VIRGINIA

Department of Transportation

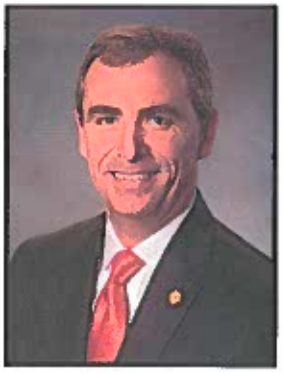
Biennial Report - 2018

VDOT
Virginia Department of Transportation

COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA 23219

Stephen C. Brich, P.E.
Commissioner



The Honorable Ralph Northam
The Honorable Shannon Valentine
Members of the General Assembly
Members of the Commonwealth Transportation Board

Dear Ladies and Gentlemen:

I am pleased to submit the Commissioner of Highways Biennial Report for 2018.

Section 33.2-232 of the *Code of Virginia* directs the Commissioner of Highways to provide the Governor, the General Assembly and the Commonwealth Transportation Board a biennial report.

To meet the requirements of the legislation, I am submitting this report, which includes the information required and explains the basis for investment in the surface transportation network maintained by the Virginia Department of Transportation.

If you have any questions, or need any additional information, please do not hesitate to contact me.

Sincerely,

Stephen C. Brich, P.E.
Commissioner of Highways

CONTENTS

Section 1: Asset Management Approach and Methodology

Section 1 of this report will cover items 1, 2, 3 and 5 listed in subsection B of § 33.2-232.

Section 2: Transportation Systems Management and Operations

Section 2 of this report will cover items 4 and 6 listed in subsection B of § 33.2-232.

Section 3: Collaboration with Private Sector

Section 3 of this report will cover item 7 listed in subsection B of § 33.2-232.

VDOT Overview

Based on § 33.2-232 subsections A and B of the *Code of Virginia,* the Commissioner of Highways (Commissioner) is to provide a biennial report* (in even-numbered years), with the contents specified by the Commonwealth Transportation Board (the Board)**. The minimum requirements of the report and the actual code language are presented below:

§ 33.2-232. Annual reports by Commissioner of Highways and the Office of Intermodal Planning and Investment.

A. The Secretary of Transportation shall ensure that the reports required under subsections B and C are provided in writing to the Governor, the General Assembly, and the Commonwealth Transportation Board by the dates specified.

B. The Commissioner of Highways shall provide to each recipient specified in subsection A, no later than November 1 of each even-numbered year, a report, the content of which shall be specified by the Board and shall contain, at a minimum:

1. The methodology used to determine maintenance needs, including an explanation of the transparent methodology used for the allocation of funds from the Highway Maintenance and Operating Fund pursuant to subsection A of § 33.2-352;

2. The methodology approved by the Board for the allocation of funds for state of good repair purposes as defined in § 33.2-369 and, if necessary, an explanation and rationale for any waiver of the cap provided for in subsection B of § 33.2-369;

3. The expenditures from the Highway Maintenance and Operating Program for the past fiscal year by asset class or activity and by construction district as well as the planned expenditure for the current fiscal year;

4. A description of transportation systems management and operations in the Commonwealth and the operating condition of primary and secondary state highways, including location and average duration of incidents;

5. A listing of prioritized pavement and bridge needs based on the priority ranking system developed by the Board pursuant to § 33.2-369 and a description of the priority ranking system;

6. A description of actions taken to improve highway operations within the Commonwealth, including the use of funds in the Innovation and Technology Transportation Fund established pursuant to § 33.2 -1531; and

7. A review of the Department's collaboration with the private sector in delivering services.

...

Section 33.2-232 subsections C and D are not shown. Based on § 33.2-232 subsection C, the Office of Intermodal Planning and Investment (OIPI) is to provide a biennial report (in odd-numbered years) explaining the outcomes of the surface transportation investment based on performance measures which are described, among other things, in the Commissioner's biennial report.

*This report provides an overview of the statutory requirements (see above), as well as the details of the Virginia Department of Transportation's processes and procedures. More technical discussion is available in the following reports:

- State of the Structures and Bridges (http://www.virginiadot.org/info/default.asp)
- State of the Pavement (http://www.virginiadot.org/info/default.asp)
- State of Good Repair Prioritization Process Methodology (http://www.ctb.virginia.gov/resources/2016/june/reso/Resolution1.pdf)

The Board approved the report requirements on October 30, 2018 - http://www.ctb.virginia.gov/resources/2018/oct/reso/15.pdf.**

VDOT Overview

9 Districts

1 Central Office

32 Residencies

95 Counties and 38 Independent Cities

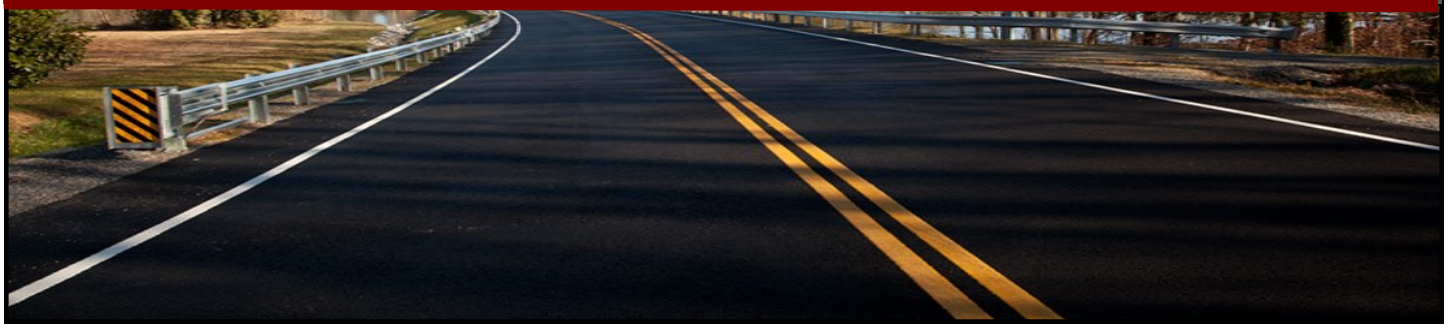
VDOT Inventory

128,561 lane miles*

21,154 Bridges**

VDOT maintains +25 Tunnels, Movable Bridges & Large, Complex, Fixed Span Bridges (VITAL Infrastructure)

+50 Years **Average Age of Assets**



*VDOT Lane Mile Inventory based on Table for State Highway Miles dated 12/31/2017
** VDOT Bridge Inventory based on Bridge Management System as of 7/1/2018

VDOT Overview

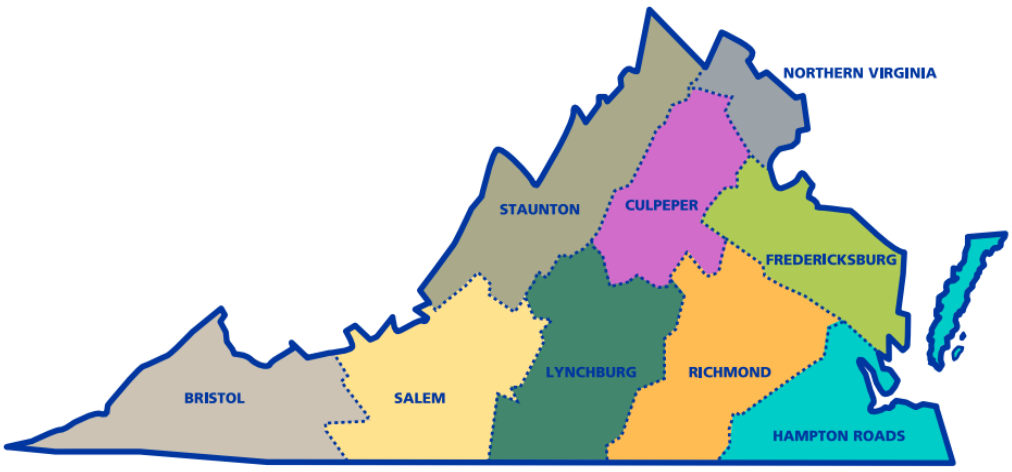
The Virginia Department of Transportation (VDOT) is responsible for building, maintaining and operating the Commonwealth's roads, bridges and tunnel systems. Virginia has the third largest state maintained highway system in the United States, behind Texas and North Carolina. VDOT is responsible for the maintenance and operation of approximately 128,600 lane miles of roadway and 21,200 bridges and large culverts.

VDOT consists of nine districts (Figure 1) with its headquarters office located in Richmond, Virginia. The nine districts are Bristol, Salem, Lynchburg, Richmond, Hampton Roads, Fredericksburg, Culpeper, Staunton and Northern Virginia. Districts are divided into 32 residencies, whose staff engage with each county government and serve as the liaison between the county and VDOT for the transportation improvements occurring within each county. Each residency, which includes area headquarters, serves one to four counties.

VDOT has developed a robust asset management program, placing maintenance of the transportation network at the forefront of VDOT's investment decisions. This commitment to responsible asset management practice is demonstrated through VDOT's annual collection of condition data on pavements and bridges along with its establishment and publication of network-level pavement and bridge performance targets. VDOT makes all of this information publically available on its website.

For more than a decade, VDOT has monitored pavement and bridge conditions using performance information (measures and targets) to determine investment strategies based on available funding levels. Recently, the Federal Highway Administration (FHWA) has begun requiring state DOTs to develop and maintain a Transportation Asset Management Plan and to establish performance measures and targets for pavements and bridges on the National Highway System (NHS). These federal performance measures and targets apply to a limited portion of VDOT's road and bridge network (less than 15% of all lane miles and 18% of all structures) leading to development of federal performance measures and targets that are different from VDOT's performance measures and targets. For more information on VDOT's application of these federal performance measures and targets see the Pavement Overview and Bridge Overview sections of this report.

Figure 1: Nine Districts



Performance Management

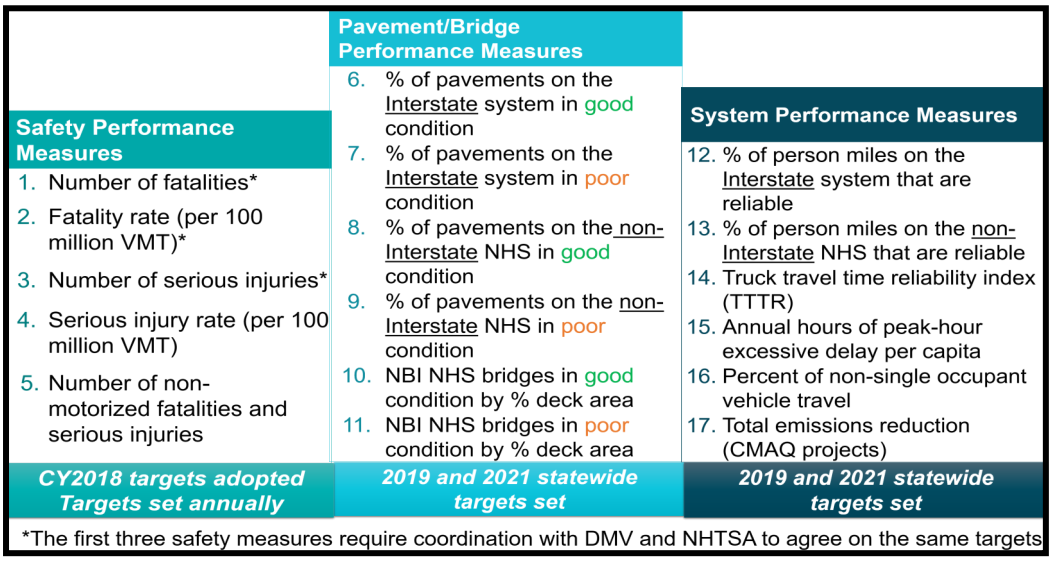
The Board established a performance management framework to assess performance of the Commonwealth's transportation system in December 2015, when the Board adopted goals, objectives, and guiding principles for VTrans2040. Since then, federal performance management requirements for transportation have begun, and VDOT has incorporated the federal performance measures and targets into its planning and programming activities. In addition, the Board has established targets for each of the federal performance measures.

Performance management (PM) is a strategic approach that uses system information to inform investment and policy decisions to achieve transportation system performance goals. Using PM, the Board is positioned to develop and implement smart, transparent, and efficient transportation policy and investment strategies which underpin a healthy economy and put Virginia's transportation program in a strong position to support the Commonwealth's economic growth and competitiveness moving forward.

The most recent federal transportation authorization act provides the Federal PM framework and requirements for USDOT, State DOTs, transit providers and metropolitan planning organizations. Federal performance measures were established to provide national standards by which transportation safety, reliability and preservation will be measured in each state, while ensuring federal resources are used to improve performance in those areas.

Figure 2 explains the 17 performance measures for which State DOTs must establish targets. Setting targets for performance measures helps to establish a strategic direction for the future of Virginia's surface transportation network.

Figure 2: Federal Performance Measures



VMT is Vehicle Miles Travelled

OIPI is responsible for the development of measures and targets to monitor performance of the Commonwealth's surface transportation network for the Board; this includes responsibility for both federally required measures and those developed by the state. OIPI worked in coordination with VDOT to develop and set targets for each of the 17 federal measures.

Performance Management

In July 2018, the Board adopted targets for five federal safety performance measures as shown in Figure 3. These targets cover all public roads in Virginia and are set annually. Three of these federal measures (number of fatalities, rate of fatalities and number of serious injuries) require coordination between VDOT and DMV. Establishing annual targets allows VDOT to evaluate progress toward fatality and serious injury reductions.

Figure 3: State Annual Safety Performance Measures

Annual Safety Performance Measures	Scope	2019 Target
Number of Fatalities	All Public Roads	**840**
Rate of Fatalities per 100 million VMT	All Public Roads	**0.94**
Number of Serious Injuries	All Public Roads	**7,689**
Rate of Serious Injuries per 100 million VMT	All Public Roads	**8.75**
Number of Non-Motorized Fatalities and Serious Injuries	All Public Roads	**714**

In September 2018, the Board approved the targets for preservation (asset condition) and system performance measures shown in Figure 4. Following establishment of these targets in July and September, VDOT submitted targets and related baseline data to the Federal Highway Administration in October 2018 as required.

Figure 4: Asset Condition and System Performance Measures

Pavement and Bridge Condition Measures	Scope	2-Year Target	4-Year Target
Percentage of Pavement in Good Condition	Interstate	**45%**	**45%**
Percentage of Pavement in Poor Condition	Interstate	**<3%**	**<3%**
Percentage of Pavement in Good Condition	NHS (non-Interstate)	**25%**	**25%**
Percentage of Pavement in Poor Condition	NHS (non-Interstate)	**<5%**	**<5%**
Percentage of Pavement in Good Condition* (IRI only)	NHS (non-Interstate)	**55%**	**55%**
Percentage of Pavement in Poor Condition* (IRI only)	NHS (non-Interstate)	**<10%**	**<10%**
Percentage of Deck Area of Bridges in Good Condition	NHS	**33.5%**	**33%**
Percentage of Deck Area of Bridges in Poor Condition	NHS	**3.5%**	**3%**
System Performance Measures	**Scope**	**2-Year Target**	**4-Year Target**
Percentage of Person-Miles Traveled that are Reliable	Interstate	**82.2%**	**82%**
Percentage of Person-Miles Traveled that are Reliable	NHS (non-Interstate)	**N/A**	**82.5%**
Truck Travel Times Reliability Index	Interstate	**1.53**	**1.56**
Annual Hours of Peak Hour Excessive Delay Per Capita	NHS	**N/A**	**26.7 hrs/ capita**
Percentage of Non-SOV Travel	NHS	**36.9%**	**37.2%**
CMAQ Program Emissions: Total Emission Reductions for Volatile Organic Compounds	Northern Virginia	**1.721 kg/day**	**1.985 kg/day**
CMAQ Program Emissions: Total Emission Reductions for Nitrogen Oxides (NOx)	Northern Virginia	**3.744 kg/day**	**4.23 kg/day**

*Per federal guidance, pavement condition is measured by two methods: 1) International Roughness Index (IRI); and 2) IRI, cracking, rutting or faulting. For 2018 to 2022, Non-Interstate NHS pavement condition is to be measured by IRI only. Beginning in 2022, Non-Interstate NHS pavement condition will be measured by all four distresses. The two pavement targets shaded in gray, for Non-Interstate NHS only, are based solely on IRI. Two sets of targets for Non-Interstate NHS pavement condition are shown to illustrate the difference in the two measurement standards.

As discussed later in this report, VDOT has used internal performance measures for their pavement and bridge assets for over a decade. Based on VDOT's lane mile and bridge inventory and FHWA's focus on a small portion of that inventory, VDOT will continue to use statewide or non-federal performance measures. VDOT in coordination with OIPI are re-evaluating existing performance measures not only to ensure VDOT has a sustainable maintenance program but also is to ensure effective deployment of resources and strategies to improve reliability, decrease congestion, and reduce the number of fatalities and serious injuries on Virginia's roads.

SECTION 1

Asset Management Approach and Methodology

Asset Management Approach Overview

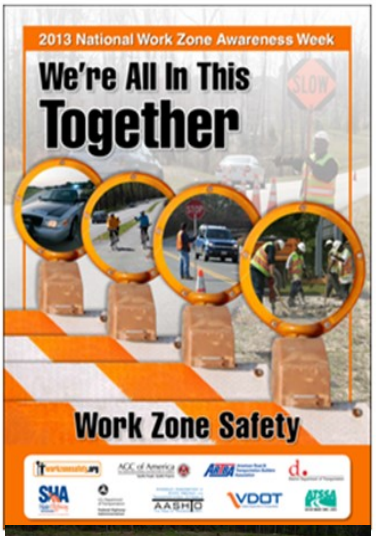
§ 33.2-232(B)(1)

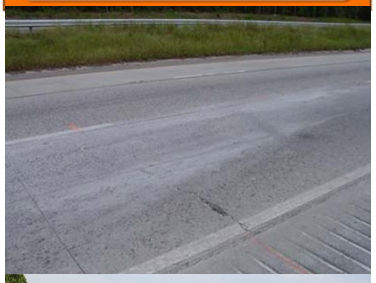
VDOT's asset management approach is a strategic and systematic process of operating, maintaining and improving physical assets throughout their lifecycle by optimizing resource allocation, project selection and infrastructure utilization. VDOT's asset management approach captures the obvious costs of VDOT's assets and services (e.g., paving or bridge inspection) and the less obvious costs (e.g., painting or sweeping of bridges). Effective asset management is comparable to vehicle ownership, requiring an owner to have routine maintenance (e.g., oil changes or tire rotation) performed on the vehicle before replacement and, at times, to have vehicle parts replaced (e.g., transmission replacement).

The methodology used to determine VDOT's maintenance needs is summarized in this report. As depicted in Figure 5, the Asset Management Approach begins with assessing Asset Inventory & Condition and ending the cycle with Performance Monitoring. The approach is a continuous cycle.

Performance measurement is an essential tool for guiding asset owners toward making the best use of limited funds in a transparent and accountable manner. A sound performance measurement program requires years of work to identify and adopt a set of metrics that are meaningful, actionable and practical to measure as well as sustainable given funding constraints. Establishment of targets helps VDOT measure the success of or modify its approach, as appropriate.

Figure 5: Asset Management Approach





Asset Management Approach Overview

§ 33.2-232(B)(1)

VDOT's asset management approach focuses on preventive actions, restoration and replacement with a goal of prolonging the life of transportation assets. An asset management approach is critical for ensuring Virginia's economic advantage (e.g. moving goods from ports to distribution centers) and enhancing the quality of life (e.g. safe and reliable travel) for Virginians. Proper and timely maintenance is critical in ensuring that VDOT avoids more expensive capital replacement in the future. Preservation of VDOT's aging infrastructure requires a majority of VDOT's resources and focus. Figure 6 illustrates the impact maintenance timing has on the approximate lifecycle costs of pavement assets. If VDOT performs preventive maintenance earlier in the lifecycle of an asset, the costs are less than if reconstruction is performed later. Investment in preventive maintenance is 22 times less expensive than the cost of reconstruction. Figure 7 illustrates the approximate cost for different maintenance treatments for Interstate pavement per lane mile.

