Work)

Asset	2019 Target – Planned Work Frequency
Turf (Mowing)	Interstate: 3 times / year, Primary: 3 times / year, Secondary: 2 times/ year
Trees	6% of inventory
Pipes	10% of inventory
Storm Water Management Facilities	2 times / year
Ditches	5% of inventory
Unpaved Roads	4 times / year
Unpaved Shoulders	20% of inventory
Signs	5% of inventory
Signals	5-year cycle
Pavement Marking	70% of inventory

The intention was to set a target that would be a stretch to achieve with current resources (i.e. no additional funding – see Figure 54).

FIGURE 54 Estimated Cost to Achieve Proposed Routine Maintenance Targets

CURRENT INVESTMENT: $725M PER YEAR — ***ALL AMOUNTS IN 2019 DOLLARS**

Routine Maintenance	Avg. Total Cost per Year, $ Millions
Performance metrics and targets in place and focus on proactive approach	**$725**
Cost differential to current investment:	**$0**

5.6 IMPLEMENTATION CONSIDERATIONS

ANNUAL REPORTING

VDOT will report annually to the Board on progress against the performance metrics.

REVIEWING TARGETS/PRIORITIES IN 2020

After a year of implementation, there will be a review of the results achieved and consideration will be given to:

- Updating the performance metrics, as necessary given lessons learned and annual performance.
- Setting priorities within the measures to guide the implementation teams.

5.7 FUTURE PROCESS ENHANCEMENTS

CONSIDER PERFORMANCE OUTCOME TARGETS

With an improved understanding of these performance metrics it will be possible for VDOT to then consider setting performance outcomes for these assets. VDOT already has good experience in setting performance outcomes for the Interstate Maintenance Contracts and this will be utilized. Performance outcomes or levels of service will require consideration of the cost to achieve the targets utilizing performance metrics information and other work undertaken in the development of these metrics.

EQUIPMENT REVIEW

VDOT intends to review current processes for purchasing and managing maintenance equipment. This review will consider opportunities to better understand the cost of ownership and identify where cost savings or efficiency improvements may be possible.

SNOW AND ICE REVIEW

VDOT already has established performance measures for snow and ice removal, but these measures need to be reviewed. The purpose of this review will be to consider current performance relative to these measures and whether alternative performance targets are appropriate.

TRAFFIC OPERATIONS REVIEW

Similarly, further consideration is needed to the investment levels and performance outcomes for traffic operations.

ANCILLARY ASSETS – DATA STRATEGY

This review will identify where additional data is required and would be most beneficial to inform decision making. Consideration will be given to how the data may be collected, how enhanced understanding will help mitigate risk, and in turn improve asset outcomes.

6 COMPREHENSIVE REVIEW SUMMARY

Over 2018 – 2019, a working group was formed to challenge VDOT to develop a more business focus mindset and ensure the long-term sustainability of investment programs and asset performance. Based on the working group's efforts, Figure 55 illustrates the new performance measures and needed investment levels to create long-term sustainability.

FIGURE 55 New Performance Targets and Investment Needs

New Performance Measures and Targets	Investment $M per year, $2019	Required Investment $M per year, $2019		Difference $M per year, $2019
Pavements				
Sufficiency Percentage Interstate – 82% Primary – 82% for ≥ 3,500 AADT, 75% for < 3,500 AADT Secondary 82% for ≥ 3,500 AADT, 60% for < 3,500 AADT	$425	Years 1-6 $463	Years 7-20 $499	Shortfall **($38-74)**
Structures				
All Systems Weighted Average GCR Average GCR ≥ 5.6 Percent non-SD Interstate - ≥97%, Primary - ≥93%, Secondary - ≥90% No posting of Interstate structures	$384	$384		**$0**
Special Structures				
Health Index and Risk-Based Prioritization performance measures to be developed	$50	Years 1-4 $152	Years 5-50 $162	Shortfall **($102-$112)**
Routine Maintenance				
Performance metrics (annual achievement) defined for ten key activities	$725	$725		**$0**

Projections of funding allocations to achieve the performance of the overall network, pavements, structures, Special Structures, and other aspects of this comprehensive review require an additional investment of $140-$186 million annually over the next 20 years.

Recognizing the full amount of funding may not be available, VDOT will prioritize the most critical projects on an annual basis to minimize risk.

To implement these changes, it is necessary for VDOT to address the following:

Pavements

- **Allocation Based on Need:** allocation to Districts must be based on optimizing performance to achieve the revised performance targets.
- **Maintain Industry Stability:** establish a floor and ceiling for each District allocation when undertaking a needs analysis to ensure sustainability of the local paving industry.
- **Gradual Achievement of Targets:** manage gradual pavement condition declines over 6-10 years to ensure that once the new target is achieved it will be sustained for the long term.

Structures

- **Funding for Cusp Structures:** invest in structures before they become 'poor' to extend their life and reduce overall costs. To achieve the new targets, VDOT will need to invest in the structures at optimal times to achieve the lowest life-cycle cost.

Special Structures

- **Annual Review of Long-Term Plan:** Updated based on additional information (e.g. new technology, investment decisions)
- **Execute the Long-Term Plan for Each Structure:** Based on the investment levels available.
- **Assess Alternative Delivery models:** Commenced with current RFI process.

Routine Maintenance

- **Build Understanding of Inventory and Services:** VDOT maintains a variety of assets (e.g., trails) while providing services to ensure the mobility of the traveling public. VDOT will investigate and catalogue the assets and services within its purview.
- **Annual Performance Review:** VDOT will report annually.

As a result of the comprehensive review, the Commonwealth Transportation Board in December 2019 has:

- Adopted new performance targets for Pavements
- Adopted new performance measures and targets for Structures
- Supported development of a Special Structures health index and risk-based prioritization of projects
- Required an Annual Report that summarizes planned and actual achievement of performance targets
- FY 2019 Comprehensive Review Report

APPENDIX A
RESOLUTION

VDOT
Virginia Department of Transportation

COMMONWEALTH of VIRGINIA

Commonwealth Transportation Board

Shannon Valentine
Chairperson

1401 East Broad Street
Richmond, Virginia 23219

(804) 786-2701
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Agenda item # ***9***

RESOLUTION
OF THE
COMMONWEALTH TRANSPORTATION BOARD

December 11, 2019

MOTION

Made By: Mr. Rucker, Seconded By: Mr. Johnsen
Action: Motion Carried, Unanimously

Title: Approval of Comprehensive Review Report related to the Robert O. Norris Bridge and Statewide Special Structures Fund and Asset Condition Performance Targets

WHEREAS, Chapters 83 and 349 of the 2019 Acts of Assembly established the Robert O. Norris Bridge and Statewide Special Structure Fund, now set forth in Va. Code § 33.2-1532; and

WHEREAS, Chapters 83 and 349, of the 2019 Acts of Assembly also required the Commonwealth Transportation Board ("the Board") to undertake a comprehensive review (the "Comprehensive Review") of the current and future condition of pavements and bridges in the Commonwealth, specifying that the review shall at a minimum (i) consider current conditions and performance targets for pavements and bridges, (ii) consider current investment strategies of the Highway Maintenance and Operating Fund and the State of Good Repair Program, (iii) recommend new performance targets for pavements and bridges with a sustainable performance over a 20-year period, and (iv) develop an investment strategy for the Highway Maintenance and Operating Fund and the State of Good Repair Program to achieve those sustainable performance targets, including a plan to address the funding needs of large and unique bridges and tunnel structures in the Commonwealth; and

