COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA 23219 2000

Charles A. Kilpatrick, P.E.
Commissioner

February 16, 2016

The Honorable Terry McAuliffe
Members of the General Assembly
The Joint Legislative Audit and Review Commission
Members of the Commonwealth Transportation Board

Dear Ladies and Gentlemen:

Section 33.2-232 of the *Code of Virginia* directs the Commissioner of Highways to submit an annual report to the Governor, the General Assembly, the Joint Legislative Audit and Review Commission, and the Commonwealth Transportation Board.
To meet the requirements of the legislation, I am submitting the attached report, which includes the information required by § 33.2-232. If you have any questions or need additional information, please let me know.

Sincerely,

Charles A. Kilpatrick. P.E.

Attachment

ANNUAL REPORT

2015

Pursuant to:

Code of Virginia § **33.2-232**

Virginia Department of Transportation
1401 East Broad Street
Richmond, Virginia 23219
November 30, 2015

Table of Contents

Executive Summary

Code of Virginia § 33.2-232 directs that by November 30 of each year the Commissioner of Highways (Commissioner) is to report in writing to the Governor, the General Assembly, the Joint Legislative Audit and Review Commission, and the Commonwealth Transportation Board. The content of such report shall be specified by the Board and shall contain, at a minimum:

1. The condition of existing transportation assets, using asset management methodology pursuant to § 33.2-352;

2. 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 (HMOF) pursuant to subsection A of § 33.2-352;

3. Beginning with the November 2015 report through the November 2019 report, the allocations to the reconstruction and rehabilitation of functionally obsolete or structurally deficient bridges and to the reconstruction of pavements determined to have a combined condition index of less than 60 and beginning with the November 2020 report, the methodology used to determine allocations of construction funds for state of good repair purposes as defined in § 33.2-369 and any waiver of the cap provided for in subsection B of § 33.2-369;

4. The performance targets and outcomes for (i) the current two-year period starting July 1 of even-numbered years and (ii) the following two-year period starting July 1 of the next even-numbered year. The targets and outcomes shall state what is expected to be achieved, based on funding identified for maintenance and state of good repair purposes, over each two-year period;

5. Beginning with the November 2016 report, 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. The Department's (i) strategies for improving safety and security and (ii) strategies and activities 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 improved incident management; and

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

The *Virginia Department of Transportation 2015 Annual Report* is submitted in response to § 33.2-232. Generally, the VDOT Annual Report presents a snapshot of the Agency's activities and programs including the Commonwealth's road system for the fiscal year that ended June 30, 2015, including unless indicated otherwise, information presented herein is based on FY 2015.

For the reader's reference, the Code of Virginia § 33.2-232, Annual Report by the Commissioner of Highways requires the Commonwealth Transportation Board to specify (or approve) the content of this report. The link to the Commonwealth Transportation Board (approved in September 2015) resolution is as follows:

http://www.ctb.virginia.gov/resources/2015/sept/reso/Resolution_Agenda_Item_11.pdf

The body of the Annual Report is comprised of four chapters.

Chapter I reports on the requirements set out in 1 through 4, above. With the third largest state maintained network of highways and roads in the United States, the Virginia Department of Transportation (VDOT) uses an asset management process[1] (see Figure 14) along with industry recognized practices to determine the condition of asset inventories and determine funding required to maintain and operate the state maintained assets. While Chapter I discusses performance, condition and the funding needed to maintain these assets, Appendix A, gives a more detailed and technical discussion of the needs methodology within the context of VDOT's asset management processes.

Performance metrics are key components of the process and provide one mechanism for setting benchmarks and quantifying success. VDOT's performance metrics are also useful when VDOT is developing recommendations for areas of emphasis going forward.

Chapter I also discusses asset management and performance for assets other than pavements and bridges. Examples include tunnels, ferries, safety rest areas, as well as traffic and safety items.

In accordance with the statute's instructions, the Commissioner will begin reporting on the requirements of item 5 in the 2016 report.

VDOT assesses the needs[2] of the asset inventory it *maintains* annually. To give the reader context on the cost if the VDOT *maintained* assets were built today, the cost would be approximately $300 billion.

When reviewing this report the reader should be aware of the following related to the VDOT *maintained* assets:

- VDOT is focused on the performance of core assets (pavements and bridges).
- The costs required to bring the Commonwealth's pavements and bridges to a performance measure of 100% is over $11 billion, the achievement of which is not feasible.
- The assets are aging and most were built over 50 years ago.
- VDOT has set performance targets following asset management practice and industry standards (discussed later in the Condition of Existing Assets portion of the report).
- Based on the current performance targets set by VDOT, the cost to fund the annual needs of pavements and bridges alone is about $1.7 billion.

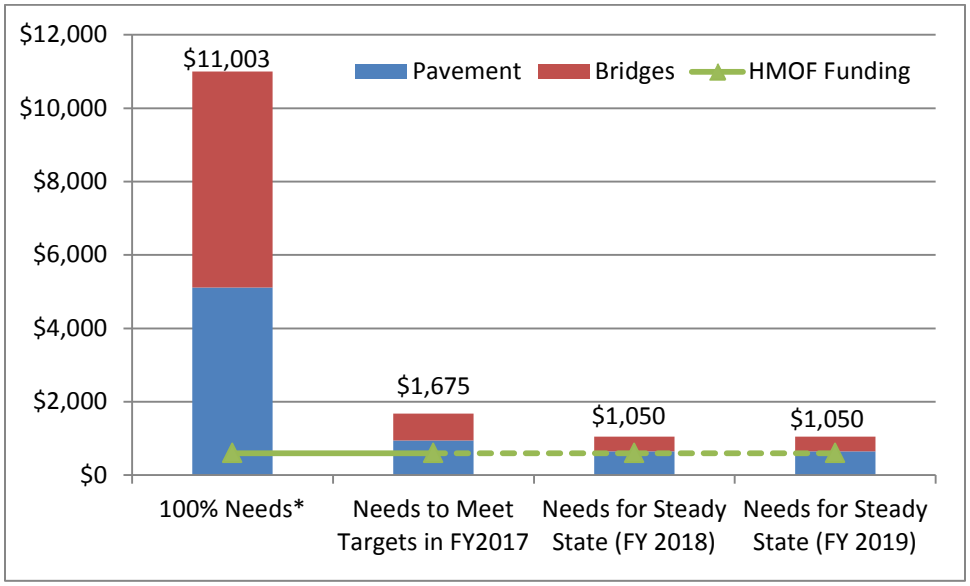
[1] Asset management process is a systematic process based on economic, engineering and business principles that monitors the performance of transportation assets and aides in making informed decisions about managing the network over the assets entire lifecycle. More details about VDOT's asset management process may be found in Appendix A of the report.

[2] In this report "needs" refer to the costs for existing assets to achieve and/or sustain a state of good repair over time, where "state of good repair" is defined in Code of Virginia § 33.2-369.

- VDOT costs to keep the core assets at a steady state after reaching VDOT's current performance targets would be over $1 billion annually.
- VDOT has only been able to fund a portion of needs required for pavement and bridge assets to achieve performance targets described later in the Summary of VDOT Needs vs. Anticipated Funding section.

Figure 1 depicts what is described above graphically:

Figure 1: VDOT Needs and Ancitipated HMOF Funding For Pavements and Bridges
($ million)



Note: amounts presented are estimates based on condition assessment of current inventory and are subject to change. The needs assessment is performed annually.

Chapter II responds to those items set out in item 6, to include VDOT's efforts to improve the safety of the motoring and non-motoring public along with an overview of the agency's security programs and protocols. Safety is paramount when developing and implementing any transportation project or program.

VDOT continues work to ensure Highway Safety Improvement Program (HSIP) funds are applied to the highest priority safety needs. VDOT's goal is to apply HSIP funds to projects with the potential to reduce severe injuries and fatalities.

This chapter also discusses VDOT's strategies and activities to improve highway operations, including the use of funds in the Innovation and Technology Transportation Fund. The final section of this chapter looks at VDOT's efforts to improve incident management.

Chapter III reports on VDOT's efforts in working with the private sector.

I.
Condition and Performance of the Existing Transportation Infrastructure

I.1 Condition and Performance Overview

This chapter reports on the condition of the existing transportation assets, the methodology to determine needs[3], available funds to address needs, the performance targets and the predicted performance outcomes based on funding.

The network of highways and roads maintained by VDOT is the third largest state maintained system in the United States. Approximately 127,000 lane miles of roadway and approximately 19,500 bridges and large culverts are *maintained* by VDOT. VDOT's aging infrastructure and system preservation requires a large portion of the department's resources and focus. VDOT applies an asset management approach to maintaining its core assets: pavements and bridges. The process focuses on proper and timely maintenance, which is critical in ensuring that VDOT avoids more expensive capital replacement in the future. Figure 2 illustrates the impacts asset maintenance timing has on costs to deliver the work. In general, if preventive maintenance is performed earlier in the lifecycle of an asset, the costs will be less when rehabilitation or reconstruction is performed later. For example, with car ownership performing preventive maintenance such as oil changes will assist in extending the life of the car's engine.

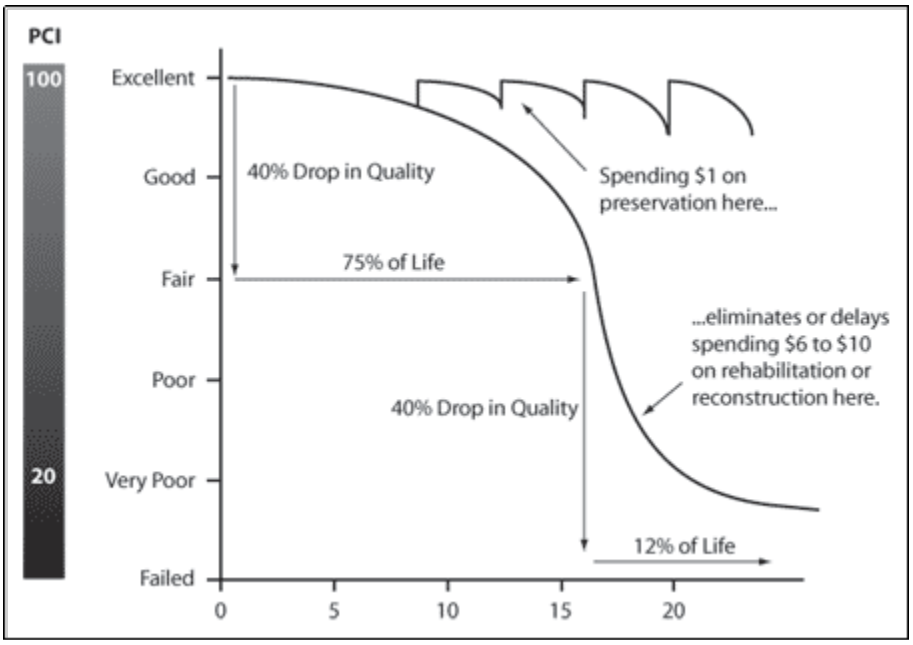
The graph depicts spending $1 on preventive maintenance today saves $6 to $10 later as the cost to reconstruct an asset is greater. The funding allocation from the Highway Maintenance and Operating Fund (VDOT's primary funding vehicle for maintenance projects) is discussed in section I.3, and the reported analysis shows that there is a significant gap between funding needed to timely maintain Virginia's pavement and bridge assets and the availability of such funding. The state of good repair[4] funding provided by the Governor's 2015 Omnibus Transportation Bill (Chapter 684, 2015 Acts of Assembly) in Code of Virginia §§ 33.2-358 (Allocation of funds among highway systems) and 58.1-1741 (Disposition of Revenues) will assist in closing the gap between needs and the projected funding.

VDOT explores ways to close the gap by using innovative project delivery methods and identifying additional sources of funding such as bonus obligation authority, grants, etc.

[3] In this report "needs" refer to the costs for existing assets to achieve and/or sustain a state of good repair over time, where "state of good repair" is defined in Code of Virginia § 33.2-369.

[4] "State of good repair" is defined in Code of Virginia § 33.2-369 and refers to improvement of deficient pavement conditions and improvement of structurally deficient bridges. See Appendix A for more detail about the state of good repair.

Figure 2: Impact of Maintenance Timing on Asset Condition



Note: This graph is based on a 2012 FHWA report on asset sustainability. It illustrates the steep deterioration commonly seen in pavements once they reach a "poor" condition. Timely preventive maintenance creates substantial value by restoring pavements to a high condition and preventing the onset of the rapid deterioration commonly seen in poorly maintained pavements. As noted in the graph, timely preventive treatment can produce a very high return on investment, while underinvestment leads to missed opportunities to prevent rapid degradation.