Figure 6: Preventive Maintenance Cost vs. Reconstruction Cost (Pavement Assets)

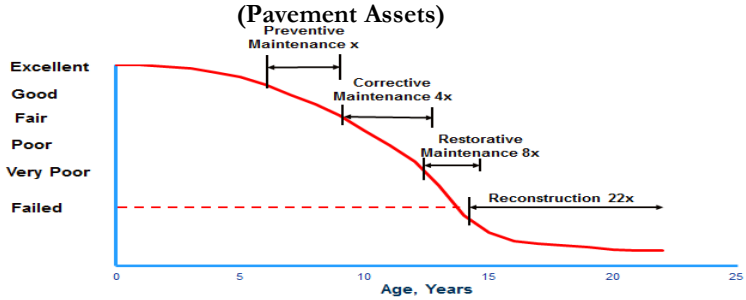


Figure 7: Estimated Unit Cost, per lane mile—Interstate

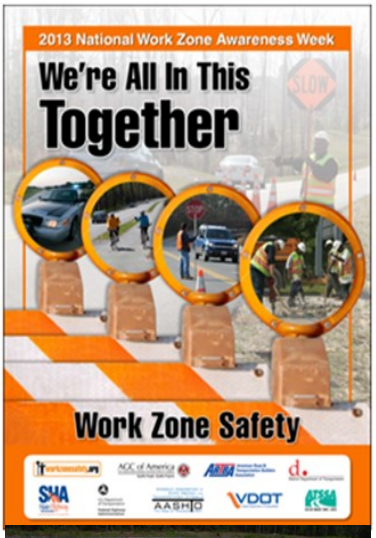
Maintenance Treatment Cost	
Preventive: $45K	Corrective: $180K
Restorative: $340K	Reconstruction: $1,000K

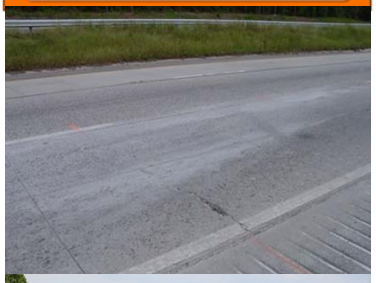
Conceptually, if an asset was constructed today with appropriate resiliency attributes (e.g. truck load increases, water level changes, etc.) and maintained as required (e.g. preventative maintenance – bridge sweeping or drain cleaning; corrective maintenance – overlay of a pavement or bridge) the asset should have a perpetual life span. While this is true for new assets, VDOT must manage existing and aging infrastructure within available resources.

While pavement and bridge assets are a major emphasis in this report, VDOT has other essential assets and services (e.g., guardrails, drainage and slopes) to operate and maintain. Pavement and bridge assets are interdependent with regard to these other essential assets and services. For example, if a highway is paved but an underlying pipe is not simultaneously replaced and subsequently fails, VDOT must repair/replace the failed pipe and repave the newly resurfaced highway. This approach is inefficient and costly.

VDOT's asset management approach requires investment in services such as snow removal and operational services (e.g., Safety Service Patrol). Safety needs are included as a part of every project and services performed by VDOT and its contractors.

This report includes internal statewide historical pavement and bridge performance achievements. Recent investment strategies have been successful in improving VDOT's pavements and bridges; however, VDOT, in coordination with OIPI, is reevaluating the pavement and bridge long-term investment strategies and performance targets to ensure performance levels are achieved, lifecycle cost are optimized and ideally a steady-state is realized.





Pavement Overview

§ 33.2-232(B)(1)

State Overview

VDOT Maintained inventory

128,561
lane miles

Primary
22,041 lane miles

Secondary
100,365 lane miles

Frontage
652 lane miles

Federal Focus

NHS Inventory

18,755
lane miles

- All Interstates
- Approx. half of all primaries
- Few Secondaries

NHS Inventory Maintenance

VDOT
15,769 lane miles

Locality
2,986 lane miles

VDOT understands the importance of maintaining Virginia's Interstate, Primary and Secondary Systems at an optimal level for driver and passenger safety, mobility and comfort. Resurfacing needs are identified through VDOT's annual pavement condition assessment. This assessment of pavement surfaces reviews distresses such as ride quality, crack severity and average rutting. Ride quality is what most motorists experience as they travel Virginia's roads. Crack severity refers to the deterioration of the road and leads to water seepage if left untreated. Rutting refers to depressions in the pavement caused by heavy usage and large trucks. Ruts collect water, creating potential road hazards.

Pavement needs are assessed based on pavement management principles to maintain the pavement asset over the term of its lifecycle in a cost effective manner. VDOT's pavement management business processes also use established asset management principles.

VDOT reports pavement conditions based on annual pavement condition assessments using continuous digital imaging and automated crack detection technology. When conducting condition assessments, the survey vehicle rides over the road surface and records the condition –see Figure 8.

Figure 8: Pavement Assessment

Pavement Overview

§ 33.2-232(B)(1)

Annually, VDOT assesses 100% of the pavement conditions on Virginia's Interstate and Primary systems and approximately 20% of conditions on the Secondary system. In 2016, VDOT had 100% of the Secondary pavement network assessed to create a condition baseline for Virginia's Secondary system. The pavement condition data is collected, compiled, analyzed and reviewed to report the optimized needs at a system and district level.

VDOT's pavement program selects resurfacing projects in relation to needs and optimizes timing of projects through a data-driven pavement management system. The typical full depth asphalt cross section and different corrective actions taken on pavements are depicted in Figures 9 and 10.

Figure 9: Pavement Structure—Typical Full –Depth Asphalt

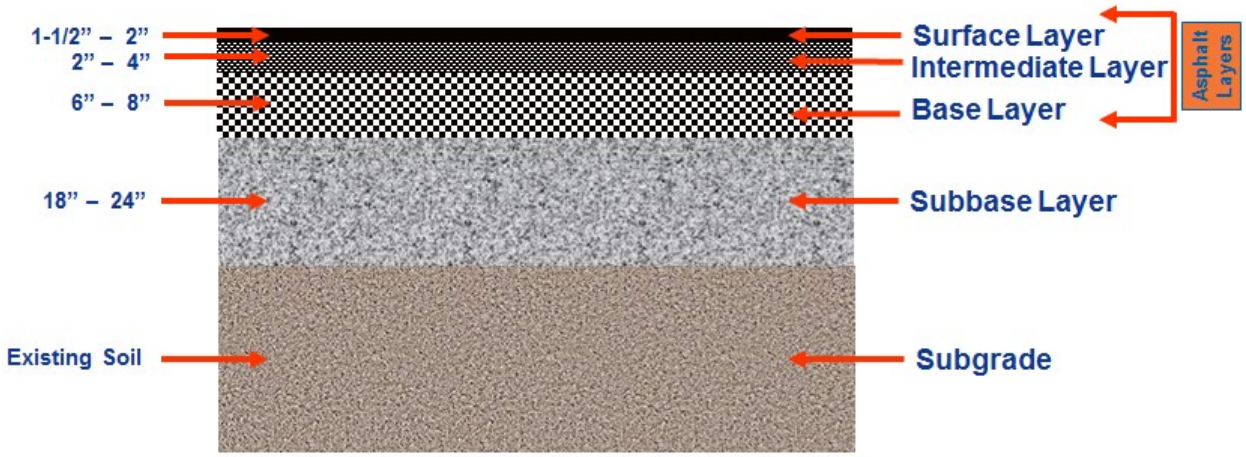


Figure 10: Pavement Corrective Actions

Pavement Overview

§ 33.2-232(B)(1)

Figure 11: Components of Pavement Needs Methodology

ASSET MANAGEMENT PROCESS COMPONENT		PAVEMENT	
	Condition Assessment	Annual condition ratings performed	
	Performance Targets*	Interstate – 82% Fair or better condition Primary – 82% Fair or better condition Secondary - 65 % Fair or better condition	Fair = Critical Condition Index ≥ 60
	Asset Management Software	Optimization through use of pavement management software	
	Other Significant Factors	Traffic volumes, maintenance history, structural and subgrade strength, Americans with Disabilities Act considerations	
	Other Cost Factors	Traffic and safety related costs: markings, guardrail, signal loops, etc.	

*VDOT statewide performance targets (non-federal)

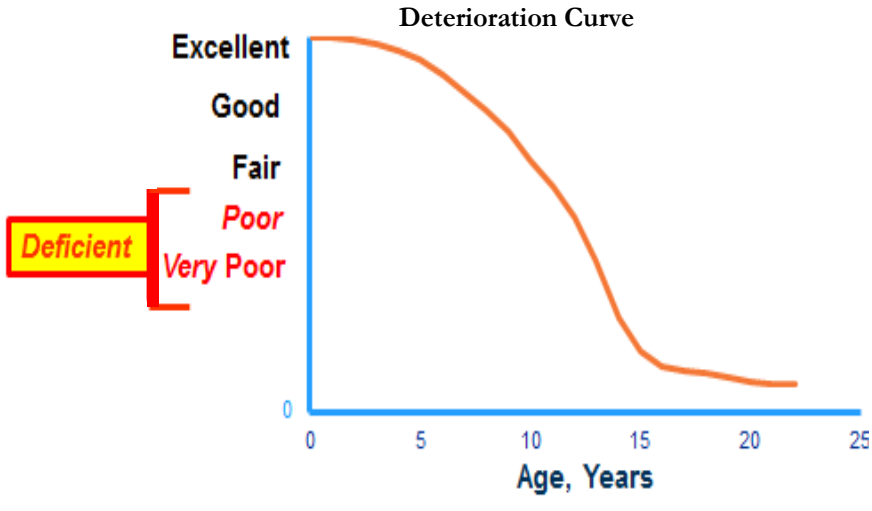
For over a decade and prior to federal performance management requirements for highways on the NHS, VDOT used annual pavement assessment condition data as a comparison to internal VDOT targets (hereinafter referred to as VDOT statewide performance targets) which entail methodology components different from those required under federal performance management, see Figure 11.

VDOT uses a numeric scale, the Critical Condition Index (CCI), to explain and categorize the sufficiency (condition) of the pavement. VDOT deems pavement condition sufficient once CCI reaches 60 (Fair) or higher. Figure 12 shows the CCI scale and the lifecycle of a typical pavement overlay.

Figure 12: Pavement Scale and Deterioration Curve

Critical Condition Index (CCI) is calculated on a scale of 0 to 100

- Pavement condition categories:
  - Excellent (≥ 90 CCI)
  - Good (Between 70 and 89 CCI)
  - Fair (Between 60 and 69 CCI)
  - Poor (Between 50 and 59 CCI)
  - Very Poor (≤ 49 CCI)



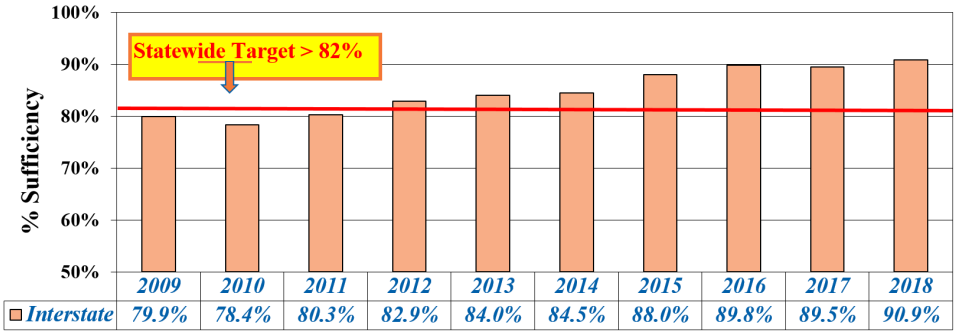
Pavement Overview

§ 33.2-232(B)(1)

Pavement needs are derived from the types of pavement treatments required for districts to meet or exceed the statewide performance targets taking into account available investment levels.

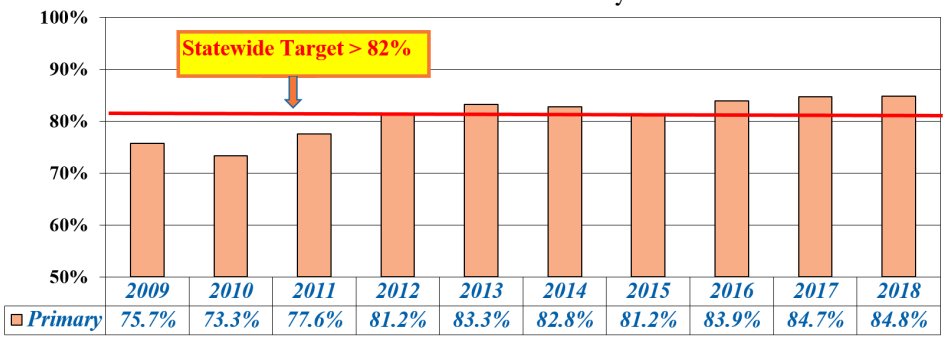
Figures 13, 14 and 15 show VDOT's historical statewide pavement performance from 2009-2018. For example, Figure 13: VDOT Pavement Performance History on Interstate shows in 2018 the statewide average Interstate pavement performance reached 90.9% sufficiency or, stated another way, of Virginia's 5,503 Interstate lanes miles approximately 5,002 lane miles were rated at CCI of 60 or higher (Fair or better condition).

Figure 13: VDOT Pavement Performance History
% Sufficient – Interstate



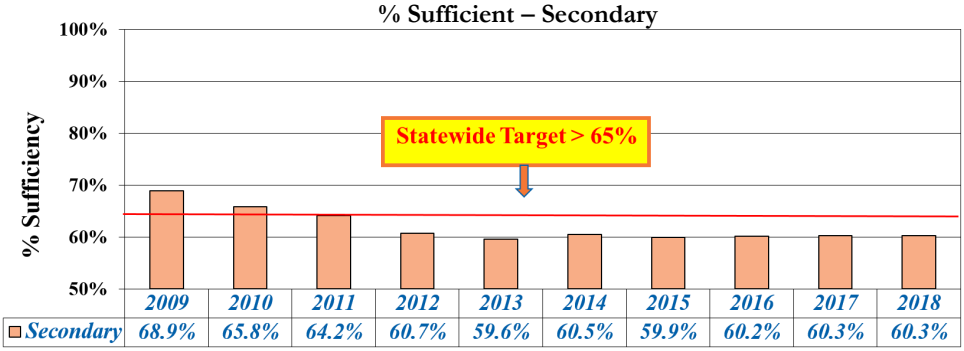
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Interstate	79.9%	78.4%	80.3%	82.9%	84.0%	84.5%	88.0%	89.8%	89.5%	90.9%

Figure 14: VDOT Pavement Performance History
% Sufficient – Primary



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Primary	75.7%	73.3%	77.6%	81.2%	83.3%	82.8%	81.2%	83.9%	84.7%	84.8%

Figure 15: VDOT Pavement Performance History
% Sufficient – Secondary



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Secondary	68.9%	65.8%	64.2%	60.7%	59.6%	60.5%	59.9%	60.2%	60.3%	60.3%

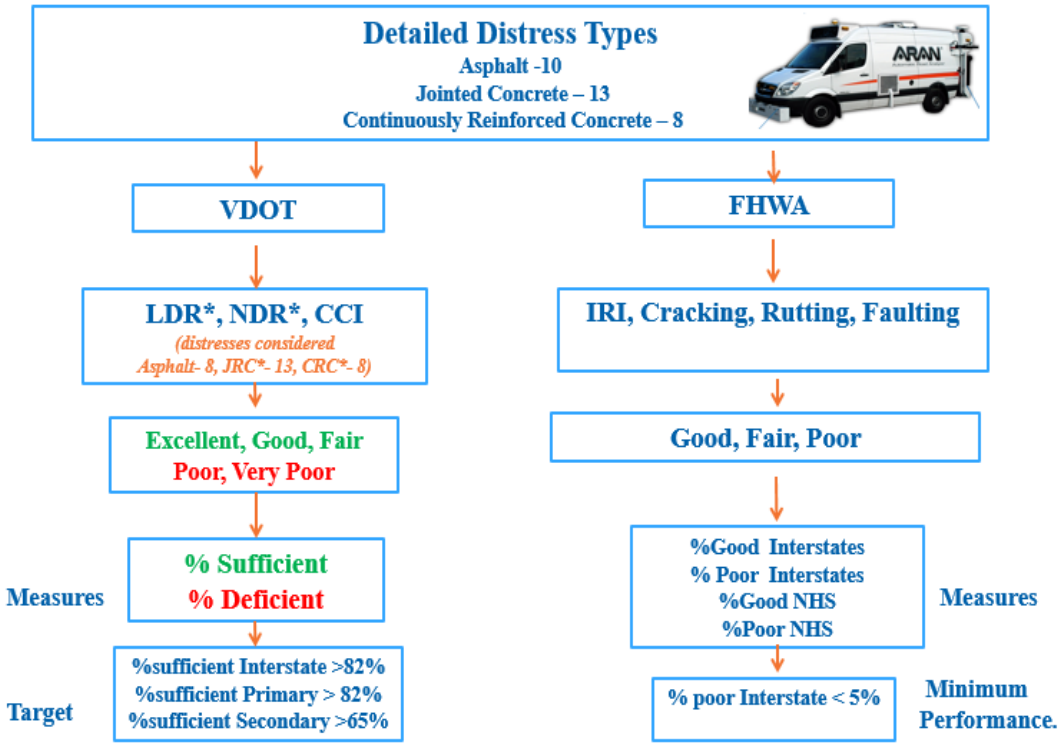
Pavement Overview

§ 33.2-232(B)(1)

As previously stated, federal performance measures are concentrated on a small portion of VDOT's inventory and only apply to highways on the NHS. VDOT maintains 128,561 lane miles, 18,755 (or 14.5%) of which are on the NHS network. Accordingly, in order to ensure that all VDOT inventory is subject to performance measures, VDOT must use two sets of performance measures, one to satisfy federal requirements applicable to the NHS and one applicable to all roads in VDOT's inventory. Figure 4 shows the federal performance targets adopted by the Board on September 18, 2018.

The pavement condition data used in Virginia's statewide performance measures contains over 13 types of distress factors while the federal measures focus on four (see Figure 16). Based on recent federal guidance, a "phase in" approach has been adopted for the non-Interstate NHS, which provides for the use of only one distress measure, i.e., the International Roughness Index (IRI) or in the alternative, four distresses (IRI, cracking, rutting and faulting). VDOT will be using the four distress option for federal purposes.

Figure 16: Comparison of VDOT and Federal Performance Measures



*LDR is Load-rated Distress Rating
*NDR is Non-load-rated Distress Rating

*JRC is Jointed Reinforced Concrete
* CRC is Continuously Reinforced Concrete

Bridge Overview

§ 33.2-232(B)(1)

3rd Largest State-Maintained Bridge Inventory

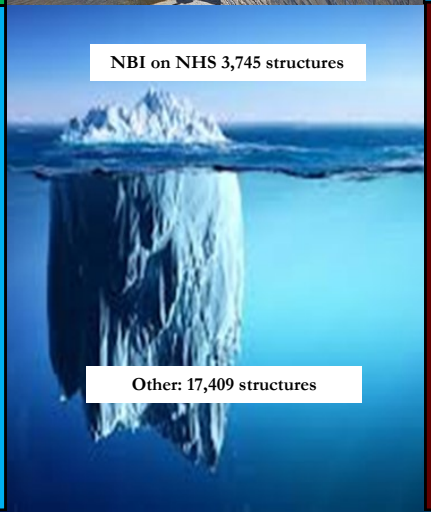
21,154 Structures

Virginia Structures by Highway System

Interstate	2,424
Primary	5,824
Secondary	11,884
Urban	1,022

Associated with Federal Performance Measures

3,745 Structures



NBI Bridges on NHS

Interstate	1,683
Primary	1,907
Secondary	62
Urban	93

18% of all Virginia Structures

VDOT follows national standards in performing safety inspections and determining general condition of the structures. Condition assessments are performed by certified safety inspection personnel. The inspection program requires a qualified inspector to complete a "hands-on" review of the structure or bridge during each inspection at least once every two years. Figure 17 shows elements inspected on a bridge, Figure 18 shows the structure inventory by type, Figure 19 illustrates Poor structural elements and Figure 20 explains the components of bridge needs.