WHEREAS, Chapters 83 and 349, of the 2019 Acts of Assembly required the Board to provide a report regarding the Comprehensive Review to the General Assembly by December 1, 2019 ("Comprehensive Review Report"); and

WHEREAS, while the Highway Maintenance and Operating Fund is legislatively distributed to other Commonwealth agencies and entities, the Comprehensive Review Report focused on VDOT's Highway Maintenance and Operations Program, namely the portion of the Highway Maintenance and Operating Fund allocated to VDOT; and

WHEREAS, the Board is being provided a draft Comprehensive Review Report for review and comment and may offer additional edits and comments to the draft Comprehensive Review Report, and in order to facilitate timely submission of the Comprehensive Review Report, the Commissioner of Highways will need authority to update the report with the edits requested by the Board prior to submission; and

WHEREAS, pursuant to §2.2-229, it is the responsibility of the Office of Intermodal Planning and Investment (OIPI) to develop measures and targets related to the performance of the Commonwealth's surface transportation network for the Board's approval, including any performance measurement required by Title 23 or 49 of the United States Code and any measures adopted by the Board pursuant to § 33.2-353; and

WHEREAS, on September 18, 2018 pursuant to 23 CFR §§490.307 and 490.407, the Board adopted Asset Condition Performance Targets relating to pavement and structure condition, which apply only to the National Highway System (NHS), which is limited to approximately 15 percent of the VDOT owned network; and

WHEREAS, OIPI, working collaboratively with VDOT to address item (iii) of the Comprehensive Review, has proposed the long term sustainable statewide asset condition performance measures and targets by roadway system for pavements and structures set out in Table A (Pavements and Structures Long-Term Sustainable Performance Measures and Targets); and

WHEREAS, OIPI, in consultation with VDOT, recommends adoption of the proposed Pavements and Structures Long-Term Sustainable Performance Measures and Targets set forth in Table A and incorporation of these measures and targets into the Statewide Transportation Plan pursuant to § 33.2-353 to address the Plan's goal for Proactive System Management:

TABLE A: Pavement and Structures Long-Term Sustainable Performance Measures and Targets

Asset	Interstate	Primary	Secondary	Average General Condition Rating
Pavement Sufficiency Rating	82 percent	AADT ≥ 3,500 – 82 percent AADT < 3,500 – 75 percent	AADT ≥ 3,500 – 82 percent AADT < 3,500 – 60 percent	N/A
Structures – Excluding the Special Structures Categories Tunnels and Movable Bridges	≥ 97 percent No postings	≥ 93 percent	≥ 90 percent	≥ 5.6

WHEREAS, the Comprehensive Review Report recommends development of a Special Structures health index and risk-based prioritization of projects; and

WHEREAS, the Comprehensive Review Report recommends the Commissioner of Highways to report on annual basis to the Board, the (i) projected and actual performance of the pavements, structures and Special Structures and (ii) planned and accomplished routine maintenance work; and

NOW, THEREFORE, BE IT RESOLVED, by the Board, that the Comprehensive Review Report, which may be amended by the Commissioner to incorporate edits and changes requested by the Board and other non-substantive modifications as deemed appropriate by the Secretary of Transportation, is approved.

BE IT FURTHER RESOLVED, that the Secretary of Transportation or her designee is authorized to take all actions necessary to submit the Comprehensive Review Report to the General Assembly.

BE IT FURTHER RESOLVED, that the Board hereby approves the Pavements and Structures Long-Term Sustainable Performance Measures and Targets set forth in Table A.

BE IT FURTHER RESOLVED, that the Board supports VDOT in developing a Special Structures health index and risk-based prioritization of projects and requests that VDOT present said prioritization to the Board.

BE IT FURTHER RESOLVED, that the Board directs the Commissioner of Highways to report on annual basis the (i) projected and actual performance of the pavements, structures and Special Structures and (ii) planned and accomplished routine maintenance work.

####

APPENDIX B

ROBERT O. NORRIS BRIDGE AND THOMAS J. DOWNING BRIDGE PPTA FEASIBILITY

VDOT
Virginia Department of Transportation

ROBERT O. NORRIS BRIDGE
AND
THOMAS J. DOWNING BRIDGE
PPTA FEASIBILITY REPORT

RESPONSE TO CHAPTERS 83 AND 349 OF ACT OF GENERAL ASSEMBLY

OFFICE OF THE PUBLIC-PRIVATE PARTNERSHIPS

ROBERT O. NORRIS BRIDGE AND THOMAS J. DOWNING BRIDGE

INTRODUCTION

The forth enactment clause of chapters 83 and 349 of 2019 Commonwealth of Virginia Acts of Assembly, now set forth in the Code of Virginia §33.2-1532, required the Commonwealth Transportation Board ("CTB") to evaluate the feasibility of using the Public-Private Transportation Act of 1995 (the "Act") to design, build, operate, and maintain the replacement of Robert O. Norris Bridge and Downing Bridge (the "Bridges").

In undertaking such feasibility efforts, the Virginia Department of Transportation ("VDOT"), at the request of the CTB, instructed the Office of Public-Private Partnerships ("P3 Office") to evaluate the feasibility of financing the replacement of the Bridges. The information provided in this report is only a high-level financial feasibility analysis and does not examine the requirements and the processes outlined in the Act and the PPTA Implementation Manual and Guidelines, as amended. Further research and studies (including a traffic and revenue, and operational study) will be needed to further refine the preliminary results discussed here.

The results provide debt-financing options to design, build, operate and maintain the replacement of the Bridges. Further, the results are based on scenarios that explored varying sensitivities to cost and revenue assumptions.

BACKGROUND

ROBERT O. NORRIS BRIDGE (NORRIS BRIDGE)

The 1.9-mile long Robert O. Norris Bridge, located on State Route 3 over the Rappahannock River between Lancaster and Middlesex Counties, is extremely long and expensive to maintain and inspect. The steel structure bridge was built in 1957 and includes one travel lane in each direction. Any incidents or unexpected closures of a travel lane significantly affects the users of the bridge. The structure is 61 years old, exceeding its 50-year anticipated service life, and is rated in Fair condition based on National Bridge Inspection Standards. The 300 feet navigation channel has a vertical

clearance of 110 feet. The detour for Norris Bridge is approximately 85 miles and therefore, is a critical infrastructure asset. Based on the official AADT Traffic Data for 2018, the average annual daily traffic (AADT) is approximately between 7,500 and 9,500 vehicles per day. Available information from the traffic monitoring system indicates that between 2009 and 2018, the traffic growth was estimated at an average of approximately 1.5 to 3 percent per year.

THOMAS J. DOWNING BRIDGE (DOWNING BRIDGE)

The 1.1-mile long Thomas J. Downing Bridge is located on U.S. Route 360 over the Rappahannock River between the Town of Warsaw in Richmond County and the Town of Tappahannock in Essex County. The pre-stressed concrete and steel bridge was built in 1963 and is rated in Fair condition. The 100 feet navigation channel has a vertical clearance of 50 feet. Similar to Norris Bridge, the Downing Bridge has one travel lane in each direction and any incidents or unexpected closures of a travel lane significantly affects the users of the bridge. The Downing Bridge is not included in the list of VITAL structures and is not in the Department's current plan for replacement. The detour for Downing Bridge is approximately 65 miles. Based on the official AADT Traffic Data for 2018, the AADT on Downing Bridge is approximately between 13,000 and 14,000 vehicles per day. Available information from the traffic monitoring system indicates that between 1997 and 2018, the traffic growth was estimated at an average of approximately 0.5 to 0.8 percent per year.