Besides pavements and bridges, VDOT has other essential transportation assets and services that must be maintained. In this report, needs and allocations are reported in the following maintenance and operations categories:

- Pavements
- Bridges
- Other Services and Repairs
    - Tunnel
    - Emergency and incident management
    - Traffic safety
    - Routine maintenance
    - Facility and other

Section I.1 of this report summarizes the condition of VDOT's pavement and bridge assets. Section I.2 describes the methodology to determine maintenance and operations needs. Section I.3 provides the draft allocation from the Highway Maintenance and Operating Fund (HMOF). Section I.4 summarizes the pavement and bridge performance targets and the expected performance outcomes based on funding identified.

Condition of Existing Assets

VDOT is responsible for building, maintaining and operating the state's roads, bridges and tunnels. VDOT is broken down into a central office and nine construction districts. The districts are divided into 29 residencies which are responsible for work in one to four counties. Figure 3 shows a map of the nine construction districts and Figure 4 shows the counties:

Figure 3: Map of Nine Construction Districts

Figure 4: Map of Nine Construction Districts and Counties

Virginia has the third largest state maintained highway system in the country, behind Texas and North Carolina. VDOT is responsible for 127,246 lane miles of roadway and 19,466 bridges and

large culverts. VDOT uses an asset management process[5] along with industry recognized practices to determine the condition of asset inventories and determine funding required to maintain and operate the state maintained assets.

The asset management process captures the obvious costs of VDOT's assets and services (e.g., inspection of bridges) but also less obvious costs (e.g., painting or sweeping of bridges). Asset management or lifecycle cost analysis is comparable to vehicle ownership which requires routine maintenance (e.g., oil changes or tire rotation) and at times replacement costs (e.g., transmission replacement).

VDOT's process focuses on preventive maintenance, rehabilitation, and replacement with a goal to prolong the life of long-term transportation assets and achieve a state of good repair[6], which is vital in maintaining the quality of life for Virginians. Proper and timely maintenance is critical in ensuring that VDOT avoids more expensive capital replacement in the future. VDOT's aging infrastructure and system preservation requires a large portion of the department's resources and focus. Figure 2 illustrates the impacts maintenance timing has on costs to deliver the work. If VDOT performs preventive maintenance earlier in the lifecycle of an asset the costs will be less than if rehabilitation or reconstruction is performed later. The graph depicts spending $1 on preventive maintenance today saves $6 to $10 later, as the cost to reconstruct an asset is greater.

Pavement

VDOT reports pavement conditions based on annual pavement condition assessments using continuous digital imaging and automated crack detection technology. When conducting condition assessment, the survey vehicle rides over the road surface and records the condition. Figure 5 provides an image of the survey vehicles used to perform the data collection. The data is collected at highway speeds as the vans are driven along the pavement. Downward images collected during the survey are processed with specialized semi-automated crack detection software for the identification of distresses. The data collected is housed in pavement management software to assist in the review of the pavement condition and performing a prioritization (or optimization) of work to be performed to assist in managing the condition of the assets. The pavement assessment is used to develop Critical Condition Index (CCI) values. The CCI is a pavement condition rating scale with values ranging from 0 to 100. Pavement assessed with a CCI value of 60 or above is categorized as being in "Fair" condition or better, also referred to as "sufficient." Figure 6 provides images of pavements in good and poor conditions. More details about the CCI rating are provided in Appendix A.

Pavement condition has been assessed on 100 percent of the Interstate and primary systems and roughly 20 percent of the secondary system every year since 2006. So far, approximately 100 percent of secondary system pavements have been assessed. In 2016, pavement condition will be assessed on 100 percent of the secondary network to create a baseline.

[5] Asset management process is a systematic process based on economic, engineering and business principles that monitors the performance of transportation assets and aides in making informed decisions about managing the network over the assets entire lifecycle. More details about VDOT's asset management process may be found in Appendix A of the report.

[6] See footnote 4 for a definition of "state of good repair".

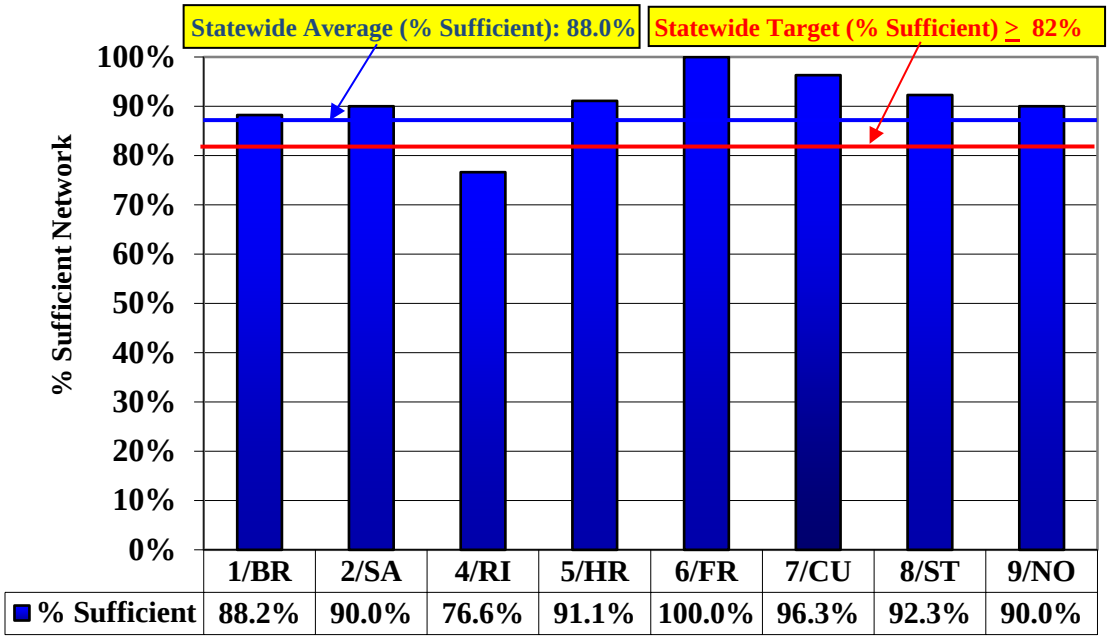
Figure 5: How Pavement Condition is Assessed

Figure 6: Comparison of Pavements in Poor and Good Conditions

Figures 7-9 display the 2015 percent of lane miles with sufficient or fair or better CCI[7] pavement condition in the nine VDOT construction districts, for example District 1/BR represents Bristol District, and for the Interstate, primary and secondary systems.

[7] CCI values are presented on a scale of 0 to 100 with 100 being a pavement with no visible distress. Details on the definition of CCI are provided in Appendix A of this report.

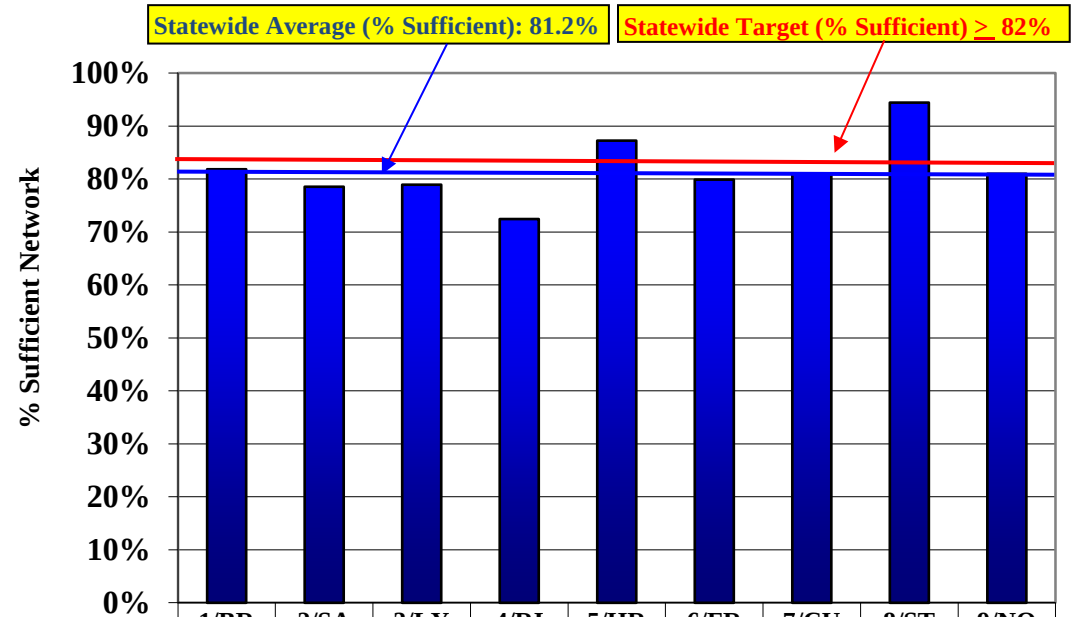
Figure 7: Statewide Percent Sufficient Pavements by District - Interstate



	1/BR	2/SA	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
% Sufficient	88.2%	90.0%	76.6%	91.1%	100.0%	96.3%	92.3%	90.0%

Note: There is no Interstate network in Lynchburg district.

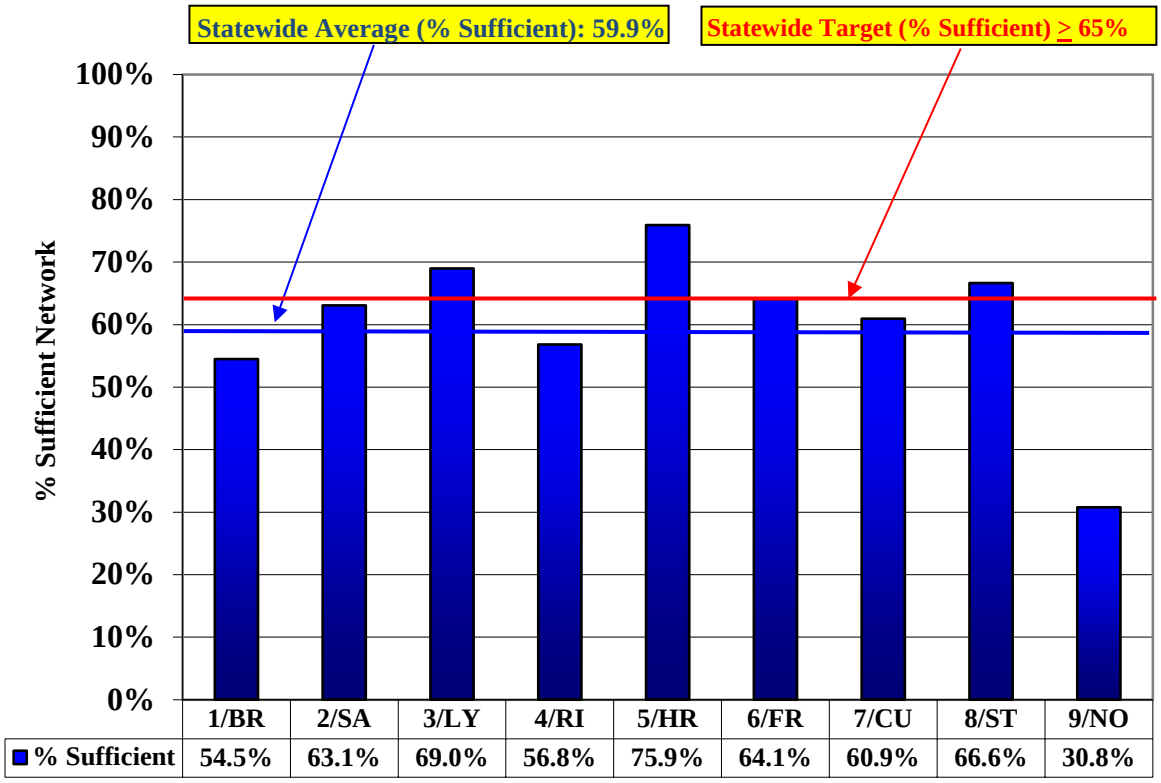
Figure 8: Statewide Percent Sufficient Pavements by District - Primary



	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
% Sufficient	81.9%	78.6%	78.9%	72.5%	87.3%	79.9%	81.1%	94.4%	81.0%

Note: Figure 8 - VDOT 2015 assessment shows that the statewide primary pavement performance target was not met. This is primarily due to the 2014 snow removal costs, resulting in the need to extend paving contracts. VDOT forecasts that the 2016 assessment will show improvements in this number.

Figure 9: Statewide Percent Sufficient Pavements by District – Secondary



Note: The lower secondary pavement condition in NOVA District is due primarily to a focus on Interstate and primary system paving over the past years, when allocations were increased to those systems. VDOT is now focusing more on secondary pavements.

Bridge

While VDOT *maintains* 19,466 structures (bridges and culverts), it is responsible for the *inventory and inspection* of 21,084 structures. Of these structures, 13,467 are part of the National Bridge Invenory (NBI)[8], and 1,618 are maintained by localities and private owners. 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 actually requires an individual to complete a "hands-on" review (See Figure 10).