Figure 17: Bridge Structural Elements Diagram*

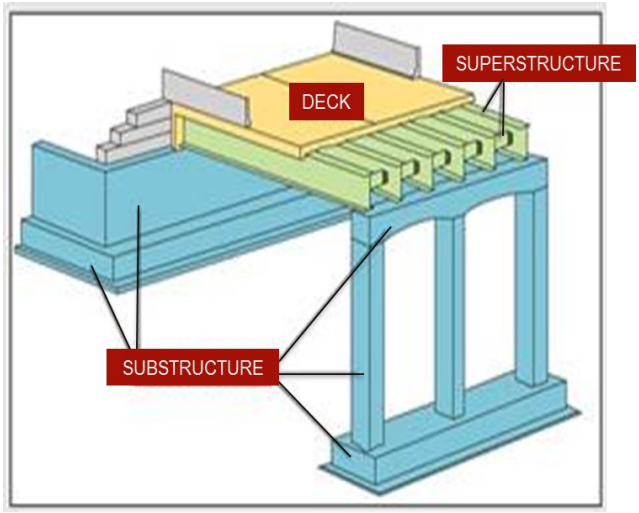
Using the National Bridge Inventory (NBI) rating scale (established by FHWA), bridge inspectors rate the following structural elements for each bridge:

Deck: The portion of the bridge that directly carries traffic.

Superstructure: The portion of the bridge that supports the deck and connects one substructure element to another.

Substructure: The portion of the bridge that supports the superstructure and distributes all bridge loads to below ground bridge footings.

Culvert (not pictured): A pipe or small structure used for drainage under a road, railroad or other embankment A culvert with a span length greater than 20 feet is included in the NBI and receives a rating using the NBI scale.



*Bridge Structural Elements Diagram courtesy of Michigan Department of Transportation

Bridge Overview

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Figure 18: Bridge Inventory by Type**

*SD is Structurally Deficient
** Inventory data in Figure 18 is as of July 1, 2018

Figure 19: Poor Structures: Examples by Structural Element

Bridge Overview

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Figure 20: Components of Bridge Needs Methodology

		BRIDGES
ASSET MANAGEMENT PROCESS COMPONENT	**Condition Assessment**	Annual condition ratings performed

	Performance Targets*	• Percentage of bridges that are not Structurally Deficient or Poor (applied Statewide and individually to each district) by count:
		  • Interstate: 99% Fair or better condition
		  • Primary: 96% Fair or better condition
		  • Secondary: 94% Fair or better condition
		  • **Statewide: 95.5% Fair or better condition**
		• Maintaining structures in the current conditions by:
		  • Repair 6% of structures with a minimum GCR=5
		  • Repair 2% of structures with a minimum GCR=6
		• Perform preventative maintenance activities
		• Improve 0.5% of the bridge deck expansion joints in each district each year

	Asset Management Software	Bridge Management System (BrM)
	Other Significant Factors	General Condition Rating (GCR)**
	Other Cost Factors	Unit costs from recent contracts including design, construction inspection, right-of-way and maintenance of traffic

Measured on a 0-9 scale, with 0 representing a failed structure and 9 representing excellent condition, a GCR is assigned to each bridge's deck, superstructure; and substructure at each inspection. Large culverts receive a single GCR. The minimum GCR for each bridge or large culvert is used to define its condition category. Three condition categories have been established: Good, Fair; and Poor as shown in Figure 21.

Figure 21: Condition Category Definitions for Highway Structures

Condition Categories for Highway Structures	Condition Category Definition***
Good Structures	Minimum GCR ≥ 7
Fair Structures	Minimum GCR = 5 or 6
Poor Structures	Minimum GCR ≤ 4

*VDOT statewide performance targets (non-federal)
**The GCR is a numerical rating of the primary components of each structure assigned during regular safety inspections.
***Prior to the current fiscal year, Virginia used slightly different definitions for the three condition categories. Virginia has recently adopted the FHWA definitions of Good, Fair and Poor highway structures.

Bridge Overview

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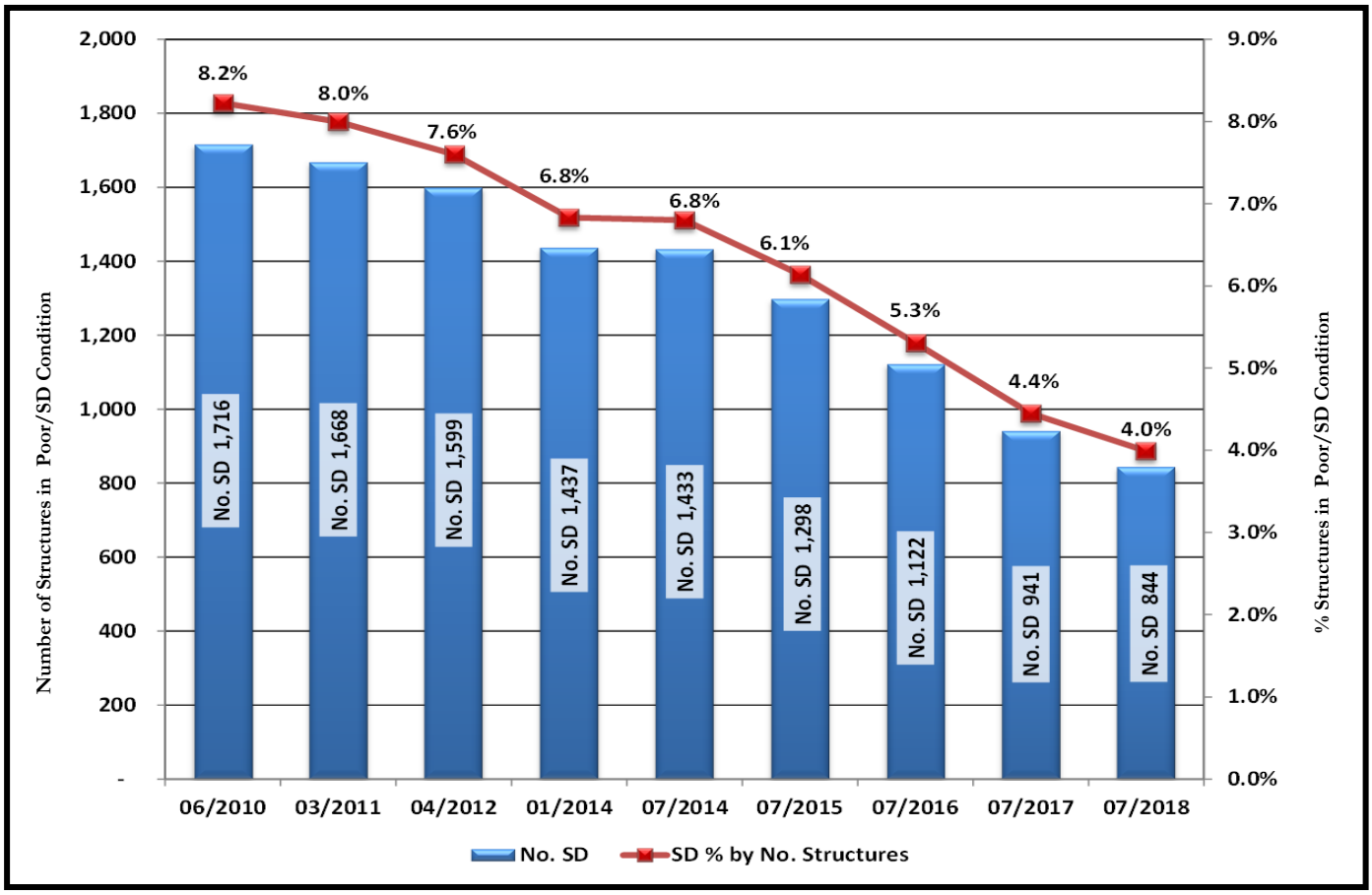
Figure 22 shows the historical performance trend of Virginia's Poor bridges.

Figure 22: Statewide Bridge Performance History



Note: Chart includes all structures for which Virginia is responsible (VDOT, localities and other state or local toll authorities and agencies) and includes both NBI and Non-NBI structures. Chart has been revised from previous versions to provide:

- Incorporation of new federal definition of "structurally deficient".
- Inclusion of all temporarily closed structures for consistency with annual submission to FHWA
- Inclusion of all border bridges per federal requirements (e.g. Woodrow Wilson Bridge)

Bridge Overview

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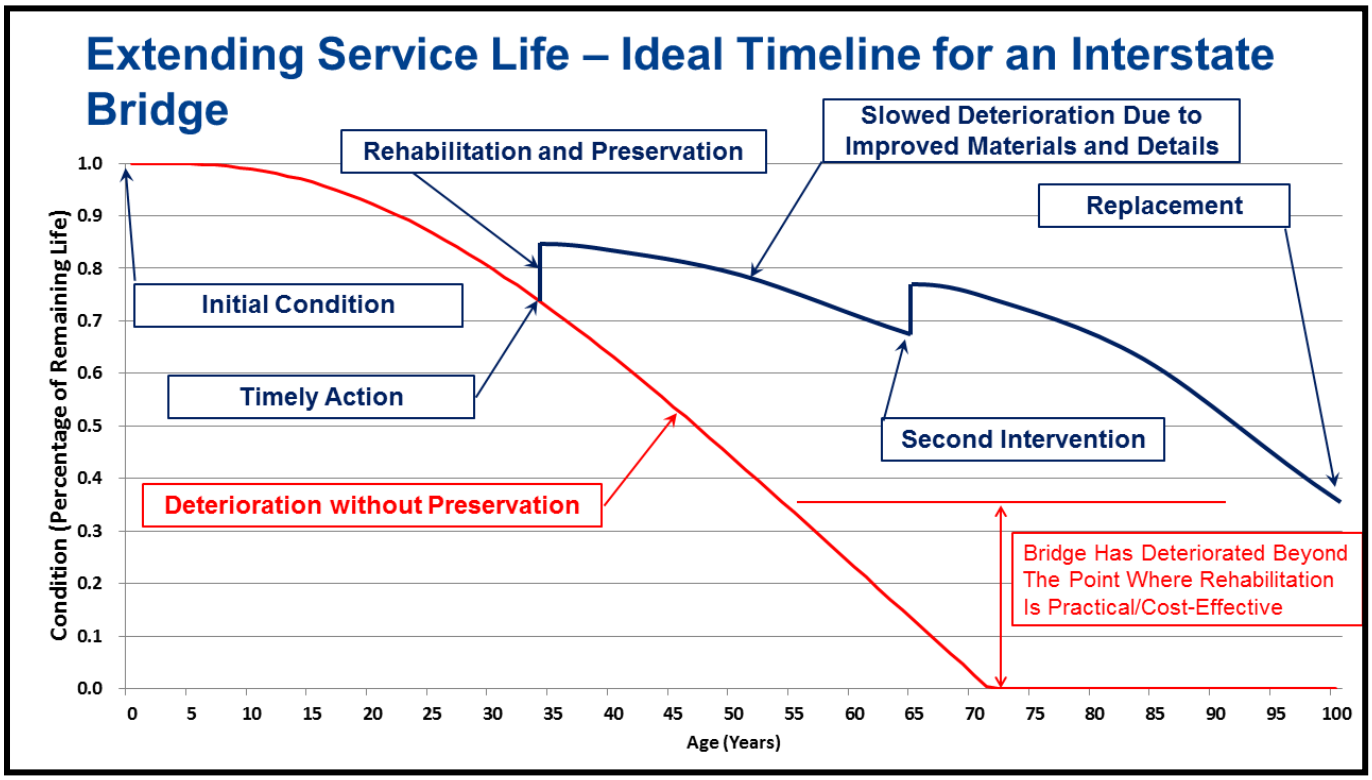
Figure 23 shows the value of conducting timely preventive, restorative and replacement actions.

Figure 23: Extending Service Life



Bridge needs are calculated with a goal of meeting or exceeding the established statewide performance targets. The assessment applies bridge management principles to maintain cost-effectively a bridge's infrastructure over the term of its lifecycle, see Figure 23.

By federal regulation, VDOT is required to conduct detailed inspections of bridge structures at intervals not to exceed 24 months and of large culverts at intervals not to exceed 48 months. VDOT uses BrM software to store bridge condition and inventory data for each structure and to program, schedule and track bridge and structure inspections. The data collected during inspections allow VDOT to use a proactive approach to maintenance. Preventive maintenance and timely intervention repairs are performed to avoid and slow deterioration that leads to greater rehabilitation or replacement cost.

Virginia's bridge maintenance program is large and complex, so in order to direct its efforts more easily, performance targets have been developed for each of the three condition categories (Good, Fair and Poor). While Virginia has been using performance measures for many years, FHWA has recently required states to track bridge conditions, establish performance targets and report results. Therefore, Virginia now has two sets of performance targets: state (see Figure 20) and federal (see Figure 4).

Bridge Overview

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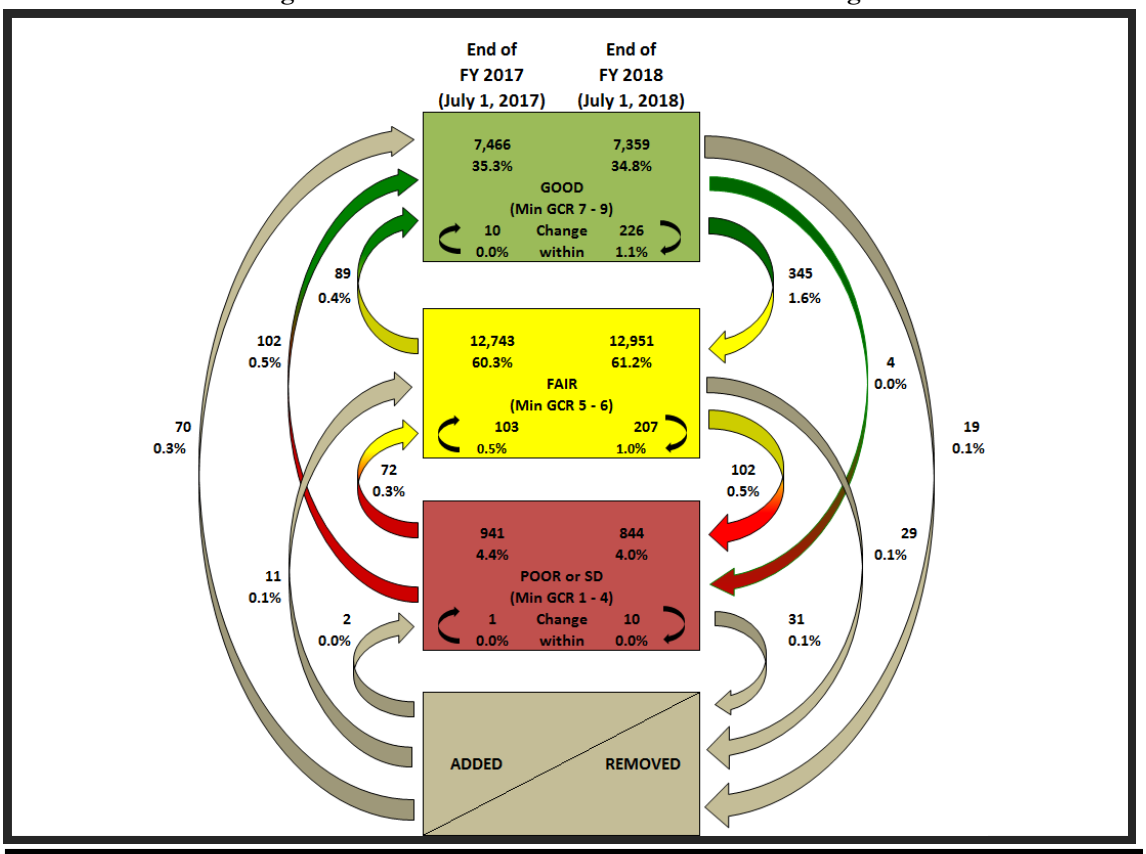
Figure 24: Annual Transitions in Conditions for Bridges



Need for a Balanced Program

Improvements were due to actual work performed

Deteriorated conditions are based on an actual data comparison between July 1, 2017 and July 1, 2018

A true system preservation program extends the service life of structures. This requires a balanced approach, wherein work is performed on structures in all condition categories (Good, Fair and Poor). The results of this approach for FY 2018 are shown in Figure 24. In order to provide an easily-understood organizational system, structures are placed in one of these three condition categories based on the minimum ("lowest") component GCR of each structure.

The large arrows between condition categories (Good, Fair, Poor) track "gross" changes in bridge conditions. The arrows within the condition categories of Good and Poor are provided to track incremental changes within broad categories and provide more refined data regarding condition changes from one year to another. For example, Figure 24 shows that 10 Good structures improved within the Good category but 226 Good structures deteriorated while staying within the Good category, thus indicating that the average conditions of the Good structures are decreasing. Additionally, Figure 24 shows that between July 1, 2017 and July 1, 2018, 345 structures deteriorated from Good to Fair condition, 102 structures dropped from Fair to Poor condition and 4 structures went from Good to Poor condition, resulting in a total of 451 structures that deteriorated to a lower condition rating. In the same time period 89 structures improved from Fair to Good, 72 structures moved from a Poor to Fair condition rating and 102 structures moved from a Poor condition rating to a Good condition rating. This resulted in a total of 263 structures improving to a higher condition rating.

In general, changes from Fair or Poor to Good are due to bridge replacements and improvements from Poor to Fair are due to bridge repair and rehabilitation activities, both of which are integral components of a balanced program.

Pavement and Bridge Investment Needs

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Annually, VDOT uses condition assessments for pavements and bridges to develop a cost estimate for repair or replacement of these assets. VDOT refers to these costs as needs.

VDOT evaluates or assesses pavement and bridge repair costs or needs in sequential steps.

Step 1

Unconstrained Needs Assessment Process

First, the assessment process begins by calculating the unconstrained investment needs. Unconstrained investment needs are, in simple terms, costs not constrained by funding or performance measures. In other words, unconstrained investment needs are the amount required in *one year's time* to fix or repair VDOT's pavements and bridges to a fair or better condition. The resources required for Unconstrained Needs are not available but the assessment is an illustration of the potential repair or replacement costs (in some instances work backlog) for these assets and are the starting point for the State of Good Repair Program funding distribution process explained later in this report. VDOT's unconstrained pavement and bridge investment needs are described further in Figure 25.

Figure 25: Unconstrained Pavement and Bridge Investment Needs

Needs Type	Pavement Definition	Pavement Costs in 2018 dollars in millions (as of July 1, 2018)	Bridge Definition	Bridge Costs in 2018 dollars in millions (as of July 1, 2018)
Unconstrained	The *one year* cost to perform recommended maintenance on all pavement sections in the network from VDOT's pavement management system. This includes, from 'do nothing' to performing preventive, corrective, restorative or major rehabilitation work as needed based on pavement condition data, sub-surface strength, volume of trucks and construction/resurfacing history. If all recommended work is performed, every pavement section in the network will have a CCI 60 (Fair) or higher. In other words, the percent sufficiency of the network will be 100% in Fair condition or better.	$4,962	The *one year* cost to perform all recommended repairs or replacements on all bridges as indicated in VDOT's bridge management system. For bridges in Poor condition, this generally means replacement or major rehabilitation. Fair bridges generally require rehabilitation in conjunction with preservation, while Good bridges may require some repair along with preservation.	$6,743

Pavement and Bridge Investment Needs

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Step 2

Constrained Needs Assessment Process

Secondly, VDOT further evaluates pavement and bridge repair costs needed to achieve the established performance measures. These are identified as the Constrained Needs. In other words, needs are constrained to meet the performance targets (or sustain existing performance if it is higher than the target) in *one year*. Available resources, such as funding, are not considered in this step of the process. VDOT's constrained pavement and bridge investment needs are described further in Figure 26.