FEASIBILITY ANALYSIS

INPUTS AND ASSUMPTIONS

The P3 Office used various resources to develop inputs to the feasibility analysis, including information from VDOT Fredericksburg District Office, Asset Management Division, Traffic Engineering Division, and Tolling Division. The P3 Office also reviewed the 2018 Governor's Advisory Council Revenue Estimates ("GACRE") report and financing assumption related to other P3 projects.

ESTIMATED COST OF REPLACEMENT OF BRIDGES

The estimated cost of replacement of Norris Bridge is based on the 2018 Special Structures Report to the General Assembly and the 2019 Special Structures Systematic Statewide

Long Term Plan. Downing Bridge is not currently part of the Department's replacement plan, therefore, the estimated cost of replacement is based on the Department's Project Cost Estimating System (PCES). The estimated ranges of order of magnitude costs for replacement of the Bridges shown in Table A are based on conceptual studies and will require additional engineering analysis to determine actual cost of replacement.

FINANCING TERMS AND DEBT INSTRUMENT

In all tolling scenarios analyzed in this study, the Commonwealth is assumed to be the preferred issuer of the tax-exempt debt. The analysis assume that tax-exempt bonds are considered general obligation bonds pursuant to Article X, Section 9(c) of the Constitution of Virginia ("9c bonds"). These bonds do not require voter approval but do require a two-thirds majority approval by each house of the General Assembly. Further, because the bonds have a general obligation ("GO") pledge of all Commonwealth revenues, the General Assembly approved debt authorization requires the Governor to opine that net project revenues will be sufficient to pay the debt service on the bonds. The Commonwealth's toll revenue bonds are rated Aaa/AAA/AAA resulting in the lowest interest rates for long-term borrowing. Table A summarizes the inputs used in the analysis.

Table A
Inputs and Assumptions

Input	Range
Estimated replacement costs (2019$)	
Norris Bridge	$320m - $350m
Downing Bridge	$80m - $100m
Operations and routine maintenance	Based on existing routine and major maintenance costs
Revenue and cost escalation factor	2.4 percent per year
Assumed financing term	35 years
Type of debt instrument	Tax-exempt bonds

FINANCIAL FEASIBILITY SCENARIOS

The P3 Office developed a range of feasibility scenarios to analyze the financing capabilities of the Bridges as (i) self-supporting assets whether stand-alone or bundled for financial or operational efficiencies, and (ii) requiring alternate source(s) of funding in additional to tolls. Table B shows a summary of various scenarios analyzed for the purposes of this study.

Table B
List of Scenarios

Scenario	Norris Bridge	Downing Bridge
A1 (self-supporting – tolls only)	✓	
B1 (self-supporting – tolls only)		✓
C1 (self-supporting – tolls only)	✓	✓
A2 (require additional funding)	✓	
B2 (require additional funding)		✓
C2 (require additional funding)	✓	✓

ASSUMPTIONS RELATED TO PROJECTED REVENUE ESTIMATION

The analysis assumes that tolls would be the primary source of revenue to cover debt service on tax-exempt bonds issued to finance replacement costs of the Bridges. The P3 Office analyzed a range of toll rates to optimize debt financing options.

Scenarios A1, B1, and C1 estimate toll rates needed to self-support the financing of the cost of replacement. Scenarios A2, B2, and C2 assume a preset toll rate to determine if self-supporting financing can be achieved under lower tolls. All scenarios assume 3+axle toll rate set at double the amount of the 2+axle toll rate.

PROJECTED RANGE OF DEBT FINANCING AND OTHER SOURCE OF FUNDING

As noted above, Scenarios A1, B1, and C1 aim to secure a range of debt financing sufficient to cover 100 percent of the replacement and operations costs of the Bridges including tolling operations, routine maintenance, and major maintenance of the entire assets. Scenarios A2, B3, and C2 examine the range of debt financing that could be secured based on maintaining the toll rates at $1 - $1.50 (for 2-axle vehicles) and $2 - $3 (for 3+axle vehicles).

Based on the inputs and assumptions in Table A, including the above revenue estimation assumptions, the estimated range of financing options are as follows:

Table C

Projected Range of Debt Financing and Other Source of Funding

Scenario	Bridge	Estimated Debt Capacity	Estimated Upfront Contribution[1]	Estimated Annual Contribution[2]	Estimated 2-axle Toll Rate	Estimated 3-axle Toll Rate
A1 (self-supporting)	Norris	$345m - $375m	$0	$0	$6.5 - $7.5	$13 - $15
B1 (self-supporting)	Downing	$95m - $115m	$0	$0	$3 - $4	$6 - $8
C1 (self-supporting)	Norris & Downing	$440m - $470m	$0	$0	$5 - $5.75	$10 - $11.5
A2 (require additional funding)	Norris	$25m - $30m	$290m - $300m	$3.5m - $7m	$1 - $1.50	$2 - $3
B2 (require additional funding)	Downing	$10m - $20m	$80m - $90m	$1m - $3m	$1 - $1.50	$2 - $3
C2 (require additional funding)	Norris & Downing	$65m - $75m	$330m - $360m	$6m - $15m	$1 - $1.50	$2 - $3

[1] Represents estimated upfront Commonwealth contribution for construction.

[2] Represents estimated annual Commonwealth contribution to support debt service, tolling operations, routine, and major maintenance on the entire asset due to insufficient toll revenues.

As shown in Table C, Scenarios A1, B1, and C1 result in sufficient funding of the cost of replacement of the Bridges. However, the funding source under these scenarios may require toll rates to be at a level that may not be economically feasible for the region.

Scenarios A2, B3, and C2, which consider various sensitivities to revenue and cost inflation factors, indicate a much lower debt capacity based on an estimated lower toll rates ranging from $1.00 to $3.00 per trip. As a result, toll revenues are insufficient to support 100 percent of the cost of replacement of the Bridges. Accordingly, estimated upfront Commonwealth contribution to support construction cost ranges from $90m to $360m. Furthermore, the Commonwealth would be required to make annual contributions ranging from $1m to $15m to support annual debt service, tolling operations, routine, and major maintenance (e.g. availability payment or other source as determined by CTB and General Assembly).

A more detailed traffic and revenue study, including socioeconomic impacts, would help determine the optimal toll rate that would be more economically feasible for the region.

PRIVATE SECTOR INPUT ON BRIDGE REPLACEMENTS

On September 18, 2019, the P3 Office released a Request for Information (RFI) to the private sector requesting feedback on potentially one or more opportunities to rehabilitate, maintain and/or replace movable bridges, tunnels and complex structures, which have been classified as "Special Structures," as more fully described in the "VITAL Infrastructure Report, 2018 Appropriations Act, Budget Item 450 H." Norris Bridge was identified as one of the "Special Structures" that are subject of the RFI.

VDOT received responses to the RFI on November 18, 2019. Among the thirteen respondents, two indicated that Norris Bridge could potentially be bundled with other Special Structures, while four indicated that Norris Bridge should be a stand-alone project. Three respondents proposed a financing mechanism combining a toll based structure with traditional state funding and/or availability payments.