Detailed inspections of bridge structures are completed at intervals not to exceed 24 months and for large culverts the interval is not to exceed 48 months. VDOT uses a software package (Pontis) to store bridge condition and inventory data for each structure and to program, schedule and track inspections. Data collected from inspections are used to evaluate each structure's safety and are used for decisions on planning, budgeting, performance of maintenance, repair, rehabilitation and replacement of structures.

[8] The NBI includes bridges on public roadways exceeding 20 feet in length. The NBI also includes large culverts with a combined width (as measured along the centerline of the roadway) greater than 20 feet.

Figure 10: Bridge Condition Assessment

Figure 11 shows examples of bridges in poor and good conditions.

Figure 11: Comparison of Bridges in Poor and Good Conditions

Figure 12 shows the percentage of structures (bridges and large culverts) in fair or better condition (not structurally deficient[9]). It also provides the recent trend in that percentage.

[9] A structure is defined as structurally deficient if one or more of its major components (deck, superstructure, substructure, or culvert) is deficient, which requires the structure to be monitored and/or repaired, or if it lacks adequate strength or waterway clearance. More details about bridge condition and structure deficiency rating are provided in Appendix A of this report.

Figure 12: Percentage of Structures in Good or Fair Condition

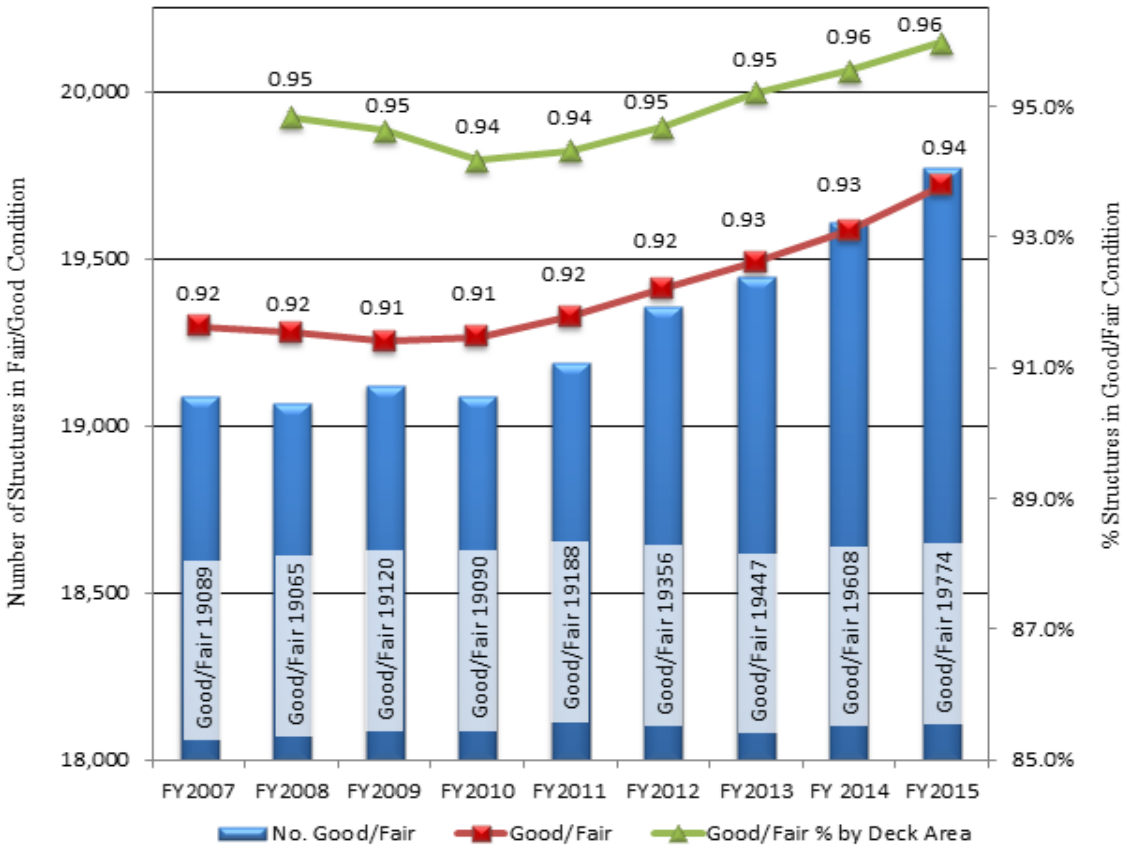


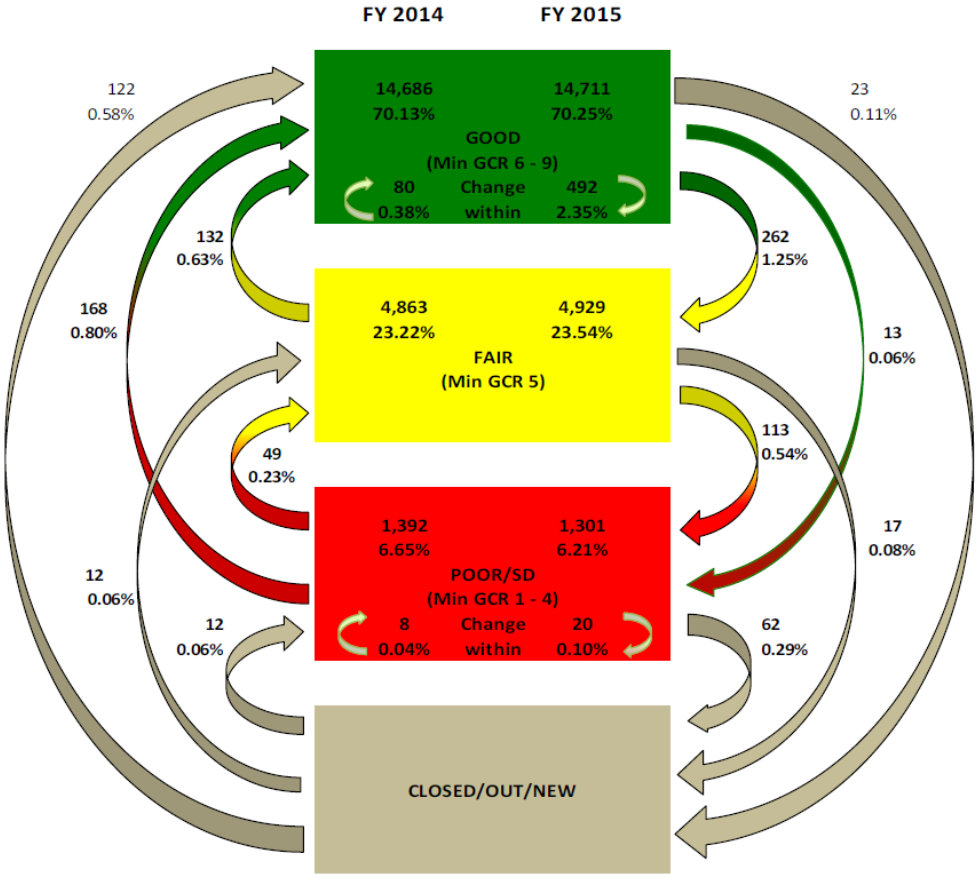
Figure 13 shows the changes to general condition ratings. From FY 2014 to FY 2015, 388 structures deteriorated to a lower condition category (Good, Fair or Poor), while 349 improved to a higher condition category.[10] In addition, 512 structures deteriorated but stayed within the same condition category, while 88 improved. The figure also shows that 102 structures were closed, a number of which are replacements (the older structure number was replaced with a new structure number in inventory), to the public or removed from the system while 146 were reopened to the public or added to the system.

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, the chart shows that 80 Good structures improved within the Good category but 492 Good structures deteriorated while staying within Good, thus indicating that the average conditions of the "Good" structures are

[10] As shown in Figure 13, to assist the readers' understanding, 262 structures deteriorated from good to fair condition, 113 structures dropped from fair to poor condition and 13 structures went from good to poor condition, which resulted in a total of 388 structures deteriorated to a lower condition category. In the meantime, 132, 49, and 168 structures improved from fair to good, from poor to fair, and from poor to good conditions respectively, which resulted in a total of 349 structures improved to a higher condition category.

decreasing. While fewer bridges are shown in a lower condition rating, more bridges have condition ratings going down. VDOT has been putting more funding in the area of preventive maintenance in order to remedy the trend.

Figure 13: Annual Transitions of GCR from FY 2014 to FY 2015



Other Services and Repairs

VDOT is responsible for other essential transportation assets and services that must be maintained or provided. VDOT maintains and operates these other assets and services based on industry practices and engineering principles. However, for these other essential assets, condition data is not readily available; for services, condition assessment is not applicable. Therefore, performance targets are not established for these other assets and services. These items include but are not limited to 6 tunnels, 43 safety rest areas, 11 welcome centers, and 6 ferries in addition to assets such as signs, signals, guardrail and thousands of other highway assets in the VDOT maintained network. Further details on the other assets and services are provided in Appendix A of this report.

I.2 Methodology to Determine Maintenance Needs

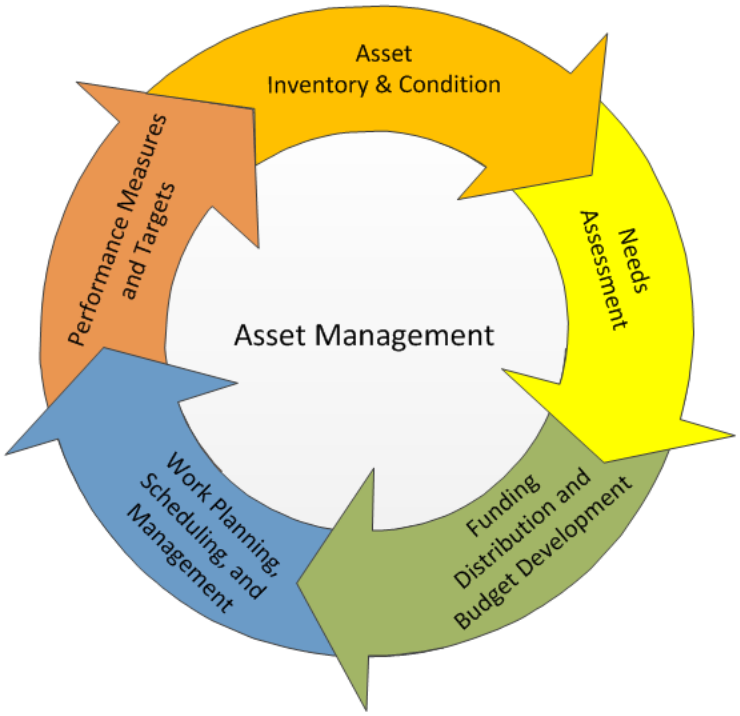
For the purpose of this report, needs refer to the maintenance costs required for an asset or infrastructure system to achieve and/or sustain a state of good repair over time. It also accounts

for the issue of how to set priorities by asset class and activity if funds are limited. The following types of needs are presented in this report:

- **Unconstrained needs (100% needs)**, which include (1) costs to bring VDOT's deteriorated pavement and structurally deficient bridge assets to the state of good repair, that is, the costs to reconstruct and rehabilitate structurally deficient bridges and to reconstruct pavements determined to have a CCI of less than 60, and (2) costs to cover preventative, corrective, and/or restorative maintenance on pavements and bridges
- **Needs to meet performance targets**, which are costs to meet performance targets for pavements and bridges in FY 2017
- **Steady state needs**, which are costs to maintain assets at a steady state once the performance targets for pavements and bridges are achieved
- **Other service and repair needs**, which are costs to maintain and operate other essential assets and services

VDOT applies an asset management approach, accepted engineering principles and business practices to identify maintenance and operations needs. Methodology used to determine maintenance needs is summarized below, while details on the approaches applied are provided in Appendix A and is illustrated in Figure 14. The reader should note that Figure 14 starts with the asset inventory and condition and the process is continuous.