Figure 26: Constrained Pavement and Bridge Investment Needs

Needs Type	Pavement Definition	Pavement Costs in 2018 dollars in millions (as of July 1, 2018)	Bridge Definition	Bridge Costs in 2018 dollars in millions (as of July 1, 2018)
Constrained (to meet current performance targets with no funding limitations)	If current performance meets the stated targets (e.g. Interstates and Primaries), needs are calculated to maintain them at the existing level *in one year*. Whereas, if current performance is below the stated target (e.g. Secondaries), needs are calculated to achieve the performance target *in five years*. The current statewide performance on the Interstates, Primaries and Secondaries are approximately 90%, 84% and 60% respectively. Therefore, the constrained needs calculate the funds needed to maintain the Interstates at 90% and the Primaries at 84% and to achieve 65% sufficiency on the Secondaries in five years. These needs are calculated by district and by system.	$900	Costs required to meet and sustain all bridge performance targets, both statewide and in each district *in one year*. These performance targets include requirements for the number of structurally deficient bridges by highway system, the number of Fair bridges requiring treatment per year, the number of Good bridges requiring treatment per year, the condition of bridge deck expansion joints, and requirements for preventive maintenance.	$893

Pavement and Bridge Investment Needs

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Step 3

Steady State Needs Assessment Process

Additionally, VDOT also evaluates the costs necessary to sustain performance at or above the performance targets, also known as the "Steady State". Specifically, after VDOT meets performance targets statewide (within each district and system), the annual costs to maintain the pavements and bridges at the performance targets are the "Steady State" costs. Figure 27 provides more description on Steady State needs.

Figure 27: Steady State Pavement and Bridge Investment Needs

Needs Type	Pavement Definition	Pavement Costs in 2018 dollars in millions (as of July 1, 2018)	Bridge Definition	Bridge Costs in 2018 dollars in millions (as of July 1, 2018)
Steady State (costs after performance targets are achieved)	Once the pavements compiled in the "constrained" needs are repaired and/or replaced, the "Steady State" needs are what is required to maintain pavements at the repaired and/or replaced level *in one year*.	$712	Once the structures compiled in the "constrained" needs are repaired and/or replaced, the "Steady State" needs are what is required to maintain structures at the repaired and/or replaced level *in one year*.	$447

Step 4

Optimized Constrained Needs Assessment Process

Finally, VDOT evaluates the Constrained needs given the funding limitations. Once the available funding in the Highway Maintenance and Operations Program, State of Good Repair Program and any other available sources has been established each year, the analysis of Constrained needs is optimized to maximize the effort to achieve statewide performance targets.

Other Assets and Services Investment Needs

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The cost to maintain and operate VDOT's other essential assets and services are determined based on engineering principles, industry recognized practices or historical expenditures. A breakdown of methods used to determine needs for the various assets and service areas are provided below.

EMERGENCY AND INCIDENT MANAGEMENT

Includes costs to operate VDOT's five Traffic Operations Centers (TOCs) along with other technology assets such as traffic cameras, electronic message signs, traffic management systems; the costs to provide incident response and safety service patrols and the cost of snow and ice removal. The methodology to determine needs is summarized below:

- TOCs and technology assets needs include, but are not limited, to contractual obligations and fixed costs to operate the facilities.
- Incident response services' needs are determined based on historical expenditures, personnel and equipment costs.
- Snow removal program needs are determined based on historical expenditures along with factors established by the Virginia Transportation Research Council to account for geographical differences among the nine districts.

TRAFFIC SAFETY

Includes the cost of striping roads, maintaining and operating traffic signals and lighting and maintaining assets such as traffic signs and guardrails.

For most assets, needs are determined based on industry-accepted lifecycle replacement and repair business rules.

Traffic Safety needs also include costs determined through engineering analysis to repair, remove and replace Traffic Safety asset ancillary structures such as signal mast arms, highway lighting poles and overhead sign structures.

Additionally, Traffic Safety asset repair and replacement are often required as part of paving (e.g., restriping pavement markings or installing rumble strips after a pavement overlay).

Other Assets and Services Investment Needs

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ROUTINE MAINTENANCE

Includes the cost for work performed by VDOT's district residencies, which includes activities such as crack sealing, pot hole patching, slurry seals and sweeping.

Also included is the cost for work to manage roadside vegetation and maintain unpaved roads, drainage, sound barriers, sidewalks, bike paths, pedestrian trails and other roadside assets.

Routine maintenance needs are calculated primarily based on the recurring cost to perform the activities related to routine maintenance.

FACILITY AND OTHER

Includes all the needs not captured in the previous categories.

Costs related to Facility and Other includes ferries, rest areas, permitting, facility security and management and direction.

A majority of the needs in this category are primarily determined based on the fixed costs to VDOT (such as equipment, material cost and overhead) in order to deliver the services or programs.

VITAL Infrastructure Overview

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As part of its ongoing asset management approach, VDOT identified a group of structures that, if allowed to deteriorate to poor condition or fail, would pose significant risks to the efficient movement of people and goods. These structures have been assigned the term "**VITAL" Infrastructure** (**V**ery Large, **I**ndispensable, **T**ransportation **A**sset **L**ist) which includes tunnels, movable bridges, and large complex fixed-span structures. As of the fall of 2018, 25 structures throughout the Commonwealth met this definition. These 25 structures were built as recently as one year ago to as far back as 80 years ago as listed in Figures 28, 29 and 30.

In general, VITAL Infrastructure exhibit one or more characteristics of concern:

- Failure Risk
- Complexity
- High cost of maintenance and operation and/or replacement
- Importance:
  - Long detours
  - High traffic
  - Economic significance (shipping and vehicular)
  - Access to critical facilities (military and ports)

VDOT's VITAL Infrastructure includes three distinct types of structures: Tunnels, Movable Bridges and Large Complex Fixed-Span Structures.

Based on a directive in the 2018 Appropriations Act, Item 450, H., the Board is required to review and report, no later than December 1, 2018, on the overall condition and funding needs of large and unique bridge and tunnel structures in the Commonwealth of Virginia. The report addresses the following topics regarding VITAL Infrastructure:

- The overall condition and funding needs;
- Recommendations addressing funding within the State of Good Repair Program; and
- Other options as identified

The Biennial Report 2018 only reflects the average annual maintenance and operations needs for VITAL Infrastructure, while the VITAL Infrastructure Report illustrates the rehabilitation and preservation actions over a 30 year period, referred to as "capital reinvestment" needs.

Pictured above are examples of VITAL Infrastructure: a movable bridge, a large/complex fixed span structure and a tunnel.

VITAL Infrastructure Investment Needs

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When evaluating VITAL Infrastructure VDOT assesses each structure's needs. Needs for VITAL Infrastructure refers to the cost of ordinary maintenance, operations, repair or replacement for the facilities or its components. The needs shown in this report are only average ordinary maintenance and operating needs. The capital reinvestment needs are not included.

Figure 28: Movable Bridges — Average Annual Maintenance and Operations Needs in FY 2020 Dollars (in millions)*
(Exclusive of Capital Reinvestment Needs)**

	District	STRUCTURE	Age	Route Carried	Maintenance	Operations	TOTAL
MOVABLE BRIDGES	RICHMOND	Benjamin Harrison	51	Rt. 156	$ 1.8 M	$ 0.5 M	$ 2.3 M
	HAMPTON ROADS	Chincoteague	8	Rt. 175	$ 1.0 M	$ 0.2 M	$ 1.2 M
	HAMPTON ROADS	High Rise	49	I-64	$ 5.5 M	$ 0.3 M	$ 5.8 M
	HAMPTON ROADS	Berkley	64 & 28	I-264	$ 4.7 M	$ 0.3 M	$ 5.0 M
	HAMPTON ROADS	Coleman	66	Rt. 17	$ 6.8 M	$ 0.3 M	$ 7.1 M
	HAMPTON ROADS	James River Bridge	38	Rt. 17	$ 4.6 M	$ 0.7 M	$ 5.3 M
	FREDERICKSBURG	Eltham	11	Rt.33	$ 1.0 M	$ 0.7 M	$ 1.7 M
	FREDERICKSBURG	Gwynn's Island	80	Rt. 223	$ 1.0 M	$ 0.7 M	$ 1.7 M
				Total	$ 26.4 M	$ 3.7 M	$ 30.1 M

*Figures may not equate due to rounding

VITAL Infrastructure Investment Needs

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Tunnels

VDOT owns seven tunnels (three land tunnels and four water tunnels). Two of VDOT's water tunnels are operated and maintained by a private entity, Elizabeth River Crossings, under a 75-year Concession Agreement entered into pursuant to the Public Private Transportation Act.

Types of tunnels include:

- Underwater tunnels
- Mountain tunnels

Figure 29: Tunnels — Average Annual Maintenance and Operations Needs in FY 2020 Dollars

	District	STRUCTURE	Age	ROUTE	Maintenance	Operations	TOTAL
TUNNELS	BRISTOL	Big Walker Tunnel	46	I-77	$ 6.3 M	$ 3.7 M	$ 10.1 M
	BRISTOL	East River Tunnel	44	I-77	$ 6.4 M	$ 3.8 M	$ 10.1 M
	HAMPTON ROADS	Tunnels of Hampton Roads Bridge Tunnel (HRBT)	60 & 44	I-64	$ 22.7 M	$ 7.8 M	$ 30.5 M
	HAMPTON ROADS	Tunnel of Monitor Merrimac Memorial Bridge Tunnel (MMMBT)	26	I-664	$ 20.1 M	$ 5.3 M	$ 25.4 M
	HAMPTON ROADS	Elizabeth River Midtown Tunnel	2 & 56	Rt. 58	*Maintained by Concessionaire Elizabeth*		$ 0.0 M
	HAMPTON ROADS	Elizabeth River Downtown Tunnel	32 & 66	I-264	*Maintained by Concessionaire Elizabeth River Crossings*		$ 0.0 M
	NORTHERN VIRGINIA	Rosslyn Tunnel	35	I-66	$ 3.9 M	$ 0.9 M	$ 4.8 M
				Total	$ 59.4 M	$ 21.5 M	$ 80.9 M

*Figures may not equate due to rounding

VITAL Infrastructure Investment Needs

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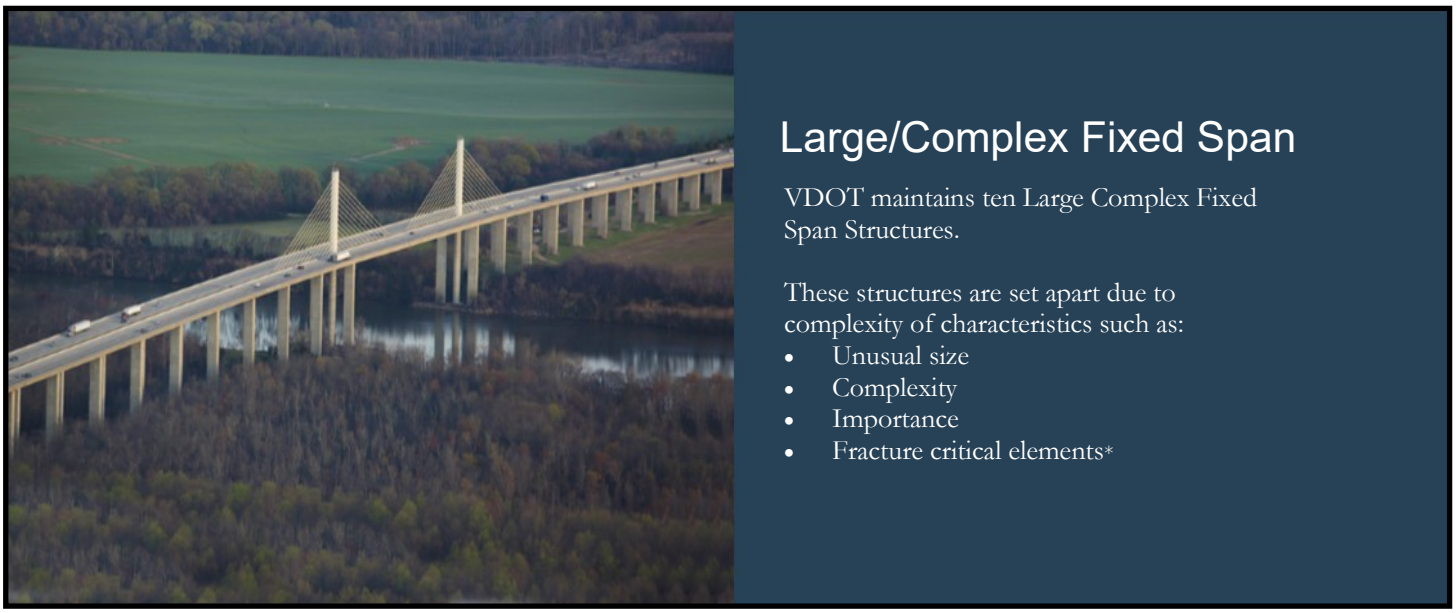

Figure 30: Large Complex Fixed Span Structures — Average Annual Maintenance and Operations Needs in FY 2020 Dollars (in millions)**

	District	STRUCTURE	Age	Route Carried	Maintenance	Operations	TOTAL
LARGE COMPLEX FIXED SPAN STRUCTURES	BRISTOL	460 Connector	1	Rt. 460	$0.3 M	$0.2 M	$0.5 M
	SALEM	Smart Road Bridge	17	SMART Hwy	$0.1 M	$0.3 M	$0.4 M
	RICHMOND	Varina-Enon	28	I-295	$1.2 M	$0.2 M	$1.4 M
	RICHMOND	895/Pocahontas Parkway	16	895	*Maintained by Globalvia*		$0.0 M
	HAMPTON ROADS	HRBT Approaches***	60 & 44	I-64	$5.7 M	$0.1 M	$5.8 M
	HAMPTON ROADS	Willoughby Bay	46	I-64	$1.0 M	$0.1 M	$1.1 M
	HAMPTON ROADS	MMMBT Approaches	26	I-664	$4.7 M	$0.1 M	$4.8 M
	HAMPTON ROADS	James River Bridge Approaches	38	Rt. 17	$7.7 M	$0.1 M	$7.8 M
	HAMPTON ROADS	High Rise Bridge Approaches	49	I-64	$0.6 M	$0.1 M	$0.7 M
	FREDERICKSBURG	Norris Bridge	61	Rt. 3	$2.0 M	$0.2 M	$2.2 M
				Total	**$ 23.2 M**	**$ 1.4 M**	**$ 24.6 M**

*Fracture critical bridges have a steel member whose failure would probably cause a portion or the entire bridge to collapse
**Figures may not equate due to rounding
***For more information on this project see http://www.hrbtexpansion.org/

Highway Maintenance and Operations Investment Needs

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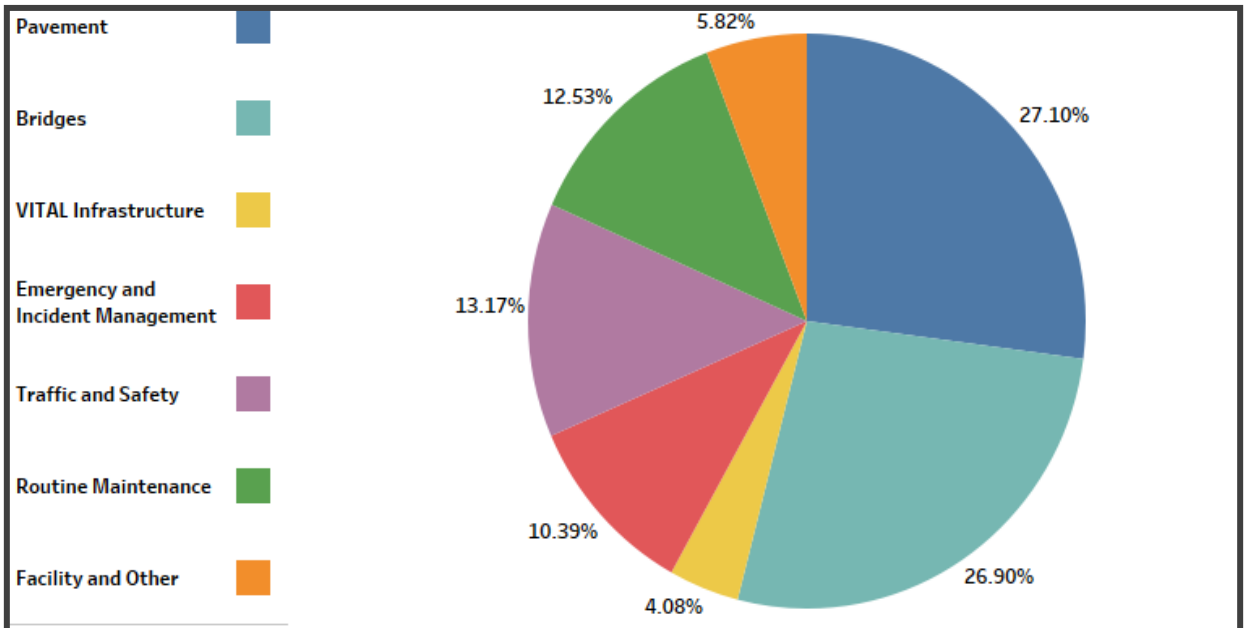
Each year VDOT expends significant funds to maintain and operate the state highway system. Figure 31 graphically represents the FY 2020 costs VDOT will incur to meet the pavement and bridge statewide performance targets and to maintain and operate the other existing transportation infrastructure. As described previously in the report, VDOT assesses the pavement and bridge needs annually. The pavement and bridge needs shown are constrained to meet current internal statewide (non-federal) performance targets for the assets. VITAL Infrastructure needs are only the annual maintenance and operating needs. The other needs categories are based on historical needs from 2015 and inflated by an inflationary factor to FY 2020 dollars. When VDOT reassesses their investment strategy in the Highway Maintenance and Operating Program, the historical needs will be analyzed in this effort.

Figure 31: Constrained Investment Needs in FY 2020 Dollars (in millions)*



	Pavement	Bridges	** VITAL Infrastructure	Emergency and Incident Management	Traffic and Safety	Routine Maintenance	Facility and Other	Total Needs
Needs	$899.9M	$893.3M	$135.5M	$345.0M	$437.4M	$416.0M	$193.4M	$3,320.4M

*Figures may not equate due to rounding. These are the Constrained Needs (without fiscal constraints) except VITAL Infrastructure and Routine Maintenance categories.