SUMMARY

Based on the results of the high-level financial feasibility analysis, other sources of funding, in addition to tolls may be required to design, build, operate, and maintain the replacement of the Bridges. This conclusion is furthered by industry feedback (from RFI responses) proposing a hybrid/combination of financing mechanisms for Norris Bridge. A more detailed traffic and revenue study would be needed in order to fully determine an acceptable level of tolling on the Bridges that make economic sense.

APPENDIX C
SPECIAL STRUCTURES P3 RFI RESPONSES

VDOT
Virginia Department of Transportation

Statewide Special Structures Report on Responses Received to Request for Information

Background

On September 18, 2019, the Virginia Department of Transportation (VDOT) Office of Public Private Partnerships released a Request for Information (RFI) to the private sector requesting feedback on potentially one or more opportunities to rehabilitate, maintain and/or replace 17 movable bridges, tunnels and complex structures, which have been classified as "Special Structures" (collectively, the "Projects"). While the "VITAL Infrastructure Report, 2018 Appropriations Act, Budget Item 450 H", identifies 25 Special Structures, 17 have been identified as not currently covered by existing contracts or ongoing projects.[1] A copy of the RFI is included as Appendix A. Responses were due on November 18, 2019.

VDOT is currently exploring options to procure and deliver the Special Structures under the Public Private Partnership Act of 1995 (PPTA). VDOT is also considering options to bundle one or more of the Special Structures with other transportation facilities in the Commonwealth to rehabilitate, replace, operate and/or maintain, leveraging a single delivery model and multiple funding options.

VDOT received responses to the RFI from 13 firms. This report summarizes the key findings of feedback received from the private sector regarding the delivery and funding/financing of the Special Structures. It does not analyze the financial or legal feasibility of the options suggested by the respondents.

Key Observations and Conclusions

Some of the key observations from the RFI responses include:

- Of the nine respondents that recommended specific bundling approaches, almost 90% recommended a geographic approach to bundling. Of these same respondents, almost 60% recommended bundling movable bridges together and 30% recommended bundling the special structures with other interconnecting roadway assets.

  The feasibility of imposing tolls or user fees for these proposed geographic bundles is limited by applicable statutory and common law. See, e.g. Va. Code § 33.2-309(D); Elizabeth *River Crossings*

[1] The Special Structures not included in this report are: High Rise Bridge and its approaches, Elizabeth River Tunnels - Midtown, Elizabeth River Tunnels – Downtown, Hampton Roads Bridge Tunnel Approaches, Willoughby Bay Bridge, 895/Pocahontas Parkway, and Smart Road Bridge. Except for Smart Road Bridge which is part of an ongoing project, all other assets are subject of existing contracts.

OpCo, LLC v. Meeks ("Meeks"), 749 S.E.2d 176, 183 (Va. 2013) and Corr v. Metropolitan Washington Airports Authority ("Corr") 702 F.3d 1334, 1338 (Fed. Cir. 2012).

- For an overall delivery approach to the various Special Structures, a DBFOM model was preferred by the most respondents (11 out of 13), with a form of turnkey model (DB or DBB) being the second most preferred model (10 out of 13). Specifically, some of the respondents proposed a DBFOM model with an availability payment financing mechanism (7 out of 13) on some or all of the Special Structures.

  The longer-term structure of a DBFOM was considered attractive due to benefits of a having single-point accountability, whole-life costing approach, optimal risk transfers, increases in efficiency, and improved delivery.

- Availability payments (APs) were the most preferred means of financing these projects (12 out of 13 respondents), while a smaller subset of respondents agreed some form of a toll concession could be pursued (7 out of 13 respondents). Some respondents proposed a financing structure primarily based on APs and supplemented by tolls or user fees (4 out of 13 respondents). All respondents were aware that enabling legislation would be required to authorize APs.

  Generally, respondents qualified that the viability of imposing tolls on existing capacities would depend on stakeholder and political acceptance. Some respondents (2 out of 13 respondents) expressly stated that they were not recommending a toll concession for any of the 17 Special Structures due to the geographic dispersion or low volume traffic of the assets.

Overview of Respondents

Responses were received from developers, financial investors, design-build contractors, and engineering contractors. Responses were received from the following firms:

- ACS Infrastructure Development, Inc./Dragados USA (Developer/DB Contractor)
- Archer Western Construction LLC/Walsh Investors LLC/Walsh Infrastructure Management (Developer/DB Contractor)
- Arup (Engineering Contractor)
- DIF Capital Partners/American Roads LLC (Developer/Financial Investor)
- Fluor Enterprises, Inc.(Developer/DB Contractor)
- Global Via (Developer/Operator)
- Itinera Infrastructure and Concessions/Halmar International (Developer/DB Contractor)
- John Laing Investments, Ltd. (Developer/Financial Investor)
- Kiewit Development Company (Developer/DB Contractor)
- The Lane Construction Corporation (DB Contractor)
- Macquarie Capital (Developer/Financial Investor)
- Parsons Transportation Group (Developer/Engineering Consultant)
- Shikun & Binui Concessions, Inc. (Developer/DB Contractor)

The majority of responses were received from developers, many of which have a demonstrated history of making equity investments in large infrastructure projects across the United States. Additionally, several of the RFI respondents noted that they have a history of working with the Commonwealth on alternative

project delivery projects, including project development, construction, and/or operations and maintenance responsibilities.

Several of the developers are established construction firms, with significant experience in providing delivery solutions for clients across North America. These respondents have highlighted their ability to contribute equity and serve as project lead, while taking on construction and O&M responsibilities. Such firms include ACS/Dragados, Archer Western/Walsh Investors/Walsh Infrastructure Management, Itinera/Halmar International, Kiewit, Parsons, and Shikun & Binui.

Other developers have noted experience in developing and providing equity investment in projects, while teaming with design, construction, and operations and maintenance partners to form bidding consortiums that meet the necessary requirements and outcomes desired by the public sponsor. These developers include John Laing and Macquarie Capital. DIF/American Roads and Global Via have a history of maintaining responsibility for operations and maintenance in additional to providing equity and serving as developer, while engaging contractors to complete construction works.

Fluor and Lane Construction have a history of providing mainly lead construction contractor services. Arup, an engineering contractor, which provides technical advisory services for highway, tunneling, and other construction works, assisted in the procurement and delivery of the Elizabeth River Crossing Project and the Pennsylvania Rapid Bridge Replacement Project.

RFI Questions & Responses

Respondents were asked to complete Table 1 (attached as **Appendix A**) which lists the 17 Special Structures, and requests that respondents indicate for each asset the most appropriate delivery model(s), most appropriate financing mechanism(s), bundling considerations, benefits and considerations, and other commentary. Respondents were also asked to address the following questions. Feedback and answers to these questions are summarized after each question below.

1. *Table 1 lists seventeen (17) Special Structures. Please fill in the table based on which facilities you think should be pursued through the below noted delivery models – it is not required that the information is provided for each of the seventeen (17) Special Structures.*

As requested by the RFI, respondents filled in Table 1 to note which facilities should be pursued using various delivery models. This feedback has been summarized under question 2b below.