Figure 14: Asset Management Process



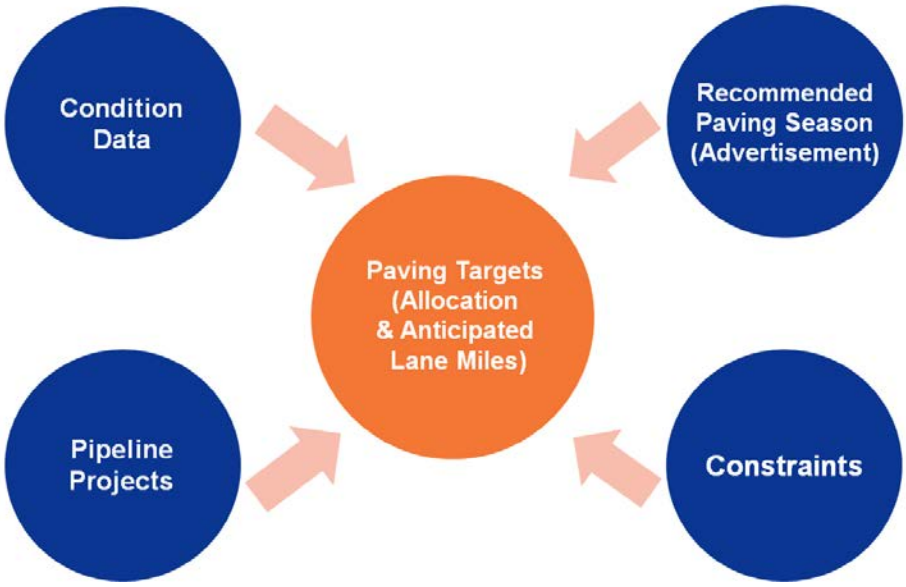
Pavement Needs Methodology

Pavement needs are assessed based on pavement management principles to cost-effectively maintain the pavement asset over the term of its lifecycle. VDOT pavement management business processes use established asset management principles and policies. These include:

- Condition assessment of the pavement network as described in the previous section,
- Setting performance targets and goals, which are
    a. Interstate - 82 percent in sufficient (fair or better) condition. All sections of Interstate pavements shall be above a CCI rating of 30
    b. Primary - 82 percent in sufficient (fair or better) condition
    c. Secondary - 65 percent in sufficient (fair or better) condition
- Optimization by using pavement management software to determine the cost to cover an optimal mix of maintenance strategies from preservation to major rehabilitation with the objective of reducing costs in the long run
- Performance monitoring and reporting
- Pavement needs account for costs associated with paving related marking, guardrail, signal loops, rumble strips, shoulders, ramps, patching, turn lanes, bike and pedestrian lanes, traffic control, inspection, and contingency.
- Needs for recommended paving work take into account factors such as traffic volume, maintenance history, structural and subgrade strength.
- VDOT implemented a process for the Americans with Disabilities Act ramp needs related to paving activities and makes every effort to construct the required ramps prior to paving.

Figure 15 provides an illustration of the pavement needs assessment process.

Figure 15: Pavement Needs Assessment Process

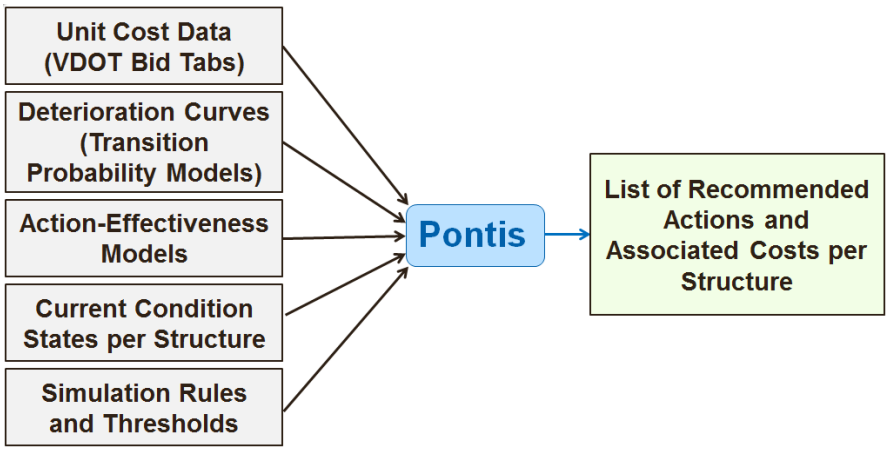


Bridge Needs Methodology

Bridge needs are calculated with a goal of meeting or exceeding the established performance targets. The assessment applies bridge management principles to cost-effectively maintain bridge infrastructure over the term of its lifecycle. The process (as illustrated in Figure 16) includes:

- Annual condition rating as described in the previous section
- Setting performance target, that is, 92 percent in fair or better condition, based on:
    a. Interstate - 97 percent in fair or better condition (not structurally deficient)
    b. Primary - 94 percent in fair or better condition (not structurally deficient)
    c. Secondary - 89 percent in fair or better condition (not structurally deficient)
- Use nationally recognized bridge management software (Pontis) to develop work recommendation. These recommendations are generated using unit prices for repair work along with deterioration curves[11], action-effectiveness models[12] and agency-developed logic to suggest cost-effective work plans.
- Needs for recommended bridge work take into account a variety of factors such as traffic and truck traffic volumes, detour, highway system, and proximity of structures to critical facilities such as hospitals, schools, and fire stations.

Figure 16: Bridge Needs Assessment Process



Note: A transition probability model specifies the likelihood of the condition of a structure to change from one state to another in a stipulated time period.

Other Services and Repairs

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

[11] A deterioration curve tracks asset performance in different condition categories over time.

[12] An action-effectiveness model estimates the impacts of maintenance treatments on structure condition based on the "cause and effect" relationship between maintenance treatments and expected improvements.

Total amount of needs for this category is provided in Figure 24.

- Tunnel
- Emergency and incident management
- Traffic safety
- Routine maintenance
- Facility and other

Tunnel

VDOT maintains two water tunnels, two mountain tunnels and two urban tunnels. Pictures of a few of the tunnels are provided in Figure 17. Tunnel needs include the fixed costs to maintain and operate the facilities 24 hours every day, maintenance projects to address risk and safety concerns and the costs to provide improvements such as safety training and tunnel maintenance management system installation.

Figure 17: Virginia Tunnel Facilities

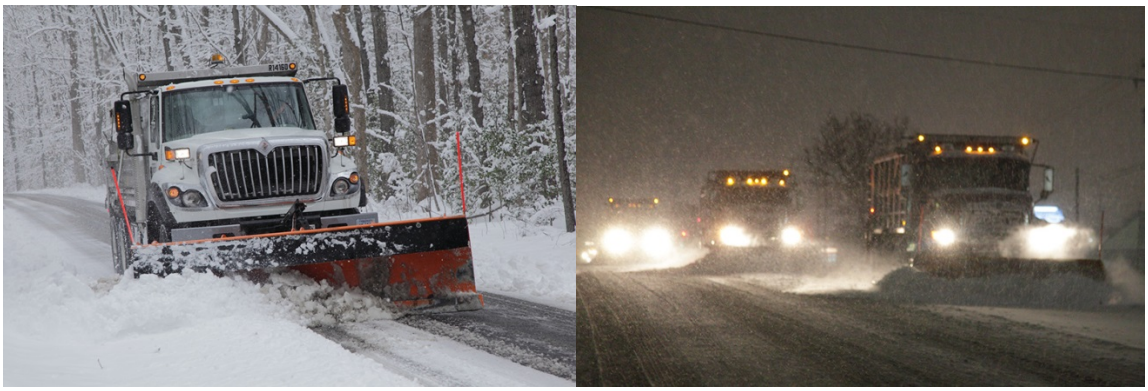
Emergency and incident management

Emergency and incident management needs includes costs to operate the transportation operations centers, the costs to provide incident response, snow and ice removal (as pictured in Figure 18), safety service patrols, and the costs to maintain technology assets such as traffic cameras, electronic message signs, and traffic management systems. The methodology to determine their needs are summarized below:

- Transportation operations centers 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 (VTRC) to account for geographical differences among the districts

Figure 18: Snow Removal Operations



Traffic safety

Traffic needs include the cost of striping roads, maintaining and operating traffic signals and lighting, and maintenance of assets such as traffic signs and guardrail. Examples of traffic safety devices are illustrated in Figure 19. For most traffic assets, needs are determined based on industry accepted lifecycle replacement and repair business rules. Needs are calculated based on asset inventory, frequency of work, expected useful life, and unit cost of work. Traffic needs also include costs determined through engineering analyses to repair, remove and/or replace traffic asset ancillary structures such as signal mast arms, highway lighting poles, and overhead sign structures. Additionally, traffic asset repair and replacement are often required as part of paving (e.g., restriping pavement markings or installing rumble strips after a pavement overlay). Costs to repair and replace traffic and safety assets as part of paving work are accounted for in traffic needs.

Figure 19: Traffic Safety Devices

Routine maintenance

Routine maintenance category includes work performed by the residencies[13], unpaved roads, drainage, vegetation management, sound barriers, sidewalks, bike paths, pedestrian trails, and other roadside assets. Figure 20 provides examples of routine maintenance activities performed. Routine maintenance needs are calculated primarily based on the cyclical cost to maintain drainage pipes and ditches, mow grass, cut brush, trim trees, and maintain sound barriers.

Figure 20 Routine Maintenance Operations

[13] Examples of work performed by the residencies include crack sealing, pot hole patching, slurry seals and sweeping.

Facility and other

Facility and other needs include all needs not captured in the previous categories. This category includes ferries, rest areas, permitting, facility security management, and management and direction. Figure 21 provides pictures of safety rest area and ferry facilities. Needs in this category are mostly determined based on the fixed costs to VDOT (such as equipment, material cost and overhead) in order to deliver the services or programs.

Figure 21: Safety Rest Area and Ferry Facilities

Summary of Needs

Figures 22 and 23 summarizes the unconstrained pavement and bridge needs (100% needs), which include: (1) costs to bring VDOT's deteriorated pavement and structurally deficient bridge assets to the state of good repair. This means the costs to reconstruct and rehabilitate functionally obsolete[(5)] or structurally deficient bridges and to reconstruct pavements determined to have a CCI of less than 60; and (2) costs to cover preventive, corrective, and restorative maintenance on pavements and bridges. The unconstrained needs are estimated to illustrate the amount of total work needed on the existing assets. It is not realistic or practical for VDOT to meet the 100% needs. Figures 22 and 23 also provide the costs for VDOT to meet performance targets for pavements and bridges in FY 2017 and the costs to maintain the two assets in a steady state once the performance targets for them are achieved.

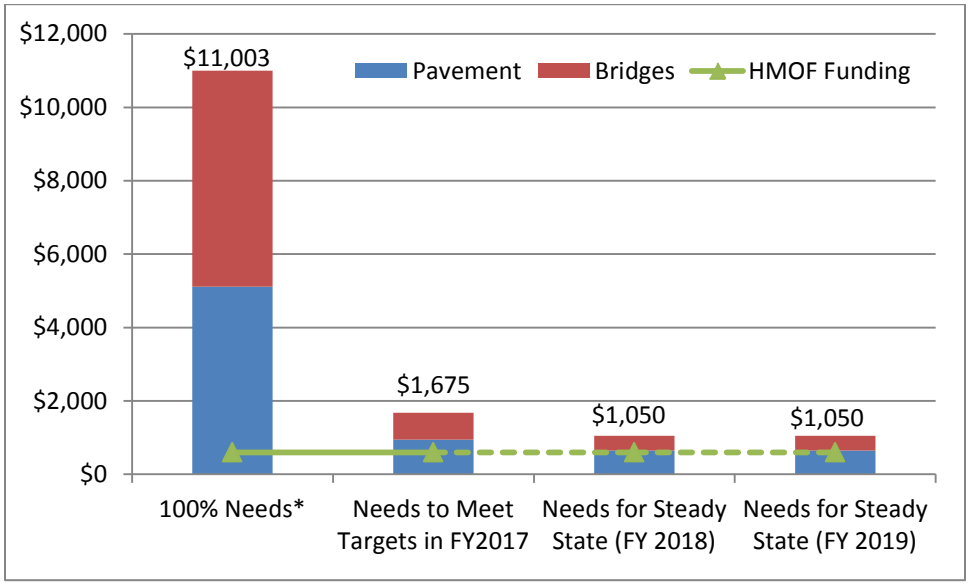
Figure 22: VDOT Needs For Pavements and Bridges ($ million)

Maintenance and Operations Category	100% Needs*	Needs to Meet Targets in FY 2017	Needs for Steady State (after Targets are met)
Pavement**	$ 5,116	$ 945	$ 650
Bridges	$ 5,887	$ 731	$ 400
Grand Total:	**$ 11,003**	**$ 1,675**	**$ 1,050**

* 100% needs are unconstrained needs that include (1) costs to correct deteriorated pavements and structurally deficient structures (to achieve state of good repair), and (2) costs to cover preventive, corrective, and restorative maintenance on pavements and bridges.

** Pavement needs account for costs associated with paving and paving related marking, guardrail, signal loops, rumble strips, shoulders, ramps, patching, turn lanes, bike and pedestrian lanes, traffic control, inspection, and contingency.

Figure 23: VDOT Needs and Ancitipated HMOF Funding For Pavements and Bridges
($ million)



Note: Amounts presented are estimates based on condition assesssment of current inventory and is subject to change. The needs assessment is performed annually.