**Ordinary Maintenance and Operating Needs (VITAL Infrastructure)

Highway Maintenance and Operating Fund Allocations

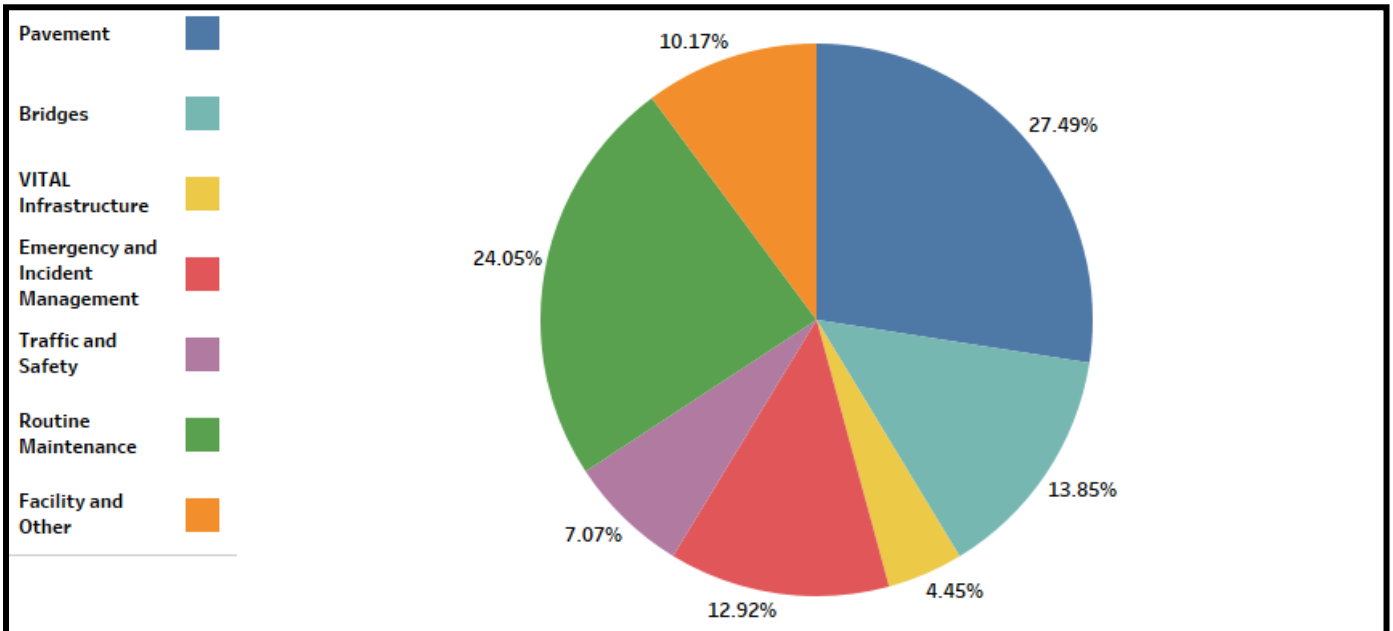
§ 33.2-232(B)(1)

The *Code of Virginia* requires payments to localities from the Highway Maintenance and Operating Fund (HMOF). The method used to compute the amount each locality shall be paid is established by law. For FY 2019, the total payments to localities was calculated to be approximately $457 million. In FY 2020, the maintenance payment to localities is projected to be approximately $456 million.

Funds from the HMOF support VDOT's Highway Maintenance and Operations Program (HMOP) for the agency's maintenance, operations and services. Once VDOT receives the HMOF distribution, funding is allocated statewide based on the needs. VDOT expenditures for the HMOP is approximately $1.7 billion annually (not including payments to localities). The needs detailed previously are more than the funding received for VDOT's annual maintenance and operations. Therefore, in order to facilitate distribution of the allocations received for VDOT's HMOP, all categories and subcategories of needs are divided geographically. For example, bridge needs are separated by district for both bridge inspection needs and bridge routine maintenance. Then, for each category and subcategory a funding distribution percentage is assigned based on the statewide constrained needs.

Figure 32 shows the Proposed Allocations to the HMOP for FY 2020.

Figure 32: FY 2020 HMOP Proposed Allocations (in millions)*



	Pavement	Bridges	VITAL Infrastructure	Emergency and Incident Management	Traffic and Safety	Routine Maintenance	Facility and Other	Total Allocation
Proposed Allocation	$475.0M	$239.4M	$76.9M	$223.4M	$122.2M	$415.5M	$175.8M	$1,728.1M

*Figures may not equate due to rounding

Highway Maintenance and Operations Program

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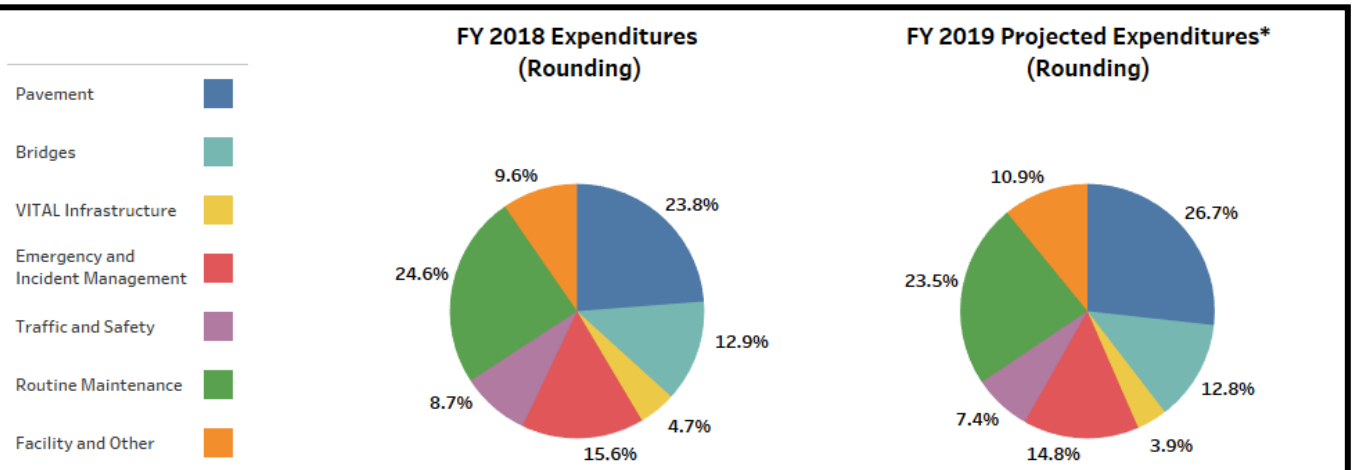
Figure 33 displays the statewide expenditures for the HMOP for the past fiscal year (FY 2018) along with the projected expenditures for the current fiscal year (FY 2019) by asset class.

Figure 34 displays the expenditures for the HMOP for the past fiscal year (FY 2018) by asset class and by district, respectively. Figure 35 depicts planned expenditures for the HMOP for the current fiscal year (FY 2019), by asset class and by district.

Figure 33: VDOT HMOP FY 2018 Expenditures and FY 2019 Projected Expenditures for Current Fiscal Year by Asset Class (in millions)**



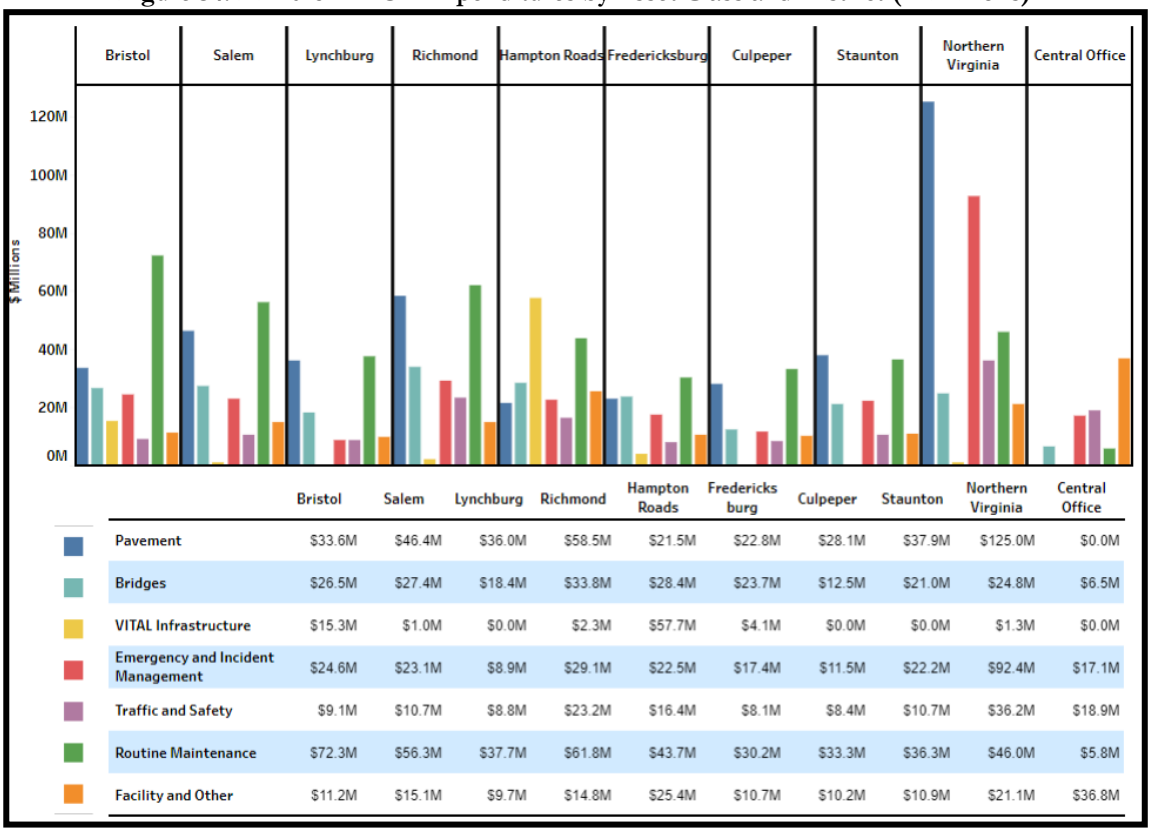
	Pavement	Bridges	VITAL Infrastructure	Emergency and Incident Management	Traffic and Safety	Routine Maintenance	Facility and Other	Totals
2018	$409.8M	$222.9M	$81.7M	$268.7M	$150.5M	$423.4M	$165.9M	$1,722.9M
2019	$463.2M	$222.1M	$67.3M	$255.6M	$128.0M	$406.9M	$188.9M	$1,732.0M

*2019 Projections as of 8/29/2018
**Figures may not equate due to rounding

Highway Maintenance and Operations Program Expenditures

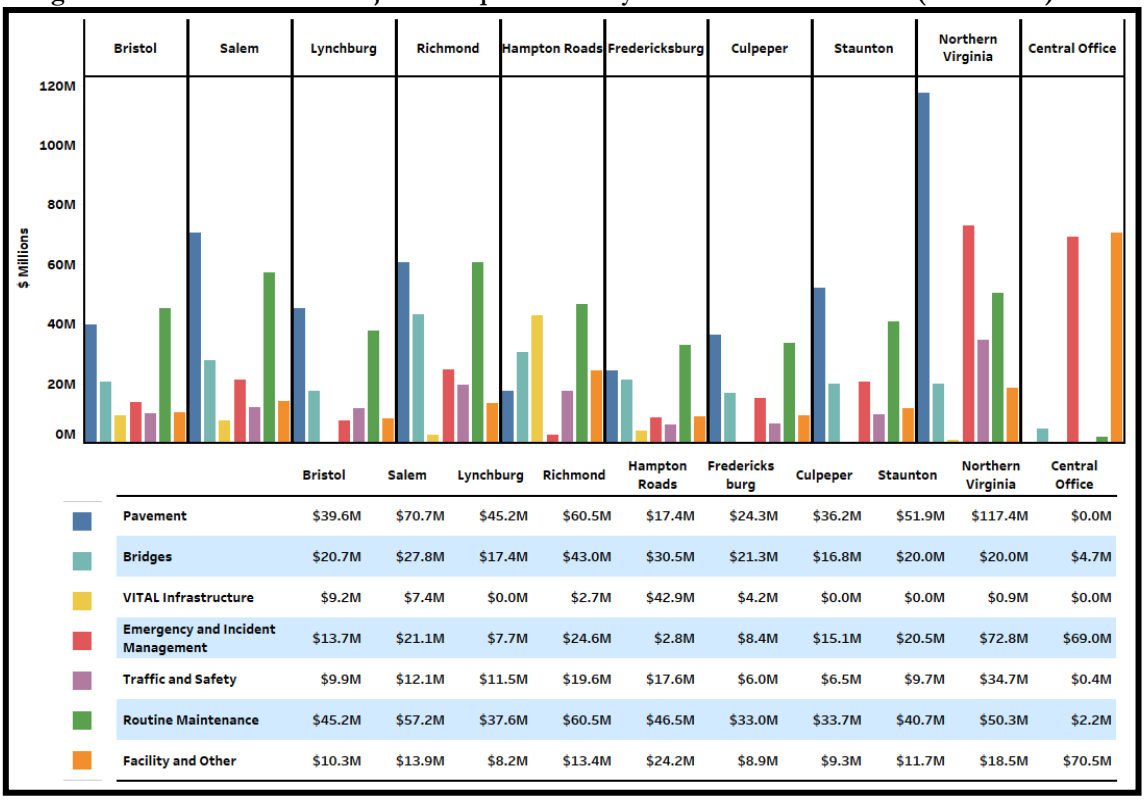
§ 33.2-232(B)(3)

Figure 34: FY 2018 HMOP Expenditures by Asset Class and District (in millions)



	Bristol	Salem	Lynchburg	Richmond	Hampton Roads	Fredericksburg	Culpeper	Staunton	Northern Virginia	Central Office
Pavement	$33.6M	$46.4M	$36.0M	$58.5M	$21.5M	$22.8M	$28.1M	$37.9M	$125.0M	$0.0M
Bridges	$26.5M	$27.4M	$18.4M	$33.8M	$28.4M	$23.7M	$12.5M	$21.0M	$24.8M	$6.5M
VITAL Infrastructure	$15.3M	$1.0M	$0.0M	$2.3M	$57.7M	$4.1M	$0.0M	$0.0M	$1.3M	$0.0M
Emergency and Incident Management	$24.6M	$23.1M	$8.9M	$29.1M	$22.5M	$17.4M	$11.5M	$22.2M	$92.4M	$17.1M
Traffic and Safety	$9.1M	$10.7M	$8.8M	$23.2M	$16.4M	$8.1M	$8.4M	$10.7M	$36.2M	$18.9M
Routine Maintenance	$72.3M	$56.3M	$37.7M	$61.8M	$43.7M	$30.2M	$33.3M	$36.3M	$46.0M	$5.8M
Facility and Other	$11.2M	$15.1M	$9.7M	$14.8M	$25.4M	$10.7M	$10.2M	$10.9M	$21.1M	$36.8M

Figure 35: FY 2019 HMOP Projected Expenditures by Asset Class and District (in millions)*#



	Bristol	Salem	Lynchburg	Richmond	Hampton Roads	Fredericksburg	Culpeper	Staunton	Northern Virginia	Central Office
Pavement	$39.6M	$70.7M	$45.2M	$60.5M	$17.4M	$24.3M	$36.2M	$51.9M	$117.4M	$0.0M
Bridges	$20.7M	$27.8M	$17.4M	$43.0M	$30.5M	$21.3M	$16.8M	$20.0M	$20.0M	$4.7M
VITAL Infrastructure	$9.2M	$7.4M	$0.0M	$2.7M	$42.9M	$4.2M	$0.0M	$0.0M	$0.9M	$0.0M
Emergency and Incident Management	$13.7M	$21.1M	$7.7M	$24.6M	$2.8M	$8.4M	$15.1M	$20.5M	$72.8M	$69.0M
Traffic and Safety	$9.9M	$12.1M	$11.5M	$19.6M	$17.6M	$6.0M	$6.5M	$9.7M	$34.7M	$0.4M
Routine Maintenance	$45.2M	$57.2M	$37.6M	$60.5M	$46.5M	$33.0M	$33.7M	$40.7M	$50.3M	$2.2M
Facility and Other	$10.3M	$13.9M	$8.2M	$13.4M	$24.2M	$8.9M	$9.3M	$11.7M	$18.5M	$70.5M

*2019 Projections as of 8/29/2018

#Figures may not equate due to rounding

State of Good Repair Program Overview

§ 33.2-232(B)(2,5)

Public investment is critical to preserving the Commonwealth's aging infrastructure. Most roads and bridges were built over 50 years ago and are in need of rehabilitation. The State of Good Repair Program prioritizes funding and the most pressing maintenance needs across the state are addressed with the goal of keeping people and commerce moving safely and efficiently.

In 2015, recognizing the aging infrastructure of the Commonwealth of Virginia, the Virginia General Assembly passed HB 1887 (Chapter 684) establishing the State of Good Repair Program.

The Board approved a process to prioritize needs with the goal of preserving and extending the service life of Virginia's complex roadway system.

Detailed information on the methodology for the Board's allocation of funds and project selection can be accessed by following this link: Process Methodology for the Board Allocation of Funds and Project Selection (http://www.ctb.virginia.gov/resources/2016/june/reso/Resolution1.pdf)

A list of prioritized pavement and bridge needs based on the priority ranking system developed by the Board can be accessed via the links below:

State of Good Repair Projects listed by District (VDOT) (http://syip.virginiadot.org/reports/244/13-FY19-FINAL-APPENDIX-A.pdf)

Paving Projects by District (VDOT) (http://syip.virginiadot.org/reports/244/15-FY19-FINAL-APPENDIX-C.pdf)

Bridge Projects by District and Locality (VDOT and Localities) (http://syip.virginiadot.org/reports/244/16-FY19-FINAL-APPENDIX-D.pdf)

Funding for the State of Good Repair Program is distributed pursuant to § 33.2-358 of the *Code of Virginia*, which sets aside 45% of VDOT's construction funds beginning in FY 2021, to meet the needs of aging infrastructure. Prior to FY 2021, the 2016, 2017 and 2018 Appropriations Acts provided funding to the State of Good Repair Program. State of Good Repair Program funding is distinct from funding for the Highway Maintenance and Operating Program.

The State of Good Repair Program (§ 33.2-369) provides funding for the reconstruction and rehabilitation of deteriorated pavements on the Interstate and Primary systems and Primary Extensions (both VDOT and locally maintained or owned), as well as the replacement or rehabilitation of Poor bridges (both VDOT and locally maintained or owned) on all systems. Allocation of the funding is based on a needs prioritization methodology. Under the State of Good Repair Program, all nine districts receive funding, with no district receiving less than 5.5% or more than 17.5% of the State of Good Repair Program funds in a given year. However, the Board has the ability to approve two exceptions or waivers to the State of Good Repair Program funding distribution. The first exception waives the funding cap in order to provide funds for an urgent pavement or bridge project resulting from extraordinary circumstances. The second waiver allows the Board to reserve 20% of funds for use by the nine districts on Secondary pavements if VDOT does not meet Secondary pavement statewide performance targets.

The second enactment clause of Chapter 684 (2015) required the Board to develop a priority ranking system for the State of Good Repair Program by July 1, 2016. Pursuant to that requirement, a priority ranking system, the State of Good Repair Prioritization Process Methodology, was developed by the Board and approved by resolution on June 14, 2016.

State of Good Repair Program Allocation Overview

§ 33.2-232(B)(2,5)

A description of the State of Good Repair Program project priority ranking system follows. The Prioritization Process consists of three main steps, which are outlined below:

Step 1

The Needs Assessment Process

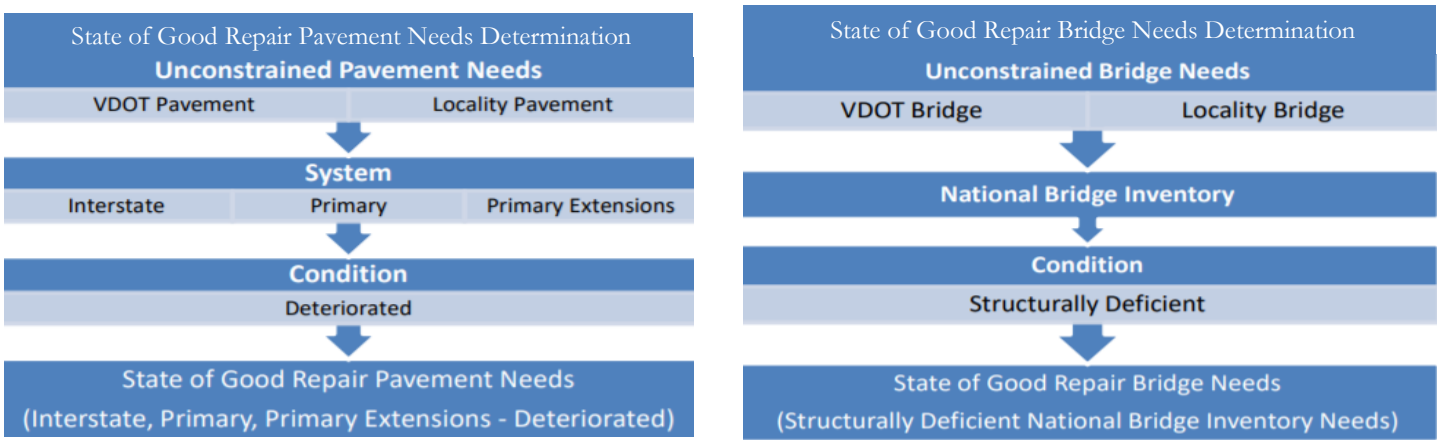
Unconstrained or 100% of needs for pavements and bridges are assessed. Annually VDOT collects 100% of the needs for Interstate, Primary and Primary Extensions and 20% of the needs for Secondary pavements. Annually VDOT collects 100% of the needs for VDOT-maintained bridges while localities provide VDOT the needs for structures in the National Bridge Inventory (NBI) that are owned or maintained by localities. Localities do not provide non-NBI needs to VDOT.