2. *VDOT developed the Special Structures 30-Year Plan ("the Plan"), using an asset management approach, which focuses on timely rehabilitation and preservation actions to maintain the structures in fair or good condition. However, where rehabilitation is no longer cost-effective, the Plan includes the replacement cost for the specified structures. VDOT has considered several project delivery options for the rehabilitation/replacement work for each facility, including:*
   - *a turnkey approach where the facility is turned over to VDOT for operations after rehabilitation or replacement is completed, and*
   - *a rehabilitate and operate approach where a private entity is allowed to operate and/or maintain the facility after rehabilitation or replacement is completed to recoup costs either through a toll concession or other financing mechanism.*

   a) *Which delivery model and financing mechanism are most appropriate for the Special Structures? Please fill out your responses in Table 1 provided below. If you think there are other more appropriate project delivery models or financing mechanisms that should be considered, which are not included in the list above, please note them.*

Discussion of the most appropriate delivery models and financing mechanisms for the Special Structures as identified by the RFI respondents are summarized under question 2b below.

b) *Please highlight the benefits and considerations of the delivery models and financing mechanisms you think are most well suited for the Special Structures. Also please identify any key features that may make a specific delivery model not suitable for a specific delivery model. Please include these answers in Table 1.*

Delivery Models

The RFI responses varied, but in general, respondents showed preference in delivery models that transferred long-term responsibilities and risks to the private sector. Eleven of the 13 respondents suggested that a form of a DBFOM delivery model be pursued for at least some of the Special Structures that would include rehabilitation, operations and/or maintenance obligations be given to the selected concessionaire. The DBFOM delivery model was primarily preferred due to the benefits of a whole-life costing approach, transfer of risk to the party best suited to manage such risks, cost optimization and

increases in efficiency, improved project delivery timeframes, decreased likelihood of delays or cost overruns, and improved positioning for long-term maintenance and lifecycle obligations when the consortium responsible for construction also operates and maintains the Special Structures.

There was also interest in turnkey solutions (DB or DBB), which represented the second most popular delivery model choice with 10 of 13 respondents recommending it. Multiple respondents noted DB delivery as the most appropriate for Projects that are geographically isolated from others or those that were proposed as bundles. DBB was also suggested for geographically isolated Special Structures, those considered particularly complex, or those with an unusual scope of work.

Recommended by fewer respondents, 4 of the 13, were the DBF and DBFM delivery models. Responses gravitated toward turnkey or full rehabilitate and operate models, with less interest in taking on only financing and/or maintenance responsibilities incremental to turnkey delivery.

One-off responses included the suggested uses of either "Progressive P3s" or construction-manager-at-risk procurement methods. Under a Progressive P3, the scope of the procurement is developed and optimized to align with public sector cash flow constraints. Decisions on design, construction, operations and maintenance, lifecycle, and financing responsibility are based on the needs of the project as they develop. Under construction-manager-at-risk, design responsibilities remain with the procuring agency and construction works are contracted at a fixed price in order to increase cost certainty for the Commonwealth.

Respondents' backgrounds and industry types generally had some correlation with their preferred delivery models. All respondents categorized as Developers/Financial Investors felt that a DBFOM was appropriate for at least some of the Projects, and the respondents categorized as DB contractors without a developer focus more often viewed turnkey as the optimal solution for each of the Special Structures.

Financing Mechanisms

Among the RFI responses, support was strongest for an availability payment (AP) mechanism, with 12 of 13 respondents recommending such a mechanism. Respondents proposed forms of performance-based AP mechanisms or monthly level payments during the operations period.

Seven of 13 respondents proposed that a demand risk toll concession could be pursued for at least a few of the Projects. Respondents tended to show preference of APs over the use of toll concessions, noting that many (including the Benjamin Harrison, Varina-Enon, Eltham Bridges, Gwynn's Island and Norris Bridges) of the Special Structures did not lend themselves well to tolling, either due to geographic location, or limited usage. Some respondents pointed out that legally, tolling may not be implemented in the Commonwealth without capacity expansion, rehabilitation and/or improvements, which a few of the Special Structures may not require. For structures not currently tolled and/or without a free alternative, some responses noted the likelihood of strong stakeholder opposition. Sole reliance on tolls as the payment mechanism may require high toll rates given low traffic volumes on many of the Special Structures, likely leading to strong public and political opposition. While the AP mechanism was preferred, several respondents who suggested APs noted that enabling legislation would be required.

Four of the 13 respondents suggested that a hybrid financing mechanism may be appropriate for Projects delivered under a long-term agreement. One possibility was combining elements of a revenue-risk toll

concession (whereby the private sector takes some degree of revenue risk), complimented by APs to increase financial feasibility. This structure would reduce the APs required by the Commonwealth and introduce the potential for revenue upside to the private sector. Another possibility was providing a floor or minimum amount of tolling revenue to the selected concessionaire to reduce the demand risk taken by the private sector. Conversely, it was suggested that revenue risk remain with the Commonwealth via the introduction of tolling but that amounts collected could be used to fund availability payments. These hybrid structures varied in terms of which party takes on demand risk and consequently, the amount of upside offered to potential concessionaires.

Some respondents identified milestone, progress payments, and/or final acceptance payments as a preferred mechanism, which could be combined with generated toll revenue or availability payments under a long-term concession in order to provide adequate compensation for the design, construction, operation and/or maintenance of the Projects. For those recommending turnkey delivery models, pay-go funding and/or the incurrence of additional Commonwealth debt was recommended. Lastly, short-term bank or bond financing was discussed as a possibility for deferring VDOT payment obligations and accelerating Projects development.

One respondent suggested the creation of a tolling authority to manage the toll revenues of multiple Special Structures. This authority would allow for the aggregation of toll revenues from different assets across the state and/or within a bundle, which could be used for the rehabilitation and replacement of the Special Structures. One of the respondents supporting a demand-risk toll concession discussed that there would be an opportunity to support the operations and capital costs for several assets through local user fees generated from just three Special Structures around the Hampton Roads area with high average daily traffic and significant detour lengths. We note however that the feasibility of these proposals are limited by applicable statutory and common law. See, e.g. Va. Code § 33.2-309(D); Elizabeth *River Crossings OpCo, LLC v. Meeks ("Meeks"), 749 S.E.2d 176, 183 (Va. 2013) and Corr v. Metropolitan Washington Airports Authority ("Corr") 702 F.3d 1334, 1338 (Fed. Cir. 2012)*.

c) *What would be your organization's envisioned role under the proposed delivery model?*

As the majority of responses were received from developers, 11 of 13 respondents envisioned taking on the role of equity sponsor and developer in delivering the Special Structures. Respondents pointed to their flexibility to pursue project delivery under various delivery models, with increasing involvement envisioned as additional risks and responsibilities were transferred to the private sector. To the extent projects are delivered using a turnkey approach with project financing responsibilities remaining with the Commonwealth, many respondents were still interested in taking on design, construction, operation and/or maintenance works, particularly those with a demonstrated history of general and/or O&M contracting. Of the 10 respondents interested in an equity sponsor and developer role, 7 would also serve as construction and O&M lead contractor.