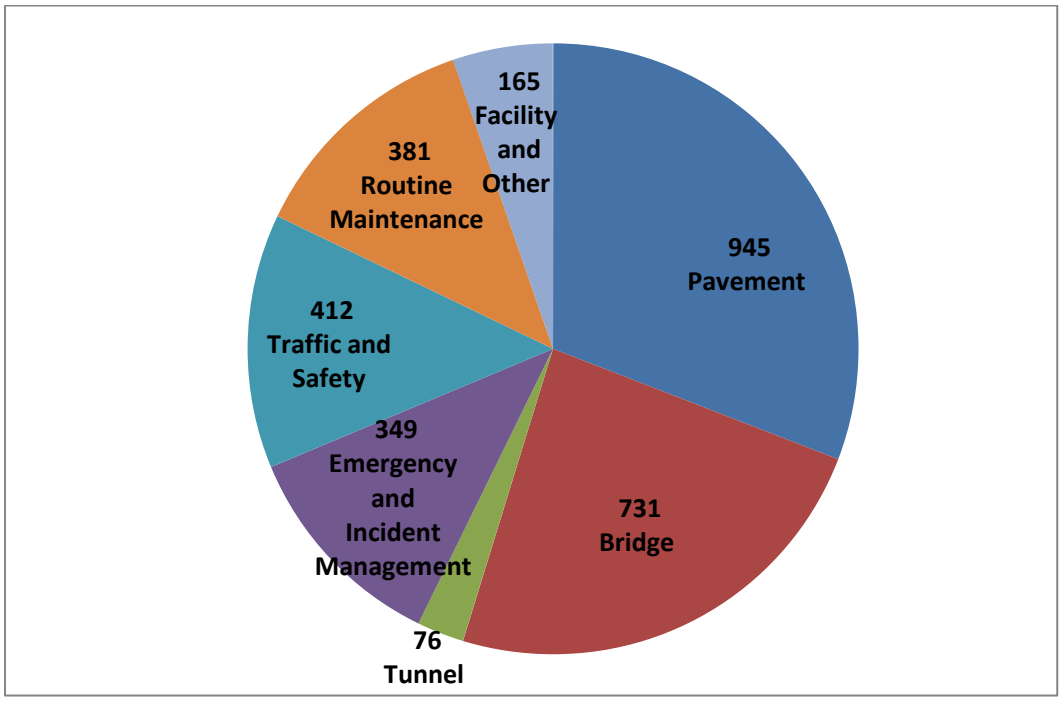
Figure 24 summarizes the funding needed in FY 2017 for VDOT to meet the pavement and bridge performance targets as well as the funding needed to maintain and operate the existing transportation infrastructure. Figure 25 shows the needs breakdown graphically.

Figure 24: FY 2017 VDOT Needs For Existing Infrastructure by Category ($ million)

Maintenance and Operations Category	Needs to Meet Performance Targets	Needs based on business practices/historical expenditures
Pavement*	$945	
Bridges	$731	
Other Services and Repairs		$1,383
Grand Total:	**$ 3,059**	

* Pavement needs account for costs associated with paving and paving related marking, guardrail, signal loops, rumble strips, shoulders, ramps, patching, turn lanes, bike and pedestrian lanes, traffic control, inspection, and contingency.

Figure 25: FY 2017 VDOT Needs Breakdown ($ million)



I.3 Allocations

Final HMOF allocations are presented to the CTB annually in June. The allocation is determined through a needs-based and data-driven approach by a cross functional team within VDOT with representation from the districts. The allocation is determined based on a number of programmatic priorities, including:

- Focus on the core assets (pavements and bridges) and align resources so as to achieve and maintain the state of good repair
- Provide funding to cover on-going paving work and start-up work for the upcoming year
- Fully fund bridge inspection program
- Fully fund emergency operations such as snow removal
- Provide funding to cover the fixed costs of conducting business at the area headquarters
- Ensure funding to cover other essential activities

Summary of VDOT Needs vs. Anticipated Funding

Figure 26 illustrates the draft distribution of FY 2017 funding from the HMOF based on the FY 2016 – FY 2022 Six Year Financial Plan. Figure 27 summarizes FY 2017 needs for the existing VDOT maintained assets, the anticipated funding from the maintenance and construction programs and the gap between needs and available funding.

Background on the methodology to determine the needs are provided in Appendix A. On the funding side, while VDOT focuses on the state of good repair for its pavement and bridge assets, readers should be aware that VDOT must also provide several essential services and repairs.

Many of these services and repairs are interrelated with state of good repair and they can impact pavement and bridge condition. As an example, drainage pipe failures can affect the condition of the overlaying pavement.The FY 2017 draft allocations to these core services and repairs total to about $1 billion and include activities such as:

- A $296 million emergency management and incident response program, out of which, $215 million is dedicated to snow removal.
- A $334 million routine maintenance program to cover minimum costs of field maintenance in order to keep the system running. Some examples of such areas are unpaved roads, drainage, vegetation management, bike paths, pedestrian trails, sidewalks, and soundwall repair.
- About $162 million traffic safety program to cover costs of areas such as striping roads, maintaining traffic signs, guardrails, signals and highway lights.
- About $165 million to cover the costs of maintaining and operating facilities such as safety rest areas, and ferries and another $50 million to cover the operations of six tunnels.

Figure 26: Draft Distribution of FY 2017 Anticipated Funding from HMOF
($ million)

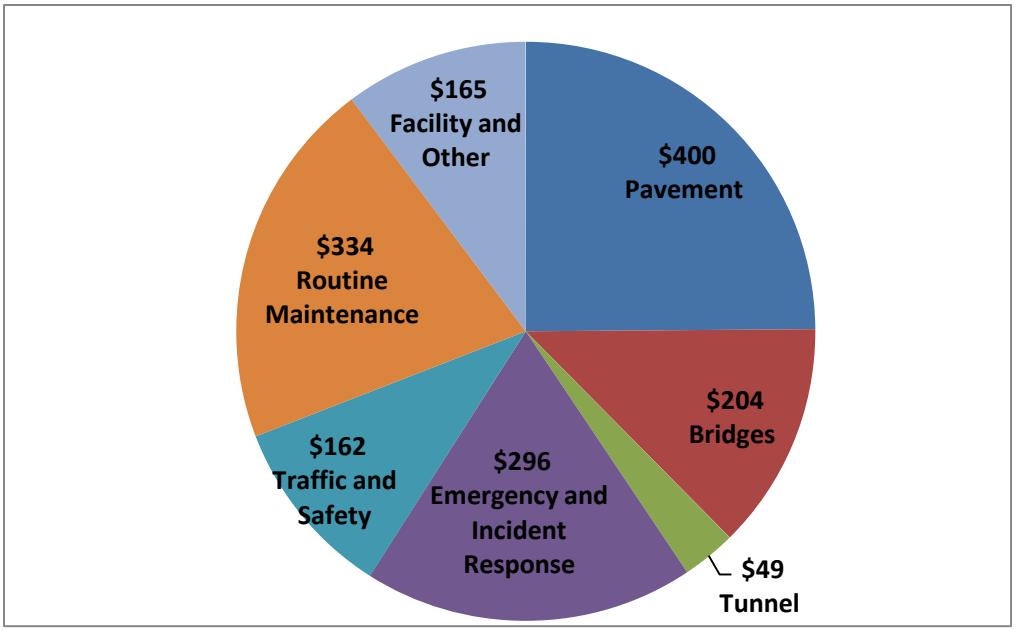


Figure 27: FY 2017 VDOT Annual Needs and Draft Allocations for Existing Infrastructure
($ million)

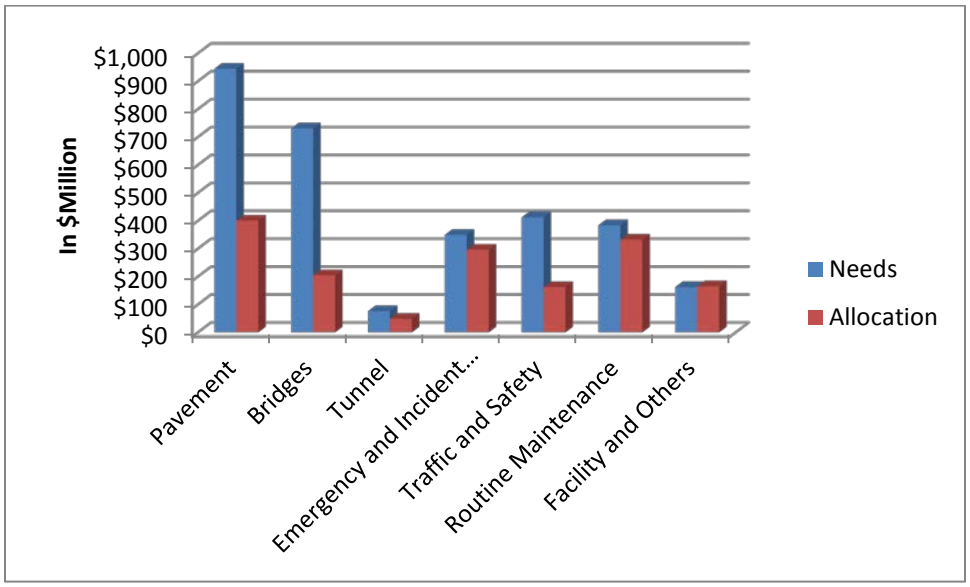
Category	Annual VDOT Needs	Draft M&O Allocations	Draft Construction Allocations**	Total Draft Allocation	Difference between Needs and Draft Allocations
Pavement*	$ 945	$ 400	$ 70	$ 470	$ (475)
Bridges	731	204	64	268	(463)
Other Services and Repairs	1,383	1,006		1,006	(377)
Total	**$ 3,059**	**$ 1,610**	**$ 134**	**$ 1,744**	**$ (1,315)**

* Pavement needs and draft allocation account for costs associated with paving and paving related marking, guardrail, signal loops, rumble strips, shoulders, ramps, patching, turn lanes, bike and pedestrian lanes, traffic control, inspection, and contingency.

** Draft construction allocations are averaged to annualize the allocations.

Figure 28 illustrates the gap between FY 2017 VDOT needs and anticipated allocation from HMOF.

Figure 28: Gap between FY 2017 VDOT Needs and Anticipated Allocation from HMOF



VDOT's aging infrastructure and system preservation requires a large portion of the department's resources and focus. As conveyed earlier in this report and illustrated in Figure 2, timely preservation is critical in lowering long term maintenance costs. If VDOT performs preventive maintenance earlier in the lifecycle of an asset the costs will be less than if rehabilitation or reconstruction is performed later. The graph depicts spending $1 on preventive

maintenance today saves $6 to $10 later as the cost to reconstruct an asset is greater. The reported analysis of needs and anticipated funding shows that there is a significant funding gap in order to timely maintain the pavement and bridge assets. The state of good repair funding enacted by the Governor's 2015 Omnibus Transportation Bill in Code of Virginia §§ 33.2-358 (Allocation of funds among highway systems) and 58.1-1741 (Disposition of Revenues) will assist in closing the gap between needs[14] and the projected funding.

Based on enactment clause 2 of HB1887 (Chapter 684) of the 2015 Acts of the General Assembly, VDOT must implement a priority ranking system for pavement and bridge projects by July 2016. The funding distribution is based on the annual needs. VDOT and localities will work together in the prioritization of these projects as funding will be used towards VDOT maintained assets as well as locally owned bridges and municipality-maintained primary extensions.

Efforts are underway to identify additional funding to help address the funding gaps in the pavement and bridge areas. Based on this effort, VDOT anticipates advertising an additional $75 million in pavement projects and an additional $120 million in bridge projects in FY 2016. If emergencies or disaster events are realized, VDOT will need to update the additional advertising amounts to address these items.

I.4 Performance Targets and Outcomes

As discussed in Section 2 of this Chapter, VDOT's performance targets for pavements are:

- Interstate - 82 percent in sufficient (fair or better) condition
- Primary - 82 percent in sufficient (fair or better) condition
- Secondary - 65 percent in sufficient (fair or better) condition

VDOT's bridge performance target is for 92 percent of structures to be in fair or better condition. The target is further broken down as follows:

- Interstate - 97 percent in fair or better condition (not structurally deficient)
- Primary - 94 percent in fair or better condition (not structurally deficient)
- Secondary - 89 percent in fair or better condition (not structurally deficient)

Figures 29 through 34 present the expected performance outcomes for pavements and bridges based on funding identified for maintenance and state of good repair through 2025.

The solid black lines represent performance since 2011 based on funding provided to the pavement and bridge assets through 2015. The gray lines represent trends of deteriorating conditions if no additional funding is to be provided for the state of good repair purpose. The orange lines represent trends of predicted conditions with actions taken to address the state of good repair needs. The state of good repair funding is provided in the Code of Virginia §§ 33.2-358 (Allocation of funds among highway systems) and 58.1-1741 (Disposition of Revenues). With an additional $250 million a year to the pavement program and about $100 million a year

[14] In this report "needs" refer to the cost for assets to achieve and/or sustain a state of good repair over time, where "state of good repair" is defined in Code of Virginia § 33.2-369 .

to the bridge program over the next six years, VDOT would be able to continue to improve the condition of the two core assets towards achieving and maintaining the state of good repair. The charts do not take into account the passing of the federal transportation authorization, Fixing America's Surface Transportation Act, (FAST Act) and/or the improved state revenue forecasts.