Step 2

State of Good Repair Needs and Funding Distribution Methodology

The needs collected in Step 1 (The Needs Assessment Process) are then separated in order to identify deteriorated pavements and structurally deficient bridges (VDOT and locally maintained/owned). During this process of determining the needs to use for the State of Good Repair Program, VDOT's needs are reduced if locality data for the same needs are not available. For example, if pavements' need assessments are not available for localities' urban/collector pavements, VDOT's needs on its Secondary System are removed from consideration for the State of Good Repair Program. Another example would be if bridge needs assessments are not available for the localities' non-NBI structures, VDOT's needs on its non-NBI structures are removed from consideration for the State of Good Repair Program. See Figure 36.

Figure 36: State of Good Repair Program Needs Determination



State of Good Repair Program Allocation Overview

§ 33.2-232(B)(2,5)

2 Cont.

State of Good Repair Needs and Funding Distribution Methodology Continued

The State of Good Repair Program needs are the basis for the percentage of funds allocated to each district (see Figure 37), with each district receiving no less than 5.5% and no more than 17.5% in a given year.

Within each district, the State of Good Repair Program funding is distributed as shown in Figures 38 and 39. The percentages in Figure 39 were approved by the Board on May 16, 2018.

Funding is set aside for distribution to each asset category for VDOT and the localities. The recommended State of Good Repair Program bridge and pavement projects are submitted for inclusion in the Six-Year Improvement Program.

Figure 37: State of Good Repair Funding Distribution

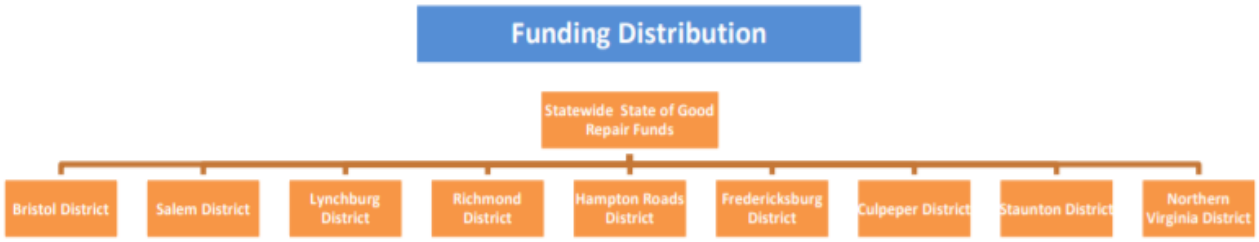


Figure 38: District Distribution by Asset

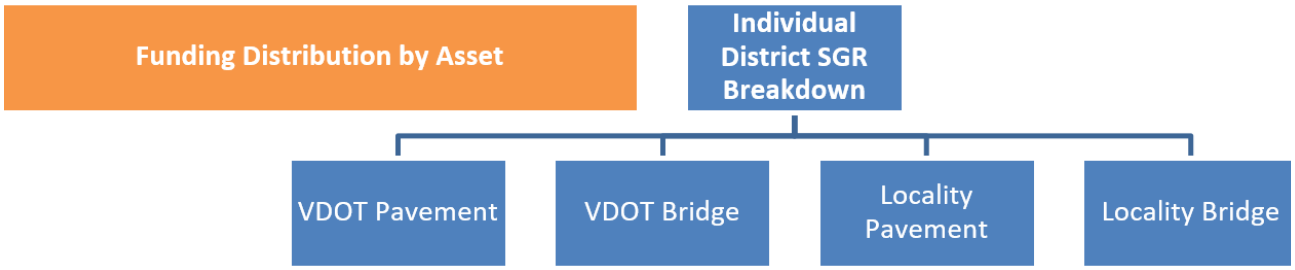


Figure 39: FY 2019 Percentage Fund Distribution

FY 2019 State of Good Repair Percentage Fund Distribution							
District	FY 2019	VDOT			Localities		
		Pavement	Bridge	Total	Pavement	Bridge	Total
Bristol	**12.53%**	18%	60%	**78%**	2%	20%	**22%**
Salem	**11.40%**	25%	59%	**84%**	6%	10%	**16%**
Lynchburg	**6.39%**	22%	63%	**85%**	9%	6%	**15%**
Richmond	**17.50%**	17%	71%	**88%**	4%	8%	**12%**
Hampton Roads	**17.50%**	3%	37%	**40%**	26%	34%	**60%**
Fredericksburg	**11.66%**	11%	85%	**96%**	1%	3%	**4%**
Culpeper	**6.39%**	26%	40%	**66%**	3%	31%	**34%**
Staunton	**10.23%**	27%	64%	**91%**	6%	3%	**9%**
Northern Virginia	**6.39%**	24%	65%	**89%**	10%	1%	**11%**

State of Good Repair Program Allocation Overview

§ 33.2-232(B)(2,5)

Step 3

The Priority Ranking System Methodology

Pavement

VDOT:
Each district will compile pavement projects based on the number of lane miles of deficient pavement that qualify for the State of Good Repair Program. These pavement projects are ranked for recommended funding using criteria such as the road system, the pavement (i.e., Interstate or Primary) and the traffic count for the given section of pavement.

Localities:
Follow the established Primary Extension prioritization process approved by the Board in June 2014. Detailed information on the Primary Extension prioritization process can be accessed by http://www.virginiadot.org/business/resources/local_assistance/FY20_Primary_Extension_Application_Process.pdf

Bridge

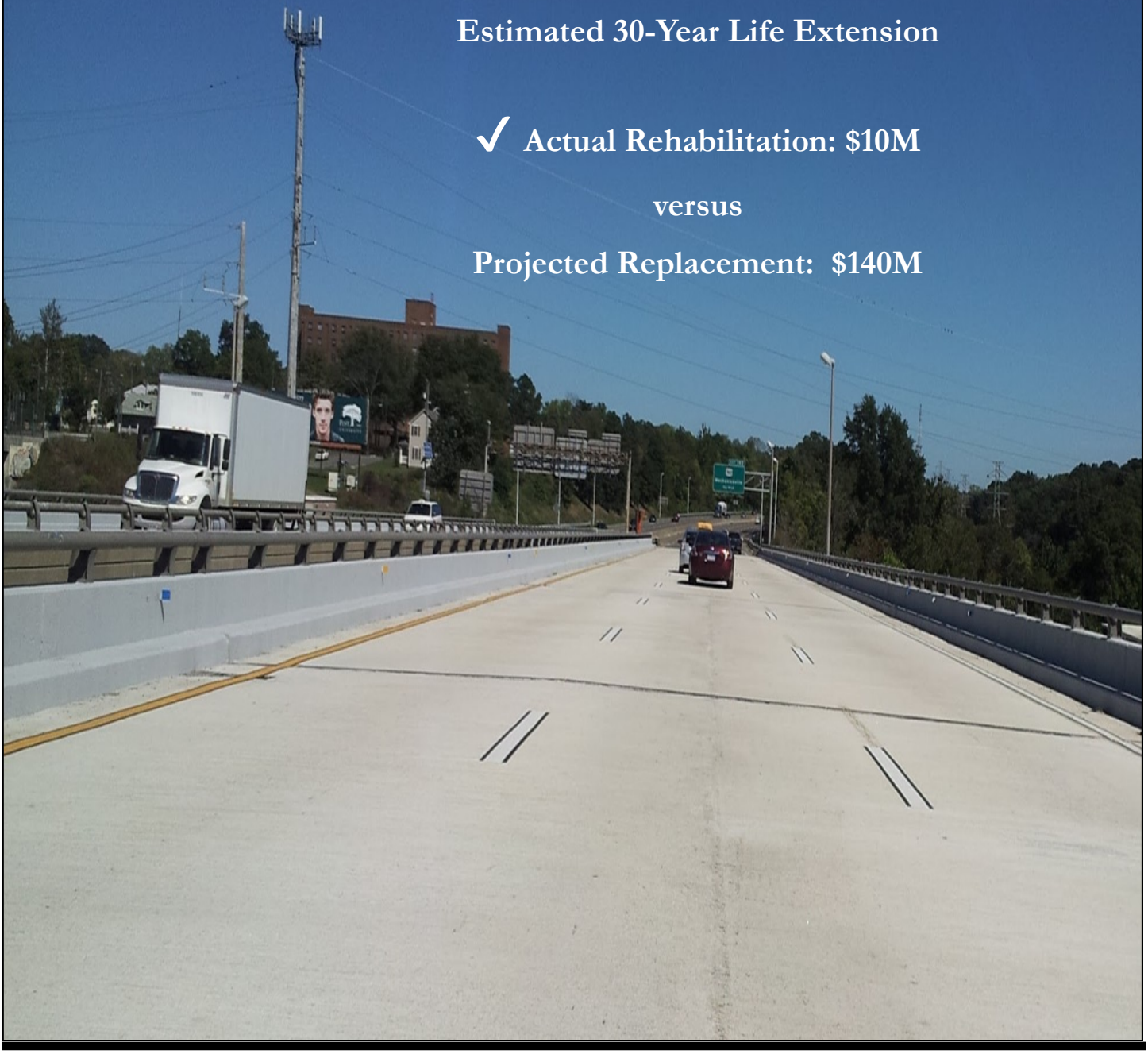
VDOT and Localities:
All bridges that are eligible for the State of Good Repair Program funding are prioritized based on factors such as condition and cost-effectiveness.

A prioritized list of bridges for repairs is developed for each district based on the rankings.

For FY 2017, FY 2018 and thus far for FY 2019 the Board did not approve any exceptions or waivers as allowed by the State of Good Repair Program in § 33.2-369 of the *Code of Virginia*.

Efficiencies - A VDOT Example

VDOT implements an effective investment strategy for the efficient preservation of the Commonwealth's highway transportation infrastructure. VDOT's investment strategy includes a strategic balancing within its paving program of preventive maintenance, corrective maintenance, restorative maintenance and reconstruction of lane miles. For structures and bridges, VDOT's strategy includes proactive rehabilitation with an emphasis on preservation, timely intervention and maximum efficiency using new materials, techniques and treatments with a higher return on investment.



SECTION 2

Transportation Systems Management and Operations

Transportation Systems Management and Operations

§ 33.2-232(B)(4)

Transportation Systems Management and Operations-Safety and Security

Operations is a significant aspect of managing the Commonwealth's highway system. Operations involves monitoring roadway conditions and using a variety of strategies and technologies to improve safety, enhance mobility and respond promptly to incidents.

VDOT's operations program has two main areas of focus:

(1) **SAFETY** includes various safety programs, incident management programs, traffic surveillance systems and activities in support of emerging transportation technologies such as connected and automated vehicles; and

(2) **MOBILITY** includes statewide incident management programs, traveler information services, highway monitoring systems, integrated corridor management and active traffic management systems. In both areas, VDOT has developed and monitored relevant performance measures.

Deaths on Virginia's highways and streets had been on a decline from 2007 to 2014.

Due to factors such as distracted driving and growth in travel, fatalities have increased 19.9% between 2014 to 2017. See Figure 40

Any transportation related fatality and serious injury is unacceptable.

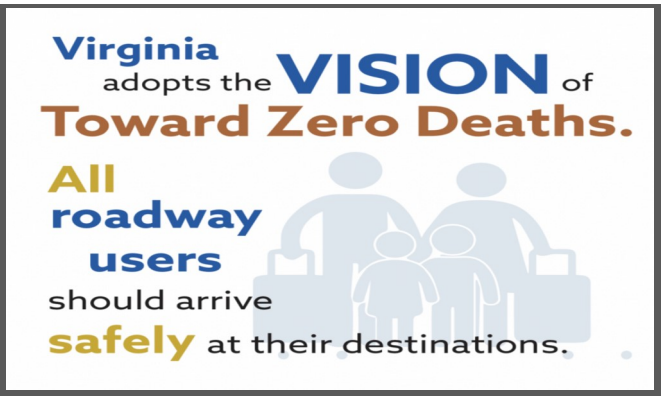
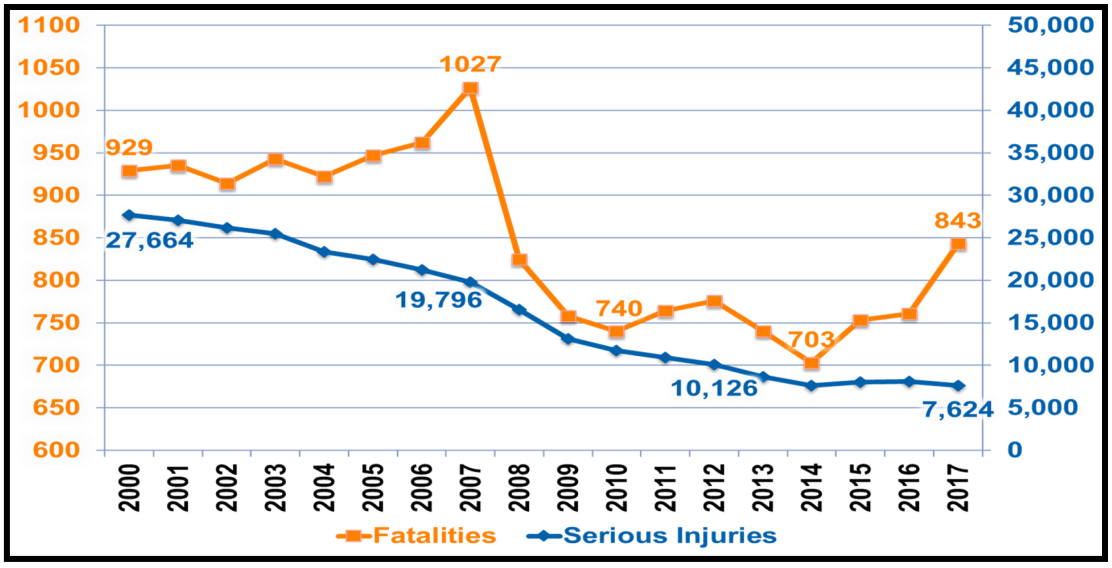


Figure 40: Annual Fatalities and Serious Injuries on Virginia Roads (2000 – 2017)



Transportation Systems Management and Operations

§ 33.2-232(B)(4)

Increasing vehicle miles traveled (VMT) and other socio-economic factors are shifting safety trends. To promote actions toward zero deaths, Virginia sets annual safety targets to evaluate progress toward fatality and serious injury reductions.

SAFTEY PERFORMANCE TARGETS

What do we measure?

- Number of fatalities
- Fatality rate (per 100 million VMT)
- Number of serious injuries
- Serious injury rate (per 100 million VMT)
- Number of non-motorized fatalities and serious injuries

How will we get there?

- Most crashes are the result of one or more behavioral emphasis areas such as "Impaired Driving" or "Speeding". Improvements to infrastructure may prevent or reduce the severity of crashes.
- VDOT is developing a data-driven process to inform target setting and investment decisions leading to better performance. This process will consider how real projects are reducing crashes and crash severity based on observed data, not just models.

In July 2018 the Board adopted targets for five federal safety performance measures. These targets cover all public roads in Virginia and are set annually. Three of these federal measures require coordination between VDOT and DMV: number of fatalities, rate of fatalities, number of serious injures.

The targets for these three federal measures are shown in Figure 3.

Arrive Alive Virginia

TOWARD ZERO DEATHS VIRGINIA

Transportation Systems Management and Operations

§ 33.2-232(B)(4)

Safety Management: Strategies and Programs and Plans for Improving Safety

All VDOT projects are developed and implemented with the public's safety as a prime consideration. VDOT's targeted safety strategies are implemented primarily through the federally funded Highway Safety Improvement Program (HSIP) and the Strategic Highway Safety Plan (SHSP).

Many planning documents in Virginia address safety with the Strategic Highway Safety Plan (SHSP) being the umbrella, tying all the plans together.

Strategic Highway Safety Plan (SHSP)

- Coordinated by VDOT
- Updated every 5 years
- Infrastructure and behavioral countermeasures
- SHSP process approved by FHWA
- Requirement of HSIP

Highway Safety Improvement Program (HSIP)

- Developed by VDOT
- Infrastructure improvements
- Establishes annual targets

Statewide and Regional Plans and Implementation Programs

- VTrans and metropolitan transportation plans identify needs and future investment priorities
- SMART SCALE, HSIP, and other programs implement projects within the Six-Year Improvement Program

Highway Safety Plan (HSP)

- Developed by Department of Motor Vehicles (DMV)
- Behavioral programs
- Establishes annual targets

Transportation Systems Management and Operations

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A federal requirement under the Highway Safety Improvement Program (HSIP), the SHSP details all VDOT safety partner efforts to improve traffic safety in Virginia over a five-year period, including projects and strategies to improve safety for bicyclists and pedestrians. Virginia has used a cooperative and coordinated multi-agency and inter-disciplinary engineering, education, enforcement and emergency response (4-E) approach to improving highway safety. The recently updated SHSP for the 2017-21 period, developed under VDOT's leadership, will be used to drive investment decisions to improve highway safety and reduce deaths and serious injuries for the next five years.

The SHSP has strategically focused on correcting poor driver behavior and improving roadway elements and traffic control to reduce crashes and their consequences. In 2017, the SHSP established the goal to reduce deaths by 2% and serious injuries by 5% per year to meet the longer term goal of eliminating deaths and injuries on Virginia's roads and streets. Within the five year SHSP horizon, strategies and action are defined across four broad areas:

- Human Behavior
- Safe Roadway Infrastructure
- Data Collection, Management and Analysis
- Technology and Partnerships

The 2017 to 2021 SHSP is available at: virginiadot.org/info/resources/SHSP/VA_2017_SHSP_Final_complete.pdf.

Transportation Systems Management and Operations

§ 33.2-232(B)(4)

HSIP funds are applied to the highest priority safety needs. VDOT's goal is to apply HSIP funds to projects with the greatest potential to reduce serious injuries and fatalities within a District, taking into consideration the investment and to track and communicate safety outcomes of completed projects.

VDOT's HSIP is composed of the following subprograms using the federal funding sources:

- Highway Safety Program (HSP): 23 USC § 148
- Bicycle and Pedestrian Safety Program (BPSP) : 23 USC § 148
- Highway-Rail Grade Crossing Program (H-RGCP) : 23 USC § 13

Each of these subprograms is focused on reducing crashes on all roads. Highway safety projects target locations at intersections and on roadway segments with above-normal incidents of crashes, based on an assessment of the highway network. Intersection improvements include advance-warning signing, traffic signal upgrades, crosswalks and pedestrian refuge islands, bike lanes and turn-lane improvements. Roadway segment projects include enhanced pavement friction, curve delineation signing, rumble strips, safety edge, shoulder widening and guardrail or barriers. Typical BPS projects include sidewalks, trails, bicycle lanes and intersection accommodations such as pedestrian signals, ramps and crosswalks. The H-RGCP targets higher risk at-grade railroad crossings with projects such as the installation of gates and flashing lights at roadway rail crossings.