One respondent discussed interest in serving as technical and financial advisor to the Commonwealth in the procurement process, and one other firm expressed interest in serving as lead contractor on any capital maintenance and/or replacement of any of the Special Structures.

d) *Please provide any feedback you may have on whether VDOT should deliver the Projects as a public private partnership (P3) under the PPTA or through traditional delivery methods. Please provide rationale for your stated preference.*

Eleven of 13 RFI responses viewed a P3 delivery method to be favorable for at least some of the Special Structures, although this recommendation varied on either a project-by-project or bundle-by-bundle basis for many of the respondents. Such responses centered on favorable aspects of a P3, including reducing the Commonwealth's upfront funding obligations, accelerated Projects delivery, improved cost certainty, and increased consideration of whole-life costs at the onset of construction and rehabilitation works. Several responses highlighted that the use of P3s encourages minimum performance standards to be met or exceeded throughout the concession, providing certainty around expected levels of service and asset condition. As highlighted in the feedback received in response to question 2b, recommendations varied regarding the most optimal allocations of risk transfer between the public and private sectors.

One firm viewed traditional delivery methods as most optimal for delivery of each of the Projects, citing that a long concession is likely to result in higher bids due to inflation, labor market uncertainty, and evolving technology over the course of the concession. The response noted that generating a reasonable and reliable estimate for long-term repairs given the variable horizon on project scope delivery is unrealistic and not an attractive business model to pursue.

3. *VDOT will consider opportunities to bundle any of the Special Structures with other transportation facilities in the Commonwealth into a single project to rehabilitate and/or replace, operate and maintain, under a single delivery model and payment, at a pre-agreed payment amount.*
    a) *Which, if any, of the Special Structures are suitable to be bundled with other transportation facilities? Please identify which other Commonwealth transportation facility should be bundled with the specific Special Structure.*

Bundling

The *Bundling Map* below indicates which Special Structures were bundled together most frequently by respondents to the RFI (note: the map is not inclusive of all bundles mentioned, but rather those that were commonly suggested among respondents, which suggested specific structures in bundles (9 of 13)). Several themes were apparent among RFI respondents describing what attributes caused certain Special Structure to be bundled with one another:

- Comparable scale
- Close proximity to one and other
- Similar technical nature
- Interdependent nature between structures (i.e approaches and bridges were popular to bundle together)

The main benefits of bundling were noted as the following:

- Economies of scale
- Cost synergies

- Time savings / accelerated project delivery
- Mobility improvements and long term cost reduction
- Interchangeability of parts circuitry and centralized storage

The primary drivers of bundling were the proximity of the bundled structures to one and other, and technical similarity. Nearly 90% of RFI respondents recommended a geographic approach to bundling for execution efficiencies, maximizing resources and work force, comprehensive incident management, and providing centralized storage. Approximately 60% of RFI respondents recommended bundling movable bridges together to enhance interchangeability of machined parts, circuitry and specialized expertise required.

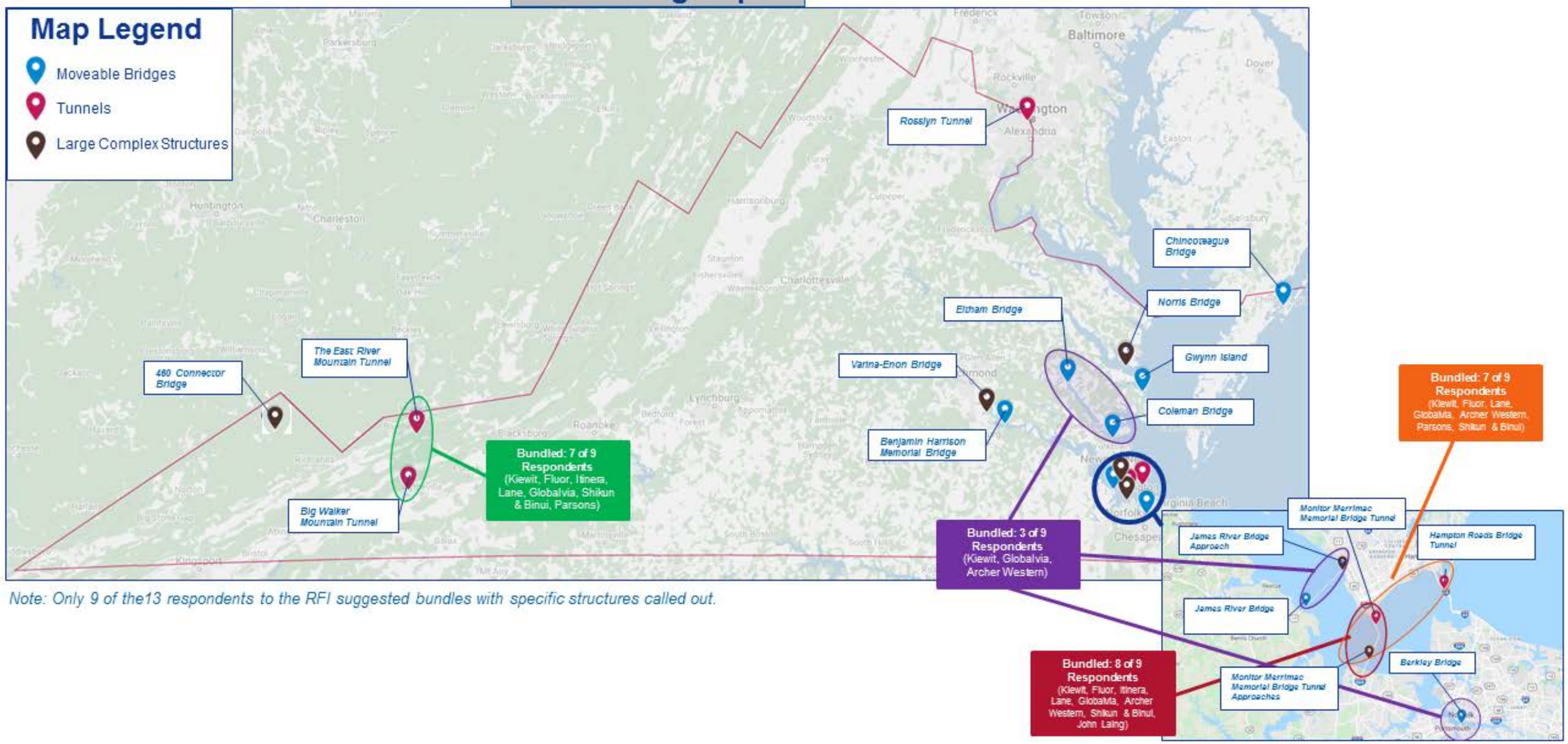
Some respondents recommended bundling certain Special Structures with interconnecting roadway assets. One respondent recommended that the existing Hampton Roads Bridge Tunnel be bundled with the HR Express Lanes Network. One respondent proposed bundling the Big Walker Mountain Tunnel and the East River Mountain Tunnel with roadway improvements on the I-77 segment from I-81 to the West Virginia State line. Nonetheless, bundling recommendations overwhelmingly proposed that Special Structures be bundled with other Special Structures.

> b) *Please highlight key considerations in relation to a bundling approach and long-term maintenance.*

Respondents felt bundling provided significant efficiencies, extended service life, and allowed acceleration of delivery (potentially significant acceleration in the first decade of VDOT's plan). Movable bridges were the most frequent Special Structures advised to be bundled, reflected on the *Bundling Map* in the form of a light blue pin, with the reasoning being they combined specialty aspects of the structures and geographical grouping. Tunnels, reflected as red pins on the *Bundling Map*, were recommended for bundling frequently as well. The driver behind tunnel bundling was geographical, with the pairing of the mountain tunnels together and the Hampton Roads tunnels together, as examples.