Pavement Past and Forecasted Condition

VDOT's performance targets for pavements are:

- Interstate - 82 percent in sufficient (fair or better) condition
- Primary - 82 percent in sufficient (fair or better) condition
- Secondary - 65 percent in sufficient (fair or better) condition

VDOT estimates that the following percentages of lane miles will be either in fair or better condition over the next two years:

- Interstate – approximately 91% in 2016 and 90% 2017
- Primary – approximately 84% in 2016 and 84% in 2017
- Secondary – approximately 60% in 2016 and 58% in 2017

The charts indicate the forecasted paving conditions if the continued annual allocation is received plus the CTB formula funds and shows the predicted decline once the CTB formula funds are no longer available (the gray line).

Figure 29: Past and Forecasted Pavement Condition (Percent Sufficient) – Interstate

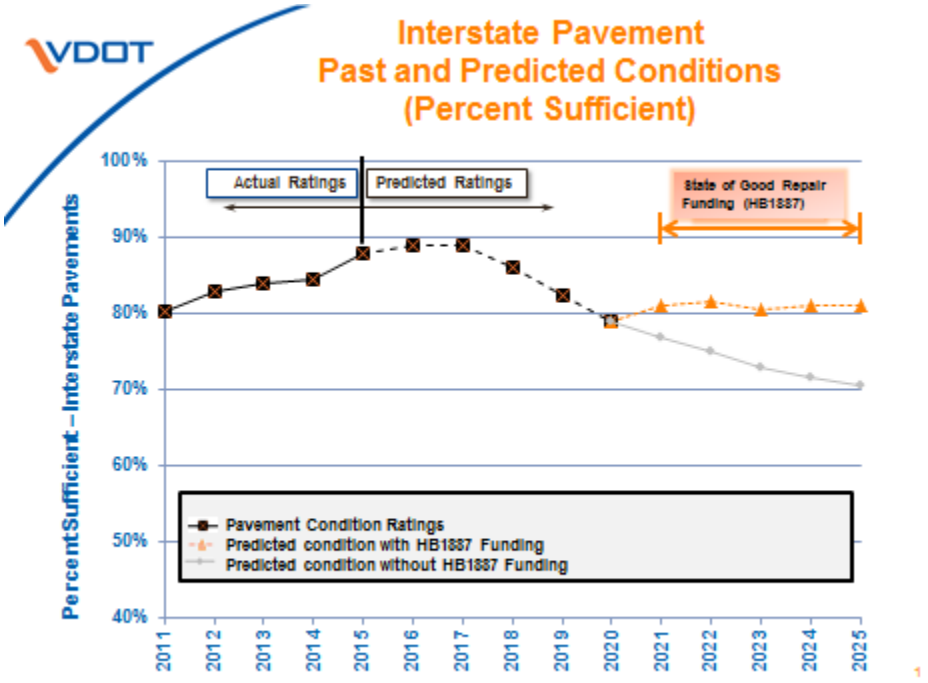


Figure 30: Past and Forecasted Pavement Condition (Percent Sufficient) – Primary

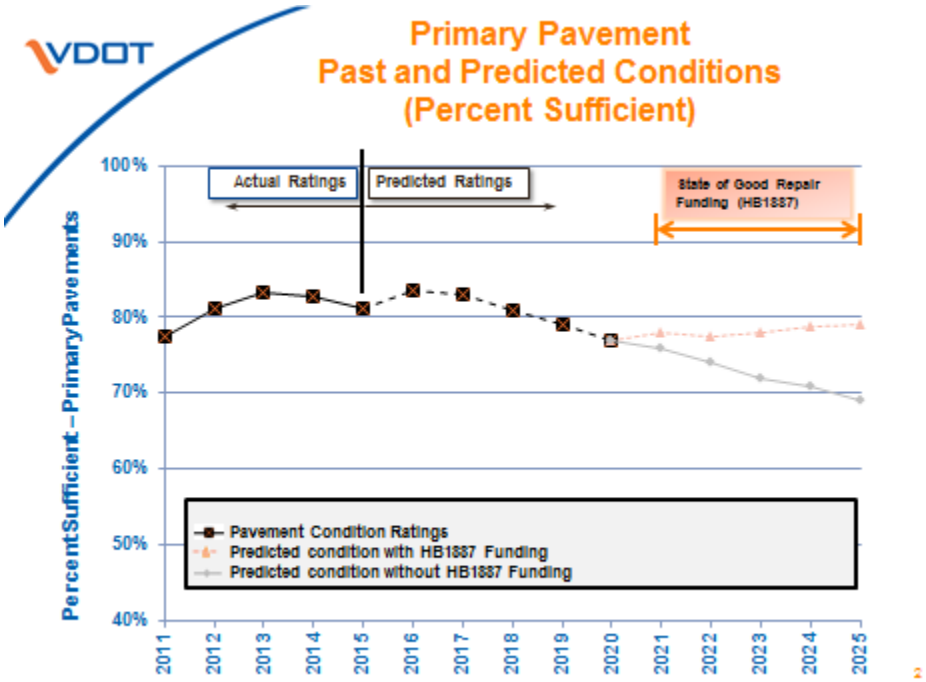
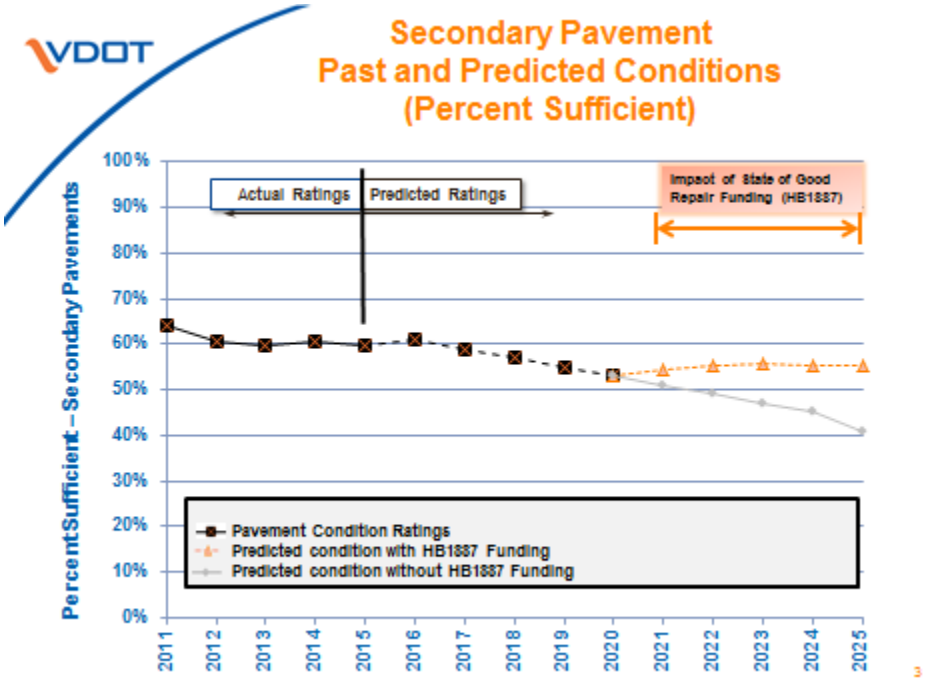


Figure 31: Past and Forecasted Pavement Condition (Percent Sufficient) – Secondary



Bridge Past and Forecasted Condition

VDOT's bridge performance target is for 92 percent of structures to be in fair or better condition. The target is further broken down as the follow:

- Interstate - 97 percent in fair or better condition (not structurally deficient)
- Primary - 94 percent in fair or better condition (not structurally deficient)
- Secondary - 89 percent in fair or better condition (not structurally deficient)

VDOT estimated that the following percentages of structures will be either in good or fair condition (not structurally deficient) at the completion of fiscal year 2017:

- Interstate – approximately 97%
- Primary – approximately 95%
- Secondary – approximately 92.5%

Figure 32: Past and Forecasted Bridge Condition (Percent of Good and Fair Structures) - Interstate

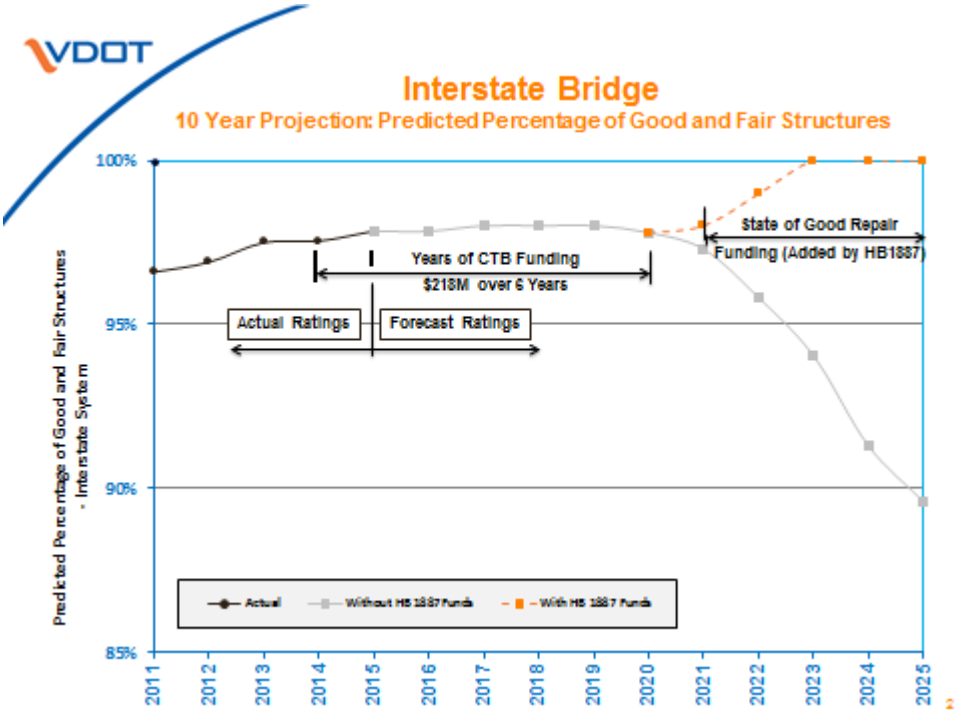


Figure 33: Past and Forecasted Bridge Condition (Percent of Good and Fair Structures) – Primary

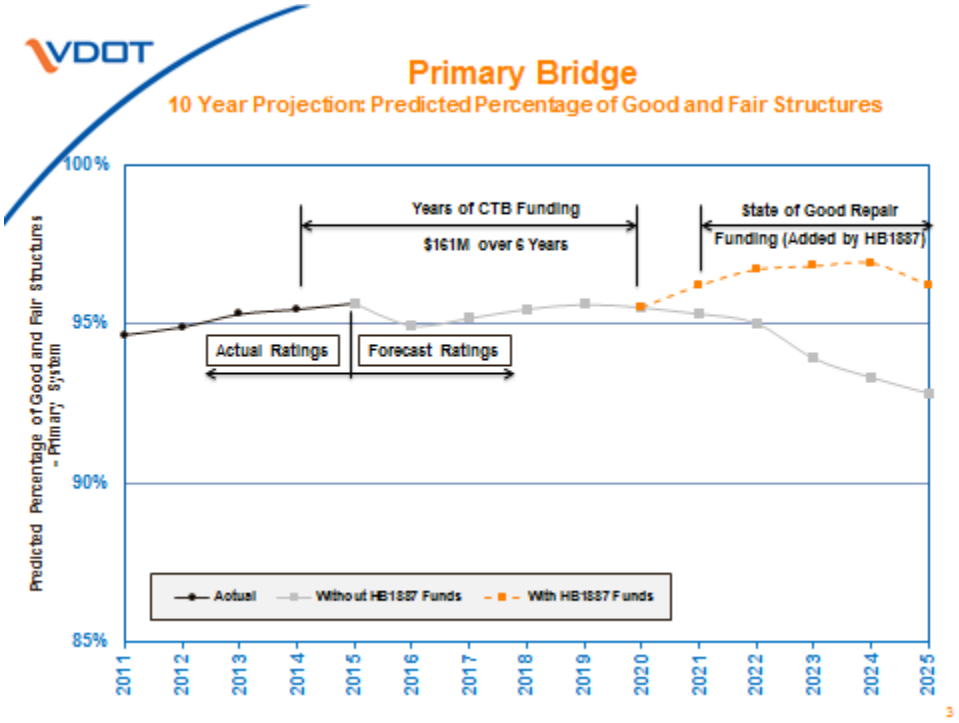
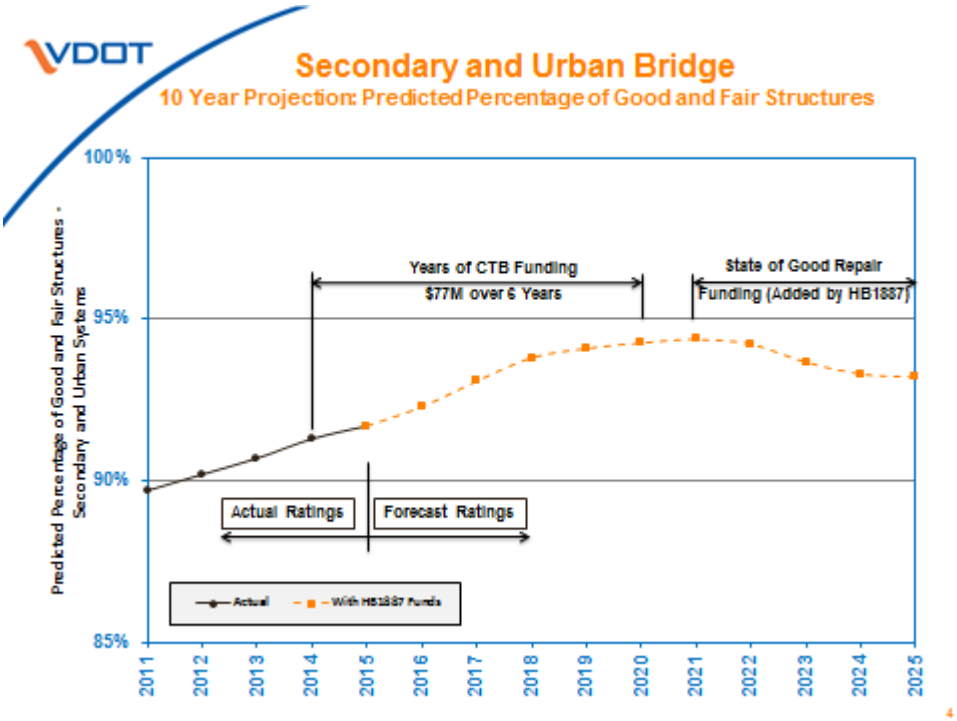