The HSIP is funded by two additional sources :

- Open Container Penalty Transfer Funds: 23 USC § 154
- High-Risk Rural Road (HRRR) Program: 23 USC § 148

The Open Container-Penalty Transfer Funds are set aside for state safety programs, pursuant to 23 USC Section 154, when a state fails to enact and enforce an open container law that is consistent with the requirements of the federal law. Open Container-Penalty Transfer Funds are programmed on the state's HSIP Section 148-eligible (HSP and BPS) safety improvement projects. The federal HRRR Program was initially established as a set-aside for safety projects on rural major and minor collectors and rural local roads. Currently, the HRRR Program requires a state to obligate (set aside) a portion of its HSIP allocation to HRRRs only if the state's fatality rate on rural roads has increased over the most recent two-year period for which data are available. Recently rural fatalities have been increasing. As such, the FHWA notified VDOT that HRRR set-aside would be invoked for federal FY 2018.

To assess HSIP effectiveness, VDOT conducts a before and after crash reduction analysis of each completed safety project. The crash analysis period for these projects covers the 36 months prior to construction and the same period after the completion year of the safety improvement. These safety projects have led to significant reductions in the number of crashes and severe outcomes.

More information concerning HSIP is available at http://www.virginiadot.org/business/ted_app_pro.asp

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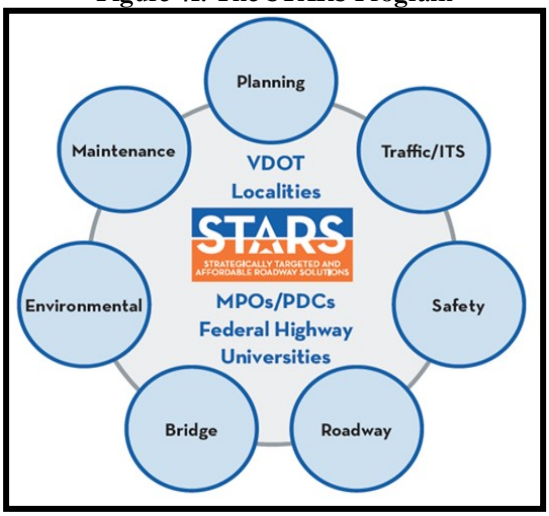
Strategically Targeted Area Roadway Solutions (STARS) Program

Strategically Targeted Area Roadway Solutions (STARS) is a multidisciplinary program, bringing together planners, traffic engineers, safety engineers, roadway design engineers, maintenance specialists and local stakeholders to jointly identify cost-effective measures aimed at improving safety and reducing congestion. In addition, VDOT district offices can leverage Statewide Planning and Research funding to help identify, plan, conceptually design and, ultimately, program projects that reduce congestion and improve safety. In many instances, STARS improvements cost less than traditional improvements and they may be eligible for implementation under one or more of VDOT's funding sources.

Figure 41: The STARS Program



Since 2007 to the present:

- Over 280 STARS studies have been completed.
- Total of $636 million funding has been for STARS studies recommendations
- Funding sources include SMART SCALE, Transform 66 Outside the Beltway Concession Funding and the Northern Virginia Transportation Authority's FY 2018–FY 2023 Six-Year Improvement Program.
- $10 million has been allocated for STARS studies in FY 2019. These studies follow a data-driven approach to focus VDOT's resources where the issues are occurring.

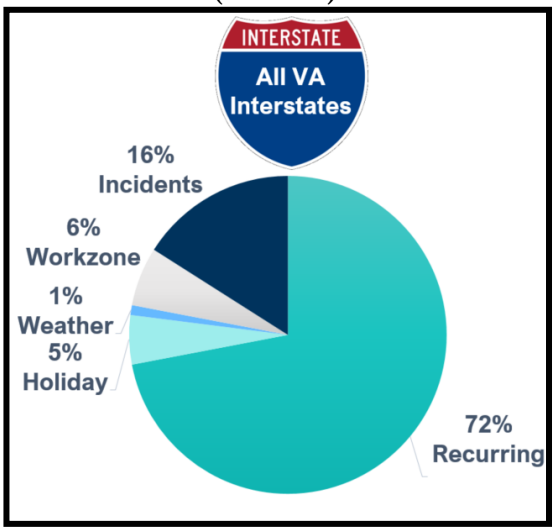
More information concerning VDOT's STARS Program is available at http://www.virginiadot.org/projects/stars.asp.

Key General Transportation Systems Management Strategies and Programs

Transportation Systems Management and Operations comprise a collection of strategies VDOT uses to improve mobility or capacity without building new highways or adding travel lanes. Congestion affects the available capacity of a roadway, is caused by a variety of factors (Figure 42) and is not solely related to the number of vehicles on the roadway. Interstate highway capacity is affected by planned and unplanned events, such as incidents, work zones and weather. The capacity of Primary and Secondary roads is also affected by traffic signals. VDOT's strategies to combat congestion include:

- Managed travel lanes
- Traffic operations (signals and incident management)
- Weather information systems
- The Arterial Preservation Program
- Variable speed limits

Figure 42: Causes of Interstate Congestion (2016-2017)



Transportation Systems Management and Operations

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MANAGED TRAVEL LANES

VDOT actively manages travel lanes through:

- Ramp metering
- Hard shoulder running
- High Occupancy Vehicle (HOV) / High Occupancy Tolling (HOT) lanes

Ramp metering regulates merging activities onto the Interstate with the use of signal lights or other devices in order to promote even travel flow.

Hard shoulder running allows drivers to drive on designated shoulders during rush hour periods to increase roadway capacity without the need to build a new travel lane.

HOV/HOT lanes allow drivers to use the facility without meeting the requirement for a specific minimum number of vehicle occupants by paying a toll. Tolls are adjusted throughout the day so that the HOT lanes do not become congested. Conversion of HOV lanes to HOT lanes allow for more throughput without building new travel lanes. There are over 48 miles of HOT lanes on portions of I-66, I-495, I-95 and I-64. Recent changes to the program include:

- HOV lanes on I-66 inside the Beltway became HOT lanes in December 2017
- HOT lanes on I-95 in Stafford County were extended an additional two miles
- Reversible lanes on I-64 in Norfolk became HOT lanes in January 2018

VDOT has several HOT lanes projects underway:

- Transform 66—Outside the Beltway
- I-95 Express Lanes Fredericksburg Extension
- I-64 Hampton Roads Bridge Tunnel Expansion Project
- I-64 High Rise Bridge Project

ARTERIAL PRESERVATION PROGRAM

The Arterial Preservation Program* (APP) is an important strategy for extending the useful life of Commonwealth transportation assets that connect population and employment centers over long distances. Access to local land development sites or the addition of numerous traffic signals and cross-overs deteriorates the safety and capacity of these facilities. Under the APP, VDOT ensures that the main purpose and function of the Arterial Preservation Network (APN) is considered along with local economic development goals.

One method to preserve the capacity of the APN includes the use of innovative intersection designs to improve existing intersections and to accommodate new development sites. Innovative intersections make the access safer for local traffic as well as for the through traffic movements and in many cases, may preclude the need for a traffic signal.

VDOT has initiated Arterial Management Plans for several facilities:

- Route 29 (Lynchburg District)
- Route 58 (Hampton Roads District)
- Route 58 (Richmond District)
- Route 220 (Salem District)
- Route 207/301 (Fredericksburg District)
- Route 3 (Culpeper District)
- Route 460 (Lynchburg and Salem Districts)

These Arterial Management Plans are developed in partnership with the local governments. It is anticipated that corridor plans, when completed, will be incorporated in the counties' comprehensive plans. Intersections and segments of these corridor plans can be submitted by the locality for Smart Scale review and possible funding.

*The Arterial Preservation Program focuses on the arterials that provide long distance travel but are not designated as limited access highways (i.e. Interstate System)

Transportation Systems Management and Operations

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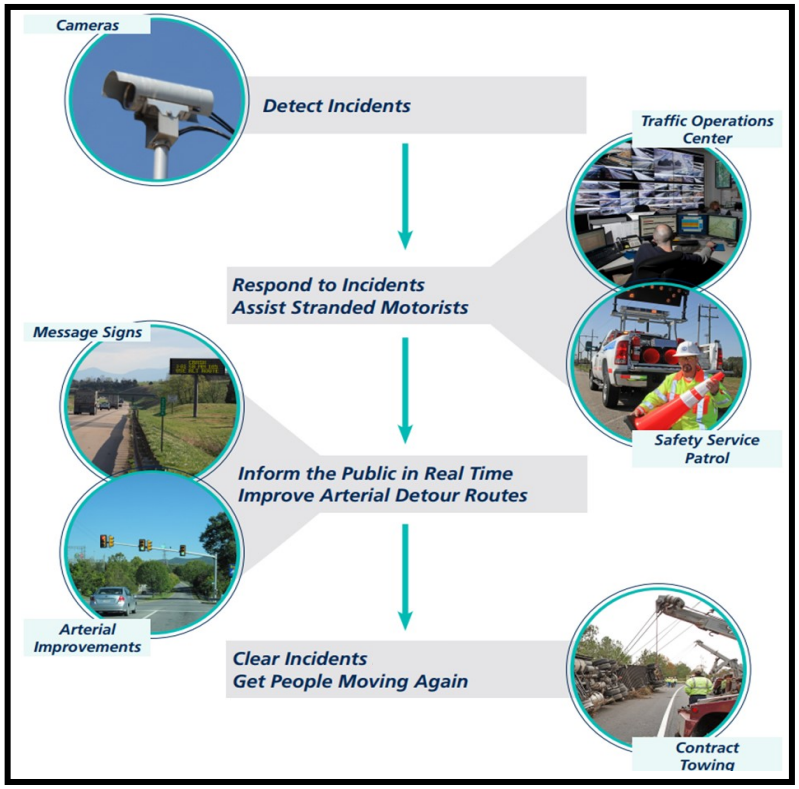
WEATHER INFORMATION SYSTEMS

In addition to its traffic monitoring systems, VDOT uses other transportation technologies and services to monitor weather events. VDOT operates 96 Road Weather Information Systems at strategic locations to monitor road surface and atmospheric conditions. VDOT also has direct contracts with independent meteorologists to provide detailed weather information to plan for major events.

TRAFFIC OPERATIONS

VDOT operates five Traffic Operation Centers (TOCs) located in Richmond (Central Region), Fairfax (Northern Region), Salem (Southwestern Region), Staunton (Northwestern Region) and Virginia Beach (Eastern Region). Staff at each TOC monitor traffic conditions, distribute traveler information messages to the public and assist with coordinating planned and unplanned incidents. Each TOC manages traffic monitoring equipment including 2,800 field devices (cameras, message signs, vehicle detectors etc.), 2,636 VDOT-owned signal systems and 47 safety service patrol routes covering 834 centerline miles. The incident management process is shown in Figure 43.

Figure 43: Incident Management Process



Transportation Systems Management and Operations

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Operating Condition of Highways

VDOT uses performance metrics to measure the highway operating condition. Two regularly reported and reviewed metrics are:

- Vehicle hours of delay
- Incident duration.

Vehicle Hours of Delay

Vehicle hours of delay (VHD) is a measure of the extra time that the public spends traveling because traffic is not moving at speeds close to the free flow speed. Delay is counted when the travel speeds are 20 miles slower than the free flow speed, which is the desired speed for drivers in low volume conditions without incidents or weather events*. VDOT uses vehicle probe data provided from INRIX**. Vehicle probe data can be collected from vehicle operators' cell phones as they travel between communication towers. VDOT also uses a VHD calculation tool provided by the Regional Integrated Transportation Information System***.

The data collection for travel speeds on non-Interstate highways can include time spent at traffic signals, short detours through parking lots, deliberate idling, time spent in "drive-thru" facilities, etc. For this reason, the vehicle hours of delay are presented separately for Interstates and for U.S. highways and State highways, the latter of which represent only a portion of the Primary and Secondary road network.

Incident Duration

VDOT measures incident duration using important metrics:

- **Roadway Clearance Time**: the time in minutes from the first recordable awareness of the incident to the time that all travel lanes are clear and available for traffic flow. This is measured for all lane-impacting incidents.
- **Scene Clearance Time**: the time in minutes from the first recordable awareness of an incident to the time that the last responder has left the scene and all lanes and shoulders are clear. This is measured for all incidents. A roadway's Scene Clearance Time can be faster than the Roadway Clearance Time because the Scene Clearance Time includes disabled vehicles on the shoulders and other simpler events.

VDOT collects data at its five TOC facilities using an internal tool, VATraffic. Operators from each TOC record the event as it becomes known and provide updates as information becomes available from the Virginia State Police, local law enforcement, other first responders and VDOT field operators.

*Typically, free flow speed is based on traffic studies that use methods such as that found in the Federal Highway Administration's Appendix N: Procedures for Estimating Highway Capacity.
**INRIX Inc. specializes in connected car services and transportation data collection.
***Developed by the University of Maryland's Center for Advanced Transportation Technology in coordination with state and federal agencies, the Regional Integrated Transportation Information System is an automated data sharing, data calculation, dissemination and archiving system designed to help participating agencies better understand the operating condition of their roadways, measure performance and communicate information between agencies and the public.

Transportation Systems Management and Operations

§ 33.2-232(B)(4)

Security Programs

Multiple strategies are deployed to promote the security of VDOT's critical highway assets, including tunnels and bridges. Key activities are outlined in Figure 44.

Figure 44: Security Programs and Strategies

	Program/Strategy	Details
SECURITY PROGRAM OR STRATEGY	**Critical Infrastructure (CI), Protection and Resiliency**	CI is generally defined as systems and assets, whether physical or virtual, so vital to VDOT's mission that the incapacity or destruction of any such system or asset would have a debilitating impact on mobility, security, economic security, public health or safety or any combination of those matters. VDOT works to ensure CI protection, promote resiliency and identify and prioritize security-related projects.
	Security Systems Oversight	The Agency Security Program Area provides a single point of contact for the design, type and performance of security equipment, projects, policies and security management systems (SMS). Security management systems include all systems and equipment that directly or indirectly relate to the physical security of facilities and structures.
	Criminal History Records Check Program	This program ensures that suitable individuals are authorized and assigned to perform work for VDOT, conduct business on behalf of VDOT and/or are granted access to VDOT's CI, systems, or information that has been deemed "sensitive." The Agency Security Program Area manages the criminal history records check process established for VDOT personnel and contractors.
	Security Response Plan Program	The Security Response Plans are comprehensive documents that focus on specific tunnel facility responses to various manmade security threats or incidents. Work on this program is on-going and includes a yearly update process to capture any facility point of contact or operational process changes.
	Training Program	In coordination with facility managers and staff an effort is made to maintain an awareness of the latest security topics and practices. Training courses are coordinated with outside agency stakeholders to support facility requests for training. General training courses included Terrorism Security Awareness Orientation, Incident Response to Terrorist Bombing, Surveillance Detection, Soft Target Awareness and Improvised Explosive Device awareness and vehicle screening.

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Actions employed by VDOT to improve operations include policy updates, projects funded through the Innovation and Technology Transportation Fund and other sources and program updates.

Policy Updates

Use of Unmanned Aircraft to Improve Incident Duration

In 2018, the General Assembly enacted an amendment to the *Code of Virginia* relating to traffic incident management (Chapters 546 and 654 of the 2018 Acts of the Assembly). This amendment allows VDOT to use unmanned aircraft systems to assist law enforcement officers prepare accident reports. Use of this technology is expected to shorten crash investigations, reduce the duration of these incidents and associated congestion and reduce opportunities for secondary collisions.

Expanded Traffic Performance Measurement

VDOT continues to use emerging data sources to monitor traffic conditions and traffic systems. VDOT is supporting the development of federal system reliability performance measures and targets which were adopted by the Board (Figure 4). VDOT also procured the necessary equipment to expand the capabilities of monitoring traffic signals.

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Traffic Incident Clearance Procedures

In 2017, the General Assembly enacted several changes to the *Code of Virginia* relating to traffic incident response and management (Chapter 350 of the 2017 Acts of Assembly). These amendments facilitated more rapid deployment of VDOT and its contractors to incidents and enhanced their ability to remove vehicles and cargo from travel lanes.

- Between FY 2017 and FY 2018, the average roadway (travel lane) clearance time for tractor trailer crashes dropped 5 minutes from 108 minutes to 103 minutes.
- The median roadway clearance for tractor trailer crashes also dropped 1 minute from 65 minutes to 64 minutes.

Chapter 350 also requires drivers who are involved in traffic incidents involving no injuries or loss of life to move the vehicles involved in the incident out of the travel lanes immediately if it is safe to do so. There were mixed results between FY 2017 and FY 2018.

- For single vehicle crashes, there was a 1 minute reduction in both the average and median roadway clearance times.
- No improvements were noted in multiple vehicle accidents average or median roadway clearance times.

The legislation's measures provide an opportunity to reduce highway congestion by reducing the duration of highway lane blockage due to incidents. VDOT measures incident duration using median roadway clearance time.

- Between FY 2015 and FY 2018, the trend line has remained relatively flat; however, during this same time period, there has been an increase in the number of events.

Statewide Advanced Traffic Management System

VDOT has awarded a contract to provide a statewide advanced traffic management system (ATMS) operating platform. The ATMS operates transportation technology devices, such as cameras, ramp metering, reversible road lanes and message signs. The ATMS also assists in providing traffic data and images and other vital communications to first responders. VDOT previously had separate systems for each of its five TOCs. Four of the five TOCs are now using the new statewide ATMS. The final TOC facility will be integrated in early 2019. It is anticipated that the single statewide ATMS will reduce costs and promote greater communication and redundancy between the TOCs to manage larger events.

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Use of the Innovation and Transportation Technology Fund

Funding for the Innovation and Transportation Technology Program became available per § 33.2-1531 of the *Code of Virginia*, which established the Innovation and Transportation Technology Fund (ITTF). A total of $125,000,000 was approved by the Board to fund pilot projects and fully developed initiatives pertaining to high-tech infrastructure improvements to improve mobility, reduce congestion and improve safety. VDOT advanced several transportation technology projects using ITTF and other funding sources. The Innovation and Transportation Technology Program consists of eight technology strategies. The recent activities by technology program strategy are as follows:

Operations Traffic Management – to improve corridor efficiency through active traffic management across multiple parallel freeways, arterial highways and transit systems.

- Greater Richmond TOC - Awarded a contract and began construction for a new TOC to provide the ability to house advanced transportation technology equipment and programs to improve mobility. The new facility will be shared with the Virginia State Police to promote event coordination during significant incidents (ITTF funded with other Capital Outlay funding).
- Greater Richmond Traffic Management Systems - Completing design plans to provide additional cameras, communication and other transportation technology devices along portions of I-64, I-85, I-95 and Virginia Route 288 (non-ITTF).
- Hampton Roads Tunnel Control Rooms **-** Completed design plans for an upgrade to the Hampton Roads Bridge Tunnel control room in order to provide greater traffic management capabilities are advancing. Developing design plans for an upgrade to the Monitor Merrimac Memorial Bridge Tunnel control room (ITTF funded).
- I-95 Ramp Metering **–** Completed design plans to expand ramp metering on I-95 in Northern Virginia to complement the I-395 ramp metering program (ITTF funded).
- Northern Virginia Integrated Corridor Management (ICM) – Conducting outreach with Northern Virginia localities, private sector transportation firms, regional transportation agencies and state organizations to promote the implementation of an ICM program. Implementing components of the ICM program such as parking management systems, ramp metering and a data store for a future decision support system promotes a regional solution to the challenge of improving mobility (non-ITTF).
- I-64 HOT Lane Design – Developing plans to upgrade the HOV lanes on I-64 from Bower's Hill to the reversible roadway in Norfolk to become HOT lanes. This project will improve the capacity on this section of I-64 by allowing single occupant vehicles to use the HOT lanes (non-ITTF).