There were a few more nuanced bundling situations that were suggested. Varina-Enon Bridge was a candidate for bundling only as part of a major geographic package for either southeast Virginia, statewide or as a separate bundle specifically for bridge replacements. On the subject of maintenance, only one respondent felt maintenance across a large geography (statewide) was advisable, with most other respondents preferring keeping maintenance responsibilities within close proximity of one another.

Bundling Map



Note: Only 9 of the13 respondents to the RFI suggested bundles with specific structures called out.

Appendix A

Statewide Special Structures
Request for Information

REQUEST FOR INFORMATION

REGARDING PROJECT DELIVERY APPROACHES FOR SPECIAL STRUCTURES BY THE VIRGINIA DEPARTMENT OF TRANSPORTATION

RFI Issuance Date: September 18, 2019

Response Letter Due: November 18, 2019 at 4:00 p.m.

POINT OF CONTACT:	**RESPONSE LETTERS:**
All inquiries regarding this RFI are to be directed to the following Point of Contact: **Marguerite Lucila, Esq.** Program Manager Office of Public-Private Partnerships Virginia Department of Transportation 1401 E. Broad Street Richmond, VA 23219 Statewidespecialstructures@vdot.virginia.gov	If submitting a response letter, email it to Statewidespecialstructures@vdot.virginia.gov by November 18, 2019 at 4:00 p.m. All times are local.

1. INTRODUCTION

The Virginia Department of Transportation ("VDOT") is issuing this Request for Information ("RFI") to solicit private-sector feedback on potentially one or more opportunities to rehabilitate, maintain and/or potentially replace movable bridges, tunnels and complex structures, which have been classified as "Special Structures" (collectively, the "Projects"), and identified in the "VITAL Infrastructure Report, 2018 Appropriations Act, Budget Item 450 H" (the "Report," attached hereto as Appendix A). As indicated in the Report, VDOT has identified twenty-five (25) Special Structures. VDOT is requesting a response on the seventeen (17) indicated in the attached table, which are not currently covered by existing contracts or ongoing projects to rehabilitate, replace, maintain and/or operate the facility.

The Commonwealth is considering the suitability of the Projects for procurement and delivery under the Public Private Partnership Transportation Act of 1995 (PPTA) (Reference: Chapter 349 of the Acts of Assembly). The purpose of this RFI is to inform the decision making process regarding the Projects' delivery method, bundling opportunities and potential financing structures. This RFI is an inquiry only and does not commit VDOT to any specific form of procurement, delivery method or financing structure. No contract or agreement will be entered into as a result of this process, nor does this RFI initiate a formal procurement or represent a commitment to issue an RFQ or an RFP in the future. However, the responses to this RFI will inform the planning and development efforts for the Projects.

This RFI requests market engagement in the form of response letters providing answers to three questions, as outlined in Section 4.

Responding to this RFI is not a prerequisite to participating in a future procurement process. Accordingly, respondents to this RFI will not be deemed *proposers* on the Projects by virtue of providing a response, and no respondent will have any advantage or disadvantage in any subsequent procurement process related to the Projects.

2. THE PROJECTS

As part of its ongoing asset management approach, VDOT identified Special Structures that, if allowed to deteriorate to poor condition or fail, would pose significant risks to the efficient movement of people and goods. Seventeen (17) movable bridges, tunnels and complex structures throughout the Commonwealth meet this definition and are identified in Table 1 below.

Using an asset management approach, VDOT has developed a 30-year plan to estimate the cost of timely rehabilitation and preservation actions needed to maintain the structures in fair or good condition. Where necessary, the replacement cost of specified facilities has been included. As of December 2018, the total cost is roughly estimated at $2.531 billion (summarized below).

3) Minimize the need for long-term maintenance of newly-rehabilitated or replaced facility, through the use of innovative technology

4. RESPONSE LETTER

Interested parties are invited to provide response letters to help refine VDOT's assumptions related to the Projects' delivery and financing. The response shall consist of a one- page transmittal letter plus an attachment having a maximum length of 12 pages including the table below; no marketing material, budgetary information, or proprietary information is requested. **Entities desiring to provide a response letter must submit it by email to Statewidespecialstructures@vdot.virginia.gov by the date and time specified on the cover page of this RFI.**

The attachment shall address the following questions:

1. Table 1 lists seventeen (17) Special Structures. Please fill in the table based on which facilities you think should be pursued through the below noted delivery models – it is not required that the information is provided for each of the seventeen (17) Special Structures.

2. VDOT developed the Special Structures 30-Year Plan ("the Plan"), using an asset management approach, which focuses on timely rehabilitation and preservation actions to maintain the structures in fair or good condition. However, where rehabilitation is no longer cost-effective, the Plan includes the replacement cost for the specified structures. VDOT has considered several project delivery options for the rehabilitation/replacement work for each facility, including:
    - a turn-key approach where the facility is turned over to VDOT for operations after rehabilitation or replacement is completed, and
    - a rehabilitate and operate approach where a private entity is allowed to operate and/or maintain the facility after rehabilitation or replacement is completed to recoup costs either through a toll concession or other financing mechanism.

    a. Which delivery model and financing mechanism are most appropriate for the Special Structures? Please fill out your responses in Table 1 provided below. If you think there are other more appropriate project delivery models or financing mechanisms that should be considered, which are not included in the list above, please note them.
    b. Please highlight the benefits and considerations of the delivery models and financing mechanisms you think are most well suited for the Special Structures. Also please identify any key features that may make a specific delivery model not suitable for a specific delivery model. Please include these answers in Table 1.
    c. What would be your organization's envisioned role under the proposed delivery model?
    d. Please provide any feedback you may have on whether VDOT should deliver the Projects as a public private partnership (P3) under the PPTA or through traditional delivery methods. Please provide rationale for your stated preference.

3. VDOT will consider opportunities to bundle any of the Special Structures with other

transportation facilities in the Commonwealth into a single project to rehabilitate and/or replace, operate and maintain, under a single delivery model and payment, at a pre-agreed payment amount.

a. Which, if any, of the Special Structures are suitable to be bundled with other transportation facilities? Please identify which other Commonwealth transportation facility should be bundled with the specific Special Structure.
b. Please highlight key considerations in relation to a bundling approach and long-term maintenance.

TABLE 1

	Special Structure	Most appropriate Delivery Model(s)	Most appropriate Financing Mechanism(s)	Appropriate for bundling with other facilities and, if yes, with which other facilities?	Benefits and Considerations	Other Comments about the Special Structure, bundled facility, Delivery Model, Financing Mechanism, or bundling opportunity
	MOVABLE BRIDGES					
#1	Benjamin Harrison Bridge					
#2	Chincoteague Bridge					
#3	Berkley Bridge					
#4	Coleman Bridge					
#5	James River Bridge					
#6	Eltham Bridge					
#7	Gwynn Island Bridge					

TUNNELS						
#8	Big Walker Mountain Tunnel					
#9	East River Mountain Tunnel					
#10	Hampton Roads Bridge-Tunnel					
#11	Monitor Merrimac Memorial Bridge Tunnel					
#12	Rosslyn Tunnel					
COMPLEX STRUCTURES						
#13	460 Connector Bridge					
#14	Varina-Enon Bridge					
#15	Monitor Merrimac Memorial Bridge Tunnel Approaches					
#16	James River Bridge Approaches					
#17	Norris Bridge					

5. SCHEDULE

Milestones	Date Expected
Release of RFI	September 18, 2019
Response Letter Submittal Deadline	November 18, 2019, 4:00 PM

6. CLARIFICATIONS

Respondents may address any clarifications to the point of contact above. Any clarifications by VDOT will be communicated through the VDOT P3 Office website.