Figure 34: Past and Forecasted Bridge Condition (Percent of Good and Fair Structures) – Secondary



Efforts to Close Funding Gaps to Maintain State of Good Repair

VDOT has utilized various means and approaches to fill the funding gaps for the state of good repair, such as:

- Innovative approaches to delivering projects. On paving projects, VDOT started to apply cost saving measures to maximize available funding. Examples of such measures include the use of in-place recycling, full depth reclamation, thin asphalt mix, and high polymer asphalt mixes as illustrated in Figure 35. On bridge projects, similar cost saving measures are taken through efforts such as improved design practices, and use of improved or new materials as pictured in Figure 36.
- Bonus obligation authority. VDOT may receive additional federal obligation annually if the state meets annual obligation requirements. In the past, additional funding has been distributed to the core asset areas to provide critical additional resources in bridging the funding gap for the state of good repair.
- Savings in snow removal or other areas are reprogrammed to address the state of good repair for pavements and bridges.

Figure 35: Examples of Cost Saving Measures Applied in Paving Projects

Inplace Recycling

Full Depth Reclamation

Thin Asphalt Mix

High Polymer Asphalt Mixes

Figure 36: Examples of Cost Saving Measures Applied in Bridge Projects

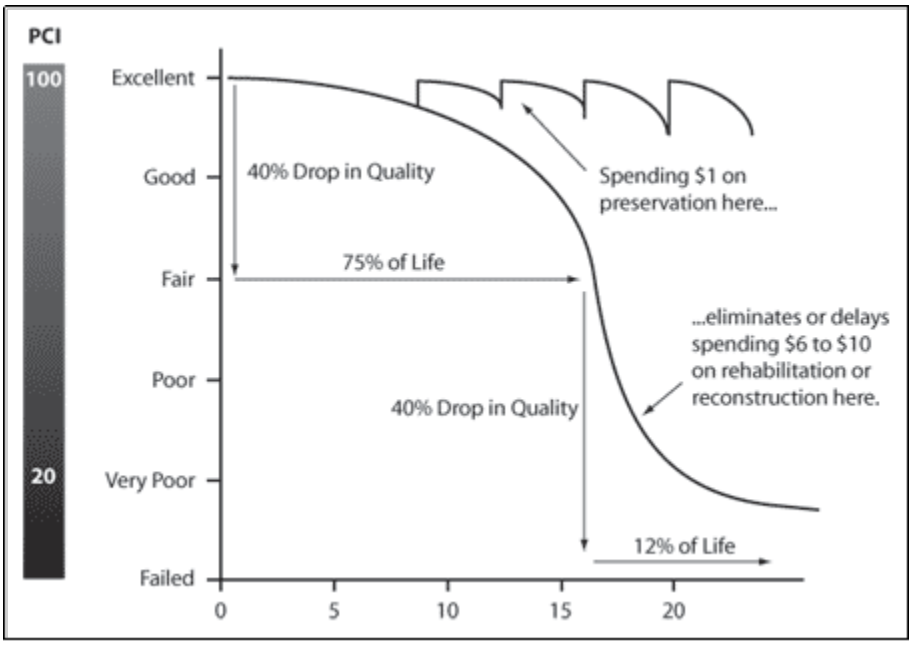
Jointless Structure ***Stainless Steel Prestressing*** ***Carbon Fiber Prestressing***

I.4 Conclusion

The estimated FY 2017 costs for VDOT to meet performance targets for pavements and bridges and the costs to maintain and operate other essential assets and services add up to about $3.059 billion. Once the performance targets are achieved, the anticipated costs to maintain pavements and bridges in a steady state are about $650 million and $400 million, respectively. The FY 2017 anticipated funding from VDOT's maintenance and construction programs total about $1.742 billion. The gap between needs and anticipated funding is $1.317 billion.

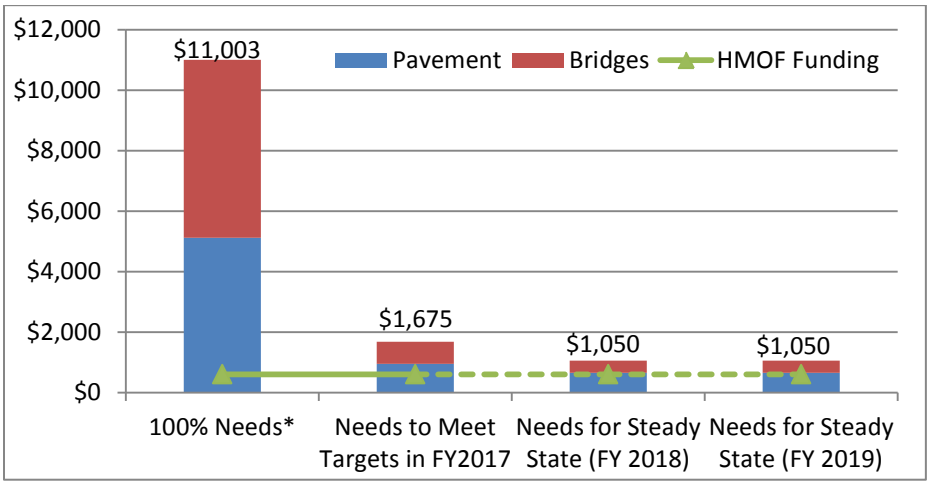
In addition, VDOT's aging assets require significant resources and focus. The estimated costs to bring VDOT's deteriorated pavements and structurally deficient bridges to the state of good repair and the costs to cover preventive, corrective, and restorative maintenance on the two assets add up to approximately $11 billion. As illustrated in Figure 37, timely preservation is critical in lowering long term maintenance costs. If VDOT performs preventive maintenance earlier in the lifecycle of an asset the costs will be less than if rehabilitation or reconstruction is performed later. The reported analysis shows that VDOT is facing a significant funding gap in order to timely maintain the pavement and bridge assets as illustrated in Figures 38 and 39.

Figure 37: Impact of Maintenance Timing on Asset Condition



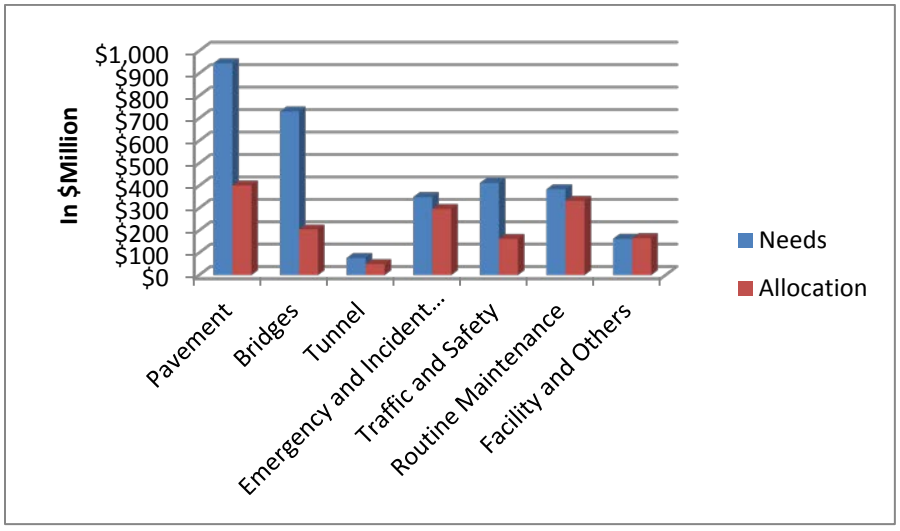
Note: This graph is based on a 2012 FHWA report on asset sustainability. It illustrates the steep deterioration commonly seen in pavements once they reach a "poor" condition. Timely preventive maintenance creates substantial value by restoring pavements to a high condition and preventing the onset of the rapid deterioration commonly seen in poorly maintained pavements. As noted in the graph, timely preventive treatment can produce a very high return on investment, while underinvestment leads to missed opportunities to prevent rapid degradation.

Figure 38: VDOT Needs and Anticipated HMOF Funding for Pavement and Bridges



Note: Amounts presented are estimates based on condition assesssment of current inventory and is subject to change. The needs assessment is performed annually.

Figure 39: Gap between FY 2017 VDOT Needs and Anticipated Allocation from HMOF



The state of good repair funding as provided in the Code of Virginia §§ 33.2-358 (Allocation of funds among highway systems) and 58.1-1741 (Disposition of Revenues) will assist in closing the funding gap and address the identified needs. In addition, VDOT has utilized various means and approaches to fill the funding gaps. Examples of such efforts include innovative cost saving measures to maximize upon available funding, securing additional federal funding (e.g., bonus obligation authority) to provide critical additional resources, and re-allocate program area savings to address the state of good repair for pavements and bridges.

II.
Safety, Security, Improving Highway Operations, the Innovation and Technology Transportation Fund and Improving Incident Management

II.1 Safety

Safety Overview

Safety is VDOT's highest priority when developing and implementing any transportation project or program. This chapter of the Annual Report describes VDOT's targeted efforts to reduce deaths and injuries from crashes on the Commonwealth's highways and streets.

The FY 2016 VDOT Business Plan continues to affirm safety as one of VDOT's overarching Department goals. In addition to implementing previous Business Plan strategies and action items, VDOT continues work to ensure Highway Safety Improvement Program (HSIP) funds are applied to the highest priority safety needs. VDOT's goal is to apply HSIP funds to projects with the potential to reduce severe injuries and fatalities within a District given the investment and to track and communicate safety outcomes of completed projects.

The Safety section begins with a summary of VDOT's progress in various efforts associated with the Agency's safety goals.

VDOT's targeted safety strategies are implemented through the federally funded HSIP. A requirement of the program is to develop and implement a Strategic Highway Safety Plan (SHSP) with stakeholders and partners. A description of VDOT's initiatives and accomplishments under the SHSP and the HSIP completes the Safety section.

Status of Various Efforts Relating to VDOT's Safety Goals

VDOT creates a pipeline of safety projects to include in the Six-Year Improvement Program (SYIP) each year. In addition, the Agency fully leverages the HSIP and the Strategically Targeted Area Roadway Solutions (STARS) program to identify short-term delivery safety and congestion enhancements. To select safety projects that will have the most impact, access to robust and accurate crash and highway data is imperative. This section provides an overview of recent improvements to the access and functionality of crash data in Virginia. The HSIP project development process and work associated with building the HSIP SYIP are explained in the HSIP section.

Work continues with the development of new software tools to view, summarize and prepare crash data reports and to share those tools with our partners. VDOT also continues to work with the Virginia Department of Motor Vehicles (DMV) to obtain more accurate and up-to-date crash

data. Fulfilling earlier Business Plan items, DMV now provides crash data to VDOT within one to two months of the occurrence.

Comprehensive traffic crash data summaries for the state produced annually by DMV can be found at: http://www.dmv.virginia.gov/safety/

There is a menu of options for crash data under the column heading "Highway Safety."

VDOT now provides interactive maps showing the crash location data received from DMV to the public at: http://www.virginiaroads.org/

There is a link for "Crashes" after clicking the "Interactive Maps" button.