Incident and Emergency Response – to detect, respond and clear incidents on the roadway, which include collisions, disabled vehicles, weather events, emergencies and man-made disasters.

- **Camera Integration –** Provided connections for the integration of 56 cameras from local jurisdictions in order to improve situational awareness at VDOT's TOCs and through 511 Virginia (non-ITTF).
- **Use of Unmanned Aircraft to Improve Incident Duration** - VDOT is working with the Virginia State Police to employ the use of unmanned aircraft to shorten the crash investigation process and to lower incident duration times (ITTF funded)

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Multimodal Travel Promotion – to increase multimodal travel by increasing access and improving its efficiency.

- **Greater Richmond Transit** - Bus Rapid Transit - Provided project management to the Department of Rail and Public Transportation to install a 7.6 mile bus rapid transit system for Richmond. This system became operational in 2018 (non-ITTF).
- **Park and Ride Lot Parking Management Systems** - Provided technical support to include parking lot management systems for planned facilities along the I-66 corridor.

The Haymarket facility is being designed to include a parking management system (non-ITTF).

Arterial Highway Management – to optimize the performance of arterial roadways through signal operations improvements and performance monitoring.

- **Arterial Monitoring** - Completed additional design plans and projects to deploy communications, advanced controllers and traffic cameras on arterial corridors. Locations include:
- US 60, Routes 143 and 199 in Hampton Roads District (ITTF funded)
    - ◊ Routes 28, 234, 286 and 294 in Northern Virginia (non-ITTF funded)
    - ◊ Routes 29, 50, 7 and 236 in Northern Virginia (non-ITTF funded)
    - ◊ US 1 in Northern Virginia (non-ITTF funded)
    - ◊ US 1 in Richmond District (non-ITTF funded)
    - ◊ US 1 in Fredericksburg District (non-ITTF funded)
    - ◊ SR 60 between Henrico County and James City County (non-ITTF funded)
- **Advanced Signal Control** – Advertised and awarded a statewide contract to provide advanced transportation controllers and firmware. This technology will allow for real-time signal and arterial management as well as vehicle to infrastructure capabilities using connected vehicle applications. The contracts are "joint and cooperative," allowing for locality use (ITTF funded).
- **Real-time Signal Performance** – The advanced traffic signal controllers include technology for Automated Traffic Signal Performance Metrics (ATSPM) and for future connected vehicle programs such as Signal Phasing and Timing (SPaT) data. Using the purchased Advanced Transportation Controller (ATC) hardware, VDOT is committed to incorporating ATSPM at all 3,050 traffic signals statewide. Efforts have begun to implement ATSPM at the 1,425 traffic signals with ATCs in the NoVA District and at additional intersections as the new ATCs are installed in the remaining 8 Districts. (ITTF funded).
- **ATC Traffic Signal Cabinet** – Installing new Advanced Traffic Controller cabinets in the Richmond and Fredericksburg Districts on the US 1 corridor to improve signal capabilities and functionality (non-ITTF funded).
- **Central Signal System (CSS) Procurement** – Procuring statewide CSS contract software for arterial management and monitoring. (ITTF funded).

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Commercial Vehicle/Freight – to manage and support freight mobility.

- **Truck Parking Information System** – Designed a real-time truck parking information system for all rest areas on the I-66, I-81 and I-95 corridors (ITTF funded).
- **Over-height Detection System Expansions** – Installed an expanded over-height detection system at the Hampton Roads Bridge Tunnel. This project will improve travel reliability on the I-64 corridor by redirecting over-height vehicles from the tunnel to turn around at more convenient locations (ITTF funded).
- **Benjamin Harrison Bridge Over-height Detector** – Installed an over-height vehicle detection system for the Benjamin Harrison Bridge (non-ITTF funded).

Conduct Emerging Technology Research – to promote the development of new technologies to improve safety, convenience and efficiency of travel through connected and autonomous vehicle technologies and bicycle and pedestrian programs.

- **Drone Technologies** - Conducted pilot test uses of drone technologies to provide traffic surveillance during peak travel periods (ITTF funded).
- **Connected and Autonomous Vehicles** –
  - ◊ Implemented specific projects such as Signal Phase and Timing (SPaT) and the SmarterRoads.org data portal, which have a direct impact on the connected vehicle programs and are discussed in other sections of this report (ITTF and non-ITTF funded).
  - ◊ Conducted direct testing and demonstration of automated vehicles with transportation executives, industry experts and research teams (non-ITTF funded).
- **Vehicle Platooning** - Supported platooning demonstrations to assess its capabilities in a live environment (non-ITTF funded). Vehicle platooning uses emerging technologies to allow adjacent commercial vehicles or automobiles to travel closer together in the same travel lane. This strategy can reduce drag to improve fuel efficiency. It can also improve safety and throughput on a highway. Over the last year, two vehicle platoon tests were conducted on Route 28 for commercial vehicles and the Interstate 95 express lanes for automobiles.

Technology Infrastructure – to promote future expansion and resiliency of technologies by deploying and upgrading supporting communication and utility services.

- **Fiber Optic Communication Expansion** -Acquired additional fiber optic cable to support transportation technology devices through Virginia's Fiber Optic Resource Sharing Program along portions of Route 7 and Route 50 in Loudoun County and Route 29 in Albemarle County (non-ITTF funded).
- **Fiber Optic Communications Facilities** - Installing a fiber link from the Northwestern Regional TOC to the statewide transportation fiber optic network to provide direct communication to transportation technology devices. All five VDOT TOC facilities will be connected to the transportation fiber optic network (non-ITTF funded).

Traveler Information – to provide real time, multi-corridor and multimodal travel information to enable pre-trip and in-route trip planning.

- **Transportation Data Portal** – In 2017, VDOT released SmarterRoads.org to provide VDOT's transportation data for third party enterprise and the public's use. The raw data include road conditions, incidents, traffic signal information, work zones, etc. In 2018, VDOT organized multiple competitions or hackathons* to promote development of traffic management or travel information tools (non-ITTF funded).

*A hackathon is an event, typically lasting several days, in which a large number of people meet to engage in collaborative computer programming.

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Incident Management Program - Improving Incident Management

Incident management includes the ability to detect, respond and clear incidents as quickly and safely as possible. VDOT partners with law enforcement, fire and rescue, emergency medical services, towing and recovery operators, hazardous material teams and others to restore traffic flow from natural and man-made incidents. VDOT's roles in incident management are:

- coordinating incident planning and training activities
- detecting and verifying incidents through monitoring systems or safety service patrols
- providing traffic control at the scene
- providing traveler information about the event and potential detours
- coordinating scene clean-up
- providing incident command, when applicable
- repairing transportation infrastructure

VDOT has taken the actions described in the following to reduce incidents.

Develop Traffic Incident Management (TIM) programs – The TIM program promotes a coordinated response among the different individuals and agencies. These coordinated responses support safer and quicker incident clearances to re-open travel lanes faster.

- Continue supporting TIM interdisciplinary training with all responders. Over 25,000 responders have attended TIM training. Virginia has one of the highest TIM participation rates in the nation.
- Developed web-based TIM training to promote additional training opportunities.
- Supported the development and implementation of 2017 House Bill 2022 (Chapter 350), which facilitated deployment of TIM service operators to incidents and enhanced their ability to remove vehicles and cargo from travel lanes.

Provide Safety Service Patrols – Safety Service Patrols (SSP) perform services to support incident management. A large portion of incidents are first detected or verified by SSP. The SSP vehicles often carry the necessary materials to clear simple incidents rapidly. Highways that begin using SSP services experience a reduction in incident durations. At this time, there are 46 patrols across Virginia providing 815 centerline miles of coverage.

- Safety Service Patrol routes have been modified to provide greater coverage of high incident events across Virginia focusing on peak periods and high incident areas.
- VDOT's *Road and Bridge Specifications* were updated to promote safety service patrol programs for long-term construction activities.

Augment On-Scene Recovery Resources – Pre-staging critical equipment and supplies to clear an incident reduces the time used to locate and deliver them to the scene.

- Augmented on-scene recovery resources as appropriate.

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Develop Towing and Emergency Relocation Programs – By having an "instant tow" program, an incident's duration is reduced by eliminating the time waiting for resources to arrive. With an "instant tow" concept, towing services and law enforcement are dispatched simultaneously.

- Statewide - Supported the implementation of 2017 House Bill 2022 (Chapter 350), which requires drivers to move their vehicles involved in non-fatal, non-injury crashes if it is safe to do so.
- Hampton Roads District - Implemented an Instant Tow Program on designated segments.
- Richmond District - Implemented a 2-year pilot Towing Recovery Incentive Program (TRIP) for greater Richmond.
- Staunton District - Implemented a contracted towing program to augment resources in Shenandoah County. Implemented an Instant Tow Program in Augusta County.

Detour Route Planning – Planning for detour routes include selecting the best routes, providing key resources such as route marking signs, and adjusting the alternative route for greater traffic flow by adjusting traffic signals. With proper planning, the impact of a large incident on mobility is reduced.

VDOT is developing freeway traffic incident diversion plans across Virginia. This effort is a multi-year, multi-phase plan. Plans are available for:

- I-64 between mile markers 143 (Louisa County) to 273 (Virginia Beach);
- I-66 between mile marker 40 to the District of Columbia;
- I-81 between exit 220 (Staunton) and the West Virginia State Line;
- I-95 between mile markers 0 and 170 (Beltway);
- Virginia 164 (entire route);
- I-295, I-395, I-495 (entire routes);
- I-664 between Exit 7 and Exit 15.

Plans are being completed for the entire I-81 corridor.

Defer Incident Cleanup to Off-Peak Hours – In accordance with § 46.2-1212.1 of the *Code of Virginia,* reasonable and prudent options to open travel lanes by first moving damaged assets or cargo to a safer location allows responders to plan the event. Road closures can be scheduled during low volume periods to minimize congestion.

- Best practices are used, as appropriate, by VDOT and contracted staff to minimize traffic impacts when clearing incidents.

Provide Traffic Queue Warnings – A vehicle and/or signage can warn motorists about an approaching traffic backup to prevent secondary collisions.

- Queue warning notifications are implemented, as appropriate, by incident type and severity.

SECTION 3

Collaboration with Private Sector

Collaboration with Private Sector

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Collaboration with Private Sector: Overview

VDOT continues to outsource and privatize where supported by good business practices. More than one-half of VDOT's FY 2018 spending was with private sector vendors. This section summarizes VDOT's spending with the private sector and its ongoing efforts to gain efficiencies by working with the private sector while maintaining management oversight to help ensure effective delivery of services.

VDOT expenditures in FY 2018, excluding debt service and transfer payments, totaled $3.62 billion, of which $2.93 billion was with the private sector. Total agency expenditures were $5.24 billion. Included in the $2.93 billion of private sector spending was the outsourcing of over $308.8 million in Interstate maintenance.

Bundled Interstate Maintenance Services (BIMS)

BIMS contracts provide for ordinary and preventive maintenance services, including activities such as repair and replacement of right-of-way assets and services such as emergency response, severe weather operations and management and disposal of hazardous materials.

In FY 2018 there were four BIMS contracts being administered by private vendors, which extend through March 2020. Three contracts were for Northern Virginia and one for Fredericksburg. The annual value of the four BIMS contracts currently in place is approximately $11 million. In addition, VDOT has contracted with private vendor for the management and maintenance of the Woodrow Wilson Bridge through June 14, 2019.

Safety Rest Areas and Welcome Centers

VDOT continues to administer property management contracts for the 24 hour/7 days a week staffing, preventive maintenance and repair of 43 Safety Rest Areas, which include 12 Welcome Centers.

Regional TOC's

Since 2013, VDOT has used an outsourced, statewide TOC contract, which provides both Safety Service Patrol and TOC floor operation services. VDOT re-advertised and awarded this contract in March 2018. VDOT also continues to develop a statewide Active Traffic Management System (ATMS) for its TOC facilities. ATMS is the main tool to operate transportation technologies such as message signs, cameras and notifications. Four of the five VDOT TOCs are now using the new statewide ATMS. The final TOC facility will be transitioned to the new ATMS in early 2019.

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Project Delivery Utilizing Transportation Public Private Partnerships (P3)

Since the Public-Private Partnership Act's (PPTA) inception in 1995, VDOT has delivered 12 PPTA projects valued at over $13 billion dollars. Three mega-projects alone generated economic activity exceeding $5.5 billion dollars.

Completed P3 Projects

Elizabeth River Tunnels (Downtown/Midtown Tunnels and MLK Extension) VDOT and private sector partner, Elizabeth River Crossings, are now in the Operations and Maintenance phase of the project with a concession period of 58 years.

P3 Projects Under Construction

Transform-66 Outside the Beltway

This $2.3 billion project is a public-private partnership between VDOT, the Virginia Department of Rail and Public Transportation and private partner, I-66 Express Mobility Partners, a consortium of Cintra, Meridiam, Ferrovial Agroman US and Allan Myers VA Inc. The Comprehensive Agreement, with a term of 50 years reached commercial close in December 2016 and financial close in November 2017, with construction scheduled for completion in 2022. The Transform 66 Outside the Beltway Project will include:

- 22.5 miles of new express lanes alongside three regular lanes from I-495 to University Boulevard in Gainesville;
- Express lanes that will be dynamically tolled to manage demand for the lanes and provide a reliable, faster trip. These lanes will be available to drivers who choose to pay a toll and free for vehicles with three or more occupants;
- New and improved bus service and transit routes;
- New and expanded Park and Ride lots, providing convenient access to the express lanes and more than 4,000 new spaces;
- Interchange improvements to enhance safety and reduce congestion, including auxiliary lanes between interchanges where needed.

Coalfields Expressway

This project is a PPTA agreement between VDOT and private sector partners that uses the private sector expertise in earth moving and extracting incidental coal to reduce the cost of constructing the roadway. This innovative partnership with coal companies allows Virginia to advance the project using coal synergy innovation and large scale earthmoving expertise for $2.8 billion, contrasted to an updated cost of $5.1 billion using traditional road building methods. During construction, the project is estimated to create approximately 29,000 construction jobs over 17 years and $4.1 billion in regional and local economic benefits. Once completed, the project is estimated to create 372 service jobs and an annual impact of $41.1 million plus $28.3 million in annual savings from travel efficiencies.

In February 2015, the Board passed a resolution to approve an alignment shift of 4.1 miles of Route 121 (Coalfields Expressway) that overlaps with a section of Corridor Q/US 460. The alignment shift results in a modified roadway that is shorter than the previously approved alignment and provides for a connector to existing Route 460 in Grundy.

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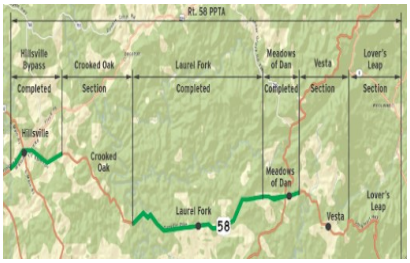
Route 58

Three phases of the Route 58 four-laning have been completed, totaling approximately 16 miles including the Meadows of Dan Bypass, Hillsville Bypass and Laurel Fork sections for a total cost of approximately $246.3 million. Three phases remain to be completed, totaling approximately 19 miles, including the Lovers Leap, Vesta and Crooked Oak sections. These sections are fully funded in the FY 2019-FY 2024 SYIP at a total estimated cost of $525.1 million.



395 Express Lanes Extension

This project is an enhancement to the original Comprehensive Agreement for the I-95 Express Lanes Project. The Amended Restated Comprehensive Agreement was executed between Transurban and VDOT on June 8, 2017. Construction started in August 2017 following Financial Close, which occurred on July 25, 2017.

At present, Early Work Activities are underway, as is Scope Validation. The new extended lanes will open in the fall of 2019 and the entire project is set for completion in the summer of 2020.

Key project improvements include:

1. Extending express lanes to the vicinity of Eads Street.
2. Providing new travel options for drivers of single-occupant vehicles.
3. Installing an active traffic management system to keep traffic moving.
4. Providing sound walls for nearby neighborhoods.
5. Improving connections between the I-395 Express Lanes and Eads Street.
6. Providing dedicated annual funding for transit.

P3 Projects Under Procurement

Hampton Roads Bridge Tunnel

The existing 3.5-mile facility consists of two 2-lane immersed-tube tunnels on artificial islands, with trestle bridges to shore. These tunnels opened in 1957 (current westbound lanes) and 1976 (eastbound lanes), respectively and are approximately 7,500 feet long. Traffic on these four lanes exceeds 100,000 vehicles per day during peak summer traffic.

The proposed Hampton Roads Bridge Tunnel Expansion Project will ease this congestion by widening the four-lane segments of the I-64 corridor in the cities of Hampton and Norfolk. The NEPA approval was received in June 2017. Including the construction contract, owner's costs and contingency, the total budget is estimated at $3.3 to $3.8 billion in 2016 dollars. This will make this project one of the largest infrastructure projects in the nation.

The Request for Qualifications was released in December 2017, with Statements of Qualifications evaluation leading to three short listed teams. The first draft Request for Proposal was released in May 2018.

Only two of the teams have elected to propose in response to the Request for Proposals: Hampton Roads Capacity Constructors and Hampton Roads Connector Partners. Both have elected to pursue a bored tunnel construction methodology.

The design-build construction contract is expected to be awarded in 2019, with an estimated project completion in 2025.

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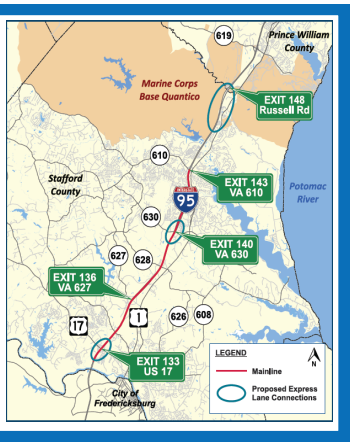
I-95 Fredericksburg Extension ("FredEx")

This project is a component of the Atlantic Gateway Project, which will extend the I-95 Express Lanes south to Fredericksburg. The scope includes constructing approximately nine miles of Express Lanes south of the current terminus near Garrisonville Road to Route 17 in Stafford County. This component will complete one of the longest Express Lanes systems in the nation, from Washington, D.C., to Fredericksburg and unlock a major point of daily congestion in the region.

The project public information meetings took place in March 2017 and VDOT Location and Design Public Hearings took place in the fall of 2017. Procurement activities began in 2018, with construction anticipated in 2019-2022. The second Amended and Restated Comprehensive Agreement is under development.



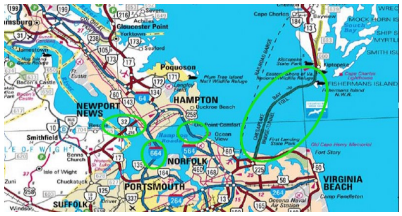
P3 Projects At the Developmental Stage

I-495 NEXT Express Lanes

The environmental study is underway for the potential extension of the I-495 Express Lanes, by approximately three miles, from the I-495 and Dulles Toll Road Interchange to the vicinity of the American Legion Bridge and Maryland state line. The environmental work began in April 2018 and is expected to be completed in summer 2019.
The P3 project will be developed as an independent, stand-alone project that will be closely coordinated and compatible with plans for the I-495 Capital Beltway in Maryland. The full scope of improvements will be refined in early 2019.

Hampton Roads Regional HOT Network Development

The project is in the development phase. An investment grade traffic and revenue study begin in March 2018 for the proposed network of express lanes on I-64. The study will provide information regarding transaction and revenue streams for a base case, lender case and equity case by the end of November 2018.



Projects at the Conceptual Stage

VDOT is also exploring various innovative concepts involving new technologies for infrastructure. These concepts include broadband installation along designated priority highways, the I-81 corridor improvements (General Assembly Report due late 2018) and a solar power assessment for VDOT facilities.

VDOT will continue to work with interested parties who may request exploration of other opportunities pursuant to the PPTA.