7. POTENTIAL FOLLOW UP DISCUSSIONS

After written responses are received, VDOT may have follow-up discussions with respondents on questions or clarifications regarding the information provided by respondents in this RFI.

8. CONFIDENTIALITY

Respondents are advised that any written materials submitted to VDOT in connection with this RFI are public records subject to the Virginia Freedom of Information Act ("FOIA"), § 2.2-3700 of the Code of Virginia. This statute guarantees access for Commonwealth citizens and media representatives to public records held by public bodies, officials, and employees.

Any materials submitted by respondents shall be handled in accordance with the Virginia FOIA and any other laws and regulations applicable to the disclosure of documents submitted under this RFI. In no event shall VDOT or any of their agents, representatives, consultants, or employees be liable to a respondent for the disclosure of any materials or information submitted in response to this RFI.

Appendix B
Summary of Responses on Bundling

	Firm	Bundling
1	DIF/American Roads	Many bundling combinations exist between VDOT's 17 Special Structures; exact pairing would require additional information and discussions
2	Lane Construction	Moveable Bridges: ; All Movable Bridges Tunnels: HRBT Tunnel + HR Express Lanes Network; Big Walker Mountain Tunnel + East River Mountain Tunnel
3	Parsons	Bridge Replacements, Movable Bridges & Tunnels: Each could be bundled separately Other Facilities: Adjacent interstate facilities on I-64 to the Hampton Roads Bridge-Tunnel and I-664 to the Monitor-Merrimac Memorial Bridge-Tunnel
4	Global Via	Group A: Benjamin Harrison Bridge; Berkley Bridge; Coleman Bridge; James River Bridge; Eltham Bridge; Hampton Roads Bridge-Tunnel; Monitor Merrimac Memorial Bridge Tunnel; Varina-Enon Bridge; Monitor Merrimac Memorial Bridge Tunnel Approaches; James River Bridge Approaches Group B: Big Walker Mountain Tunnel; East River Mountain Tunnel Standalone DB/Turnkey: Chincoteague Bridge; Gwynn Island Bridge; Norris Bridge
5	Fluor	Bundle 1: Berkley Bridge; James River Bridge; James River Bridge Approaches; Hampton Roads Bridge Tunnel; Monitor Merrimac Memorial Bridge Tunnel; Monitor Merrimac Memorial Bridge Tunnel Approaches (along with I-64 from Route 258 to I-264; I-664 from I-64 to I-264; I-264 from I-664 to I-64; Route 17 from I-64 to I-664) Bundle 2: Big Walker Mountain Tunnel; East River Mountain Tunnel (along with I-77 from I-81 to the West Virginia State Line)
6	Shikun & Binui	Movable Bridges & Complex Structures: Berkley Bridge; Coleman Bridge; James River Bridge; James River Bridge Approaches Tunnels: Big Walker Mountain Tunnel; East River Mountain Tunnel; Hampton Roads Bridge-Tunnel; Monitor Merrimac Memorial Bridge Tunnel; Monitor Merrimac Memorial Bridge Tunnel Approaches
7	Macquarie Capital	Moveable Bridges & Complex Structures: Bundled together
8	Itinera	Movable Bridges: Benjamin Harrison Bridge; Berkley Bridge; Coleman Bridge; Eltham Bridge; Gwynn Island Bridge Movable Bridge & Large Complex Structure: James River Bridge; James River Bridge Approaches Tunnels & Large Complex Structure: Big Walker Mountain Tunnel; East River Mountain Tunnel; 460 Connector Bridge Tunnel & Related Structures: Hampton Roads Bridge-Tunnel (along with HRBT North Approaches Bridge; Hampton Roads South Approach Bridge; Willoughby Bay Bridge) Tunnel & Large Complex Structure: Monitor Merrimac Memorial Bridge Tunnel; Monitor Merrimac Memorial Bridge Tunnel Approaches (along with MMMBT Approach Bridge & Tunnel & Approach Bridges)
9	Archer Western / Walsh Investors / Walsh Infrastructure Management	Recognizes that a geographical approach to bundling may be considered
10	Kiewit	Bundle 1: Benjamin Harrison Bridge; Berkley Bridge; Chincoteague Bridge; Coleman Bridge; James River Bridge; Eltham Bridge; Gwyn Island Bridge; Hampton Roads Bridge-Tunnel; Monitor Merrimac Memorial Bridge Tunnel; Rosslyn Tunnel; Varina-Enon Bridge; Monitor Merrimac Memorial Bridge Tunnel Approaches; James River Bridge Approaches; Norris Bridge Bundle 2: Big Walker Mountain Tunnel; East River Mountain Tunnel
11	ACS/Dragados	Moveable Bridges: VDOT can consider bundling using a rehabilitate and operate approach
12	John Laing	Bundle 1: Berkley Bridge; Eltham Bridge; Monitor Merrimac Memorial Bridge Tunnel; Rosslyn Tunnel; Varina-Enon Bridge; Monitor Merrimac Memorial Bridge Tunnel Approaches; Norris Bridge Bundle 2: Benjamin Harrison Bridge; Chincoteague Bridge; Coleman Bridge; James River Bridge; Gwyn Island Bridge; Hampton Roads Bridge-Tunnel; James River Bridge Approaches
13	Arup	Referred generally to bundling being favorable for a number of structures without mentioning which structures to bundle them with. Overall, bundling was expressed as optimal for 14 out of the 17 structures. Explicit Bundling Suggestions: James River Bridge and James River Bridge Approaches; Big Walker Mountain Tunnel and East River Mountain Tunnel; Monitor Merrimac Memorial Bridge Tunnel and Monitor Merrimac Memorial Bridge Tunnel Approaches

Appendix C

Summary of Responses on Delivery Models and Financing Mechanisms

			Delivery Models					Financing		
	Firm	Developer or DB?	Turnkey	DBF	DBFM	DBFOM	Others	Availability Payment	Toll Concession	Others
1	DIF/American Roads	Developer / Financial Investor	✓		✓	✓		✓	✓	
2	Lane Construction	DB Contractor	✓					✓	✓	✓
3	Parsons	Developer / Engineering Contractor	✓	✓		✓		✓		✓
4	Global Via	Developer	✓			✓			✓	
5	Fluor	Developer / DB Contractor				✓	✓	✓		✓
6	Shikun & Binui	Developer / DB Contractor	✓	✓		✓		✓	✓	✓
7	Macquarie Capital	Developer / Financial Investor				✓	✓	✓	✓	✓
8	Itinera	Developer / DB Contractor	✓		✓		✓	✓	✓	✓
9	Archer Western / Walsh Investors / Walsh Infrastructure Management	Developer / DB Contractor	✓			✓	✓	✓		✓
10	Kiewit	Developer / DB Contractor	✓	✓	✓	✓	✓	✓		✓
11	ACS/Dragados	Developer / DB Contractor		✓	✓	✓		✓		✓
12	John Laing	Developer / Financial Investor	✓			✓		✓		✓
13	Arup	Engineering Contractor	✓			✓		✓	✓	
		TOTAL	**10**	**4**	**4**	**11**	**5**	**12**	**7**	**10**