In response to results from user surveys VDOT has provided enhancements to the Roadway Network System (RNS) inventory and crash data module and has developed crash data filtering and reporting tools. In addition, VDOT HSIP staff developed intersection and roadway segment safety condition ratings based on the respective types of traffic control and roads in each District that are being published each year. This network safety data is provided to VDOT Districts annually to aid in identification of priority safety projects to be included in the HSIP six-year plan. In 2015, the identified locations were also referenced as safety needs in the VTRANS 2040 plan for use in evaluating HB2 project proposals.[15]

In addition to providing crash analysis to the District to aid in their development of safety projects, VDOT continues to identify sections on the Corridors of Statewide Significance (COSS) with high crash rates and to develop plans to improve safety conditions on the identified COSS sections. Engineering assessments have determined and programmed lower cost traffic control and shoulder improvements as well as higher cost roadway improvements to enhance safety at selected locations.

The Strategic Highway Safety Plan (SHSP)

Engineering, Education, Enforcement and Emergency Response, the 4-E Approach
Virginia has defined an SHSP through a cooperative and coordinated multi-agency and inter-disciplinary, engineering, education, enforcement and emergency response (4-E) approach to improving highway safety. The Virginia (2012-2016) SHSP, developed under VDOT's leadership, will be used to drive investment decisions to improve highway safety and reduce deaths and severe injuries. It details all safety partner efforts to improve traffic safety in Virginia.

The SHSP has strategically focused on correcting poor driver behavior and improving roadway elements and traffic control to reduce crashes and their consequences. The SHSP establishes the goal, consistent with the goal adopted by the American Association of State Highway Transportation Officials, of reducing deaths and severe injuries from traffic crashes by 50

[15] HB2 refers to House Bill 2 that was enacted by the 2014 General Assembly. HB2 established Code of Virginia §33.2-214.1, which directs the Commonwealth Transportation Board to develop a project prioritization process for capacity enhancing projects in the Six-Year Improvement Program.

percent by 2030. Traffic deaths declined to the record low of 700 in 2014 after remaining stable for several years. Additionally, severe injury crashes on Virginia's highways have steadily declined by about 10 percent each year since 2010. Within the five year SHSP horizon, strategies and action are defined across three broad areas:

1. Human Factors - strategies developed to impact driver behavior such as speeding, young driver behavior, occupant protection and impaired driving.
2. Environmental Locations - strategies developed to impact intersection safety and roadway departure crashes, including those with pedestrians and bicyclists.
3. Data Collection, Management and Analysis - strategies to identify Virginia's safety needs and focus on defining VDOT's safety performance.

The Highway Safety Improvement Program (HSIP)

While all maintenance and construction projects improve the safety of our transportation systems, the use of FHWA funds for the Commonwealth's HSIP facilitates implementation of specific projects and strategies to reduce crashes and their consequences.

VDOT's HSIP is comprised of the following subprograms utilizing the federal funding sources:

- Highway Safety Projects (HSP): 23 USC Section 148
- Bicycle and Pedestrian Safety (BPS) Projects: 23 USC Section 148
- Open Container (OC) - Penalty Transfer Projects: 23 USC Section 154
- Highway-Rail Grade Crossing (H-RGC) Projects: 23 USC Section 130

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 assessment of the highway network. Intersection improvements include advance-warning signing, traffic signal upgrades and turn-lane improvements. Roadway segment projects include curve delineation signing, rumble strips, shoulder widening and guardrails or barriers. Typical BPS projects include sidewalks, trails, bicycle lanes and intersection accommodations such as pedestrian signals, ramps and crosswalks. VDOT sets a target of allocating up to 10 percent of the agency's highway safety apportionment to BPS improvements. In FY 2015 and 2016, $5.5 million was allocated for BPS projects. OC funds may be programmed on any HSIP Section 148 eligible safety improvement project. The H-RGC Program targets higher risk at-grade railroad crossings. OC penalty transfer and H-RGC funds are apportioned by FHWA.

MAP-21 introduced substantial changes to the High-Risk Rural Road (HRRR) Program, providing states flexibility on developing methodology for determining "significant safety risk" and eliminating the requirement of an HRRR set-aside. However, MAP-21 only requires a state to obligate a portion of its HSIP allocation to HRRRs if the state's fatality rate on rural roads has increased over the most recent two year period for which data are available. Fatality rates have not been increasing on VDOT's rural roads. Therefore, there is not a requirement that VDOT set aside HSIP funds for HRRRs.

The resulting distribution of HSIP federal funding under MAP-21 for FY 2015 and 2016 is shown in Figure 40.

Figure 40: Virginia's Fiscal Year HSIP Federal Allocation of Funds

(Dollars Thousands)

Year	HSIP-Highway	Penalty Transfer	HSIP-Rail H-RGC	Total
FY 2014-15	$51,764	$20,160	$4,003	$79,257
FY 2015-16 (1,2)	$52,983		$870	$56,037
Total	$104,747	$20,160	$4,873	$135,294

Note:

(1) FY 2016 penalty transfer amounts had not been determined at the time of this report

(2) FY 2016 full rail apportionment will not be used for grade crossing safety projects.

Highway Safety Six-Year Improvement Plan Development

HSIP project planning and development follows a five step process (set forth below) conducted through collaboration of District and Central Office staff:

1. Review the above mentioned annual network safety condition rating locations, with input from other VDOT and local stakeholders, to determine priority intersections and roadway segments warranting detailed safety assessments for potential safety improvement projects.
2. Conduct detailed crash analysis and field assessment of conditions to determine safety project scopes and complete economic evaluation of feasible projects.
3. Prioritize projects in the District based on the number of crashes, benefit-cost effectiveness, and project cost and schedule.
4. Submit prioritized list of projects to Central Office for review and funding consideration.
5. Central Office staff reviews the statewide proposed projects with the available funding to confirm which projects can be programmed in the six-year plan.

In addition to HSIP projects, maintenance paving projects that are federally funded are reviewed for potential safety improvements such as upgraded signing, marking and guardrails.

VDOT has developed a safety project economic evaluation methodology to assess the benefits of proposed safety improvements. All guidelines, project submittal forms, and benefit-cost spreadsheets are provided at: http://www.virginiadot.org/business/ted_app_pro.asp. The program's policies and procedures are being updated to reflect the MAP-21 requirements and eligibility.

After the announcement of the MAP-21 HSIP budget through FY 2021, VDOT's staff is briefed on the SHSP eligible projects based on emphasis areas: roadway departures; intersection crashes; and pedestrian and bicycle crashes. The goal is to program safety projects with allocations on different phases in each fiscal year. VDOT has successfully programmed most of its FY 2016, 2017 and about 60 percent of the estimated FY 2018 and 2019 HSIP allocations on safety project phases during those years. Additional funds were programmed on phases that are scheduled in FY 2020-21.

Many of the new FY 2016 SYIP highway safety projects are shoulder and roadside improvements that will reduce or minimize the consequences of roadway departure crashes while staying within the existing right of way. In addition, geometric changes at intersections and systemic improvements to traffic signals are programmed over multiple years.

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 submission for funding 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. For example, the 57 highway safety projects completed in 2011 resulted in a 31 and 19 percent reduction in total and injury crashes, respectively, at those locations during the after period.

Bicycle and Pedestrian Safety Projects

VDOT is one of the few state agencies in the nation with a safety program that improves conditions for bicycle and pedestrian users, especially around schools.

The VDOT program preceded the Safe Routes to School program established in 2005 as part of the Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) and continued, with changes to how it is funded, under MAP-21.[16]

Bicycle and Pedestrian Safety (BPS) improvements are typically not prioritized and programmed using the traditional benefit-cost crash reduction based procedures due to the lack of multiple crashes at a specific location. In addition, the effectiveness (crash reduction) of related countermeasures for individual locations is often unknown. Despite these difficulties, VDOT recognizes that a high potential for risk exists for non-motorized travelers and that some people may not bike or walk because of safety concerns. VDOT uses a ranking system for evaluating BPS project proposals that ranks the proposals by assigning scores to a series of questions about purpose, need and expected risk reductions. Consequently, starting in FY 2004 VDOT began to target programming up to 10 percent of HSIP funds for the non-motorized safety program**.**

Of the FY 2016 Section 148 (HSIP) funds, about four percent was programmed on BPS targeted improvements, including sidewalks and intersection traffic control treatments. Other FY 2016 highway safety projects at signalized intersections and those providing wider paved shoulders also augmented non-motorized accommodations.

Finally, the following three bicycle safety recommendations are included in the state Bicycle Policy Plan:

[16] The Safe Routes to School Program (SRTS) does not have dedicated funding under current federal law. Projects submitted under SRTS are eligible for funding under the Transportation Alternatives Program (TAP), 23 USC 213(b)(3). Each state decides how much TAP funding to allocate to SRTS from among other eligible TAP programs and projects.

- VDOT should participate in roadway safety assessments for schools that are located on the state highway system, as requested. Where possible, school zone safety assessments should address bicycle access to schools, including street crossings and paved shoulders.
- VDOT should encourage biking and walking to school and provide opportunities for students to have access to bicycle safety education.
- VDOT should encourage college and universities to provide safety education classes similar to League of American Bicyclist education classes.

Virginia's Bicycle Policy Plan can be found at
http://www.virginiadot.org/programs/bicycling_and_walking/bicycle_policy_plan.asp.

Open Container-Penalty Transfer Projects

Similar to the Open Container (OC) - Penalty Transfer procedure in SAFETEA-LU, under MAP-21, Virginia is "penalized" for its existing OC law by having 2.5% of Virginia's apportioned highway funds transferred from the surface transportation program and the national highway performance program to behavioral and infrastructure safety improvement programs. Virginia's FY 2015 penalty amount, $20.16 million, was used for HSIP eligible improvements.

VDOT used FY 2015 OC funds on I-95 and I-395 interchange improvements as well as updating Virginia's Buckle-Up signs to new federal standards.

Highway - Rail Grade Crossing Program

MAP-21 continues SAFETEA-LU's funding for safety improvements at highway/rail intersections through the H-RGC Program. In general, the federal share is 90 percent. However, certain projects as described in 23 USC Section 120(c) (1) may be eligible for 100 percent federal funding. The H-RGC program was implemented to reduce risk at public highway-rail grade crossings. Improvements have been initiated across several areas: upgrading gates; traffic control devices; and crossing surfaces.

Greater Use of Rail Crossing Safety Equipment
There are two Class I railroad companies operating in Virginia with more than 3,500 miles of track and over 1,859 public at grade highway/railroad crossings.

Since the inception of the H-RGC program, VDOT has evaluated and upgraded 1,493 (representing 80%) of these crossings with active warning devices. The remaining 366 crossings remain passive.

All crossings are regularly condition reviewed so that possible upgrades, permanent closure or grade separation projects may be identified.

Using Information in order to More Effectively Use Scarce Resources
VDOT uses the Federal Railway Administration crash risk prediction methodology as a mathematical procedure to develop a prioritized ranking of grade crossing locations statewide. The priority listing is revised annually based on predicted crash risk. VDOT furnishes the listing to localities and railroads.

Proactive Upgrades to Improve Safety and Operations
In an effort to improve safety on the roadways (and railways), VDOT has completed projects at crossings with no previous crash history after conducting engineering reviews, receiving input from safety partners concerning "near misses" and evaluating the existing geometric and traffic control conditions.

H-RGC Project Funding
VDOT receives approximately $4 million each year apportioned for rail grade crossing improvements, typically funding from 20 to 40 H-RGC projects each year. More project proposals than available funding for FY 2016 were submitted, and so 21 projects valued at $4.135 million were programmed using previous funds from project balances.

Most of the H-RGC programmed projects added gates and flashing lights to provide active warning devices, some projects upgraded existing lights, and the remaining projects upgraded the crossing surface or signal preemption equipment.

II.2 Security Overview

Statewide Security Oversight

In November of 2014, VDOT realigned several core security functions under its Central Office. The agency identified that greater efficiencies could be obtained by aligning multiple security core functions. The district offices and critical infrastructure sites (CI) will retain local execution of security functions with oversight and support from the Central Office.

The following sections offer a summary of the newly aligned Agency Security Program Area. This summary demonstrates the breadth of personnel and infrastructure security issues covered within this program area. The goal is to provide a single point of contact for security, standardize the delivery of security efforts across the agency, align the program with industry standards and best practices to reduce operating costs, and enhance security and resiliency capabilities.

Agency Security Program Area and Initiatives

VDOT Infrastructure Protection and Resiliency Enhancements Program (VIPREP) Contract

The VIPREP contract is the procurement mechanism utilized by the Agency Security Program Area to enhance the delivery of VDOT's CI protection and resiliency projects and initiatives. The VIPREP contract is utilized to conduct physical security installation or enhancement projects at bridge/tunnel facilities, Transportation Operations Centers, other CI sites, and for security projects at non-CI designated facilities and structures. The VIPREP provides critical services to support VDOT's infrastructure and various statewide security systems that must be fully functional at all times to protect VDOT employees, visitors and the travelling public. Typical installations or enhancements projects under VIPREP include: access control systems, surveillance equipment, motorized gates, fencing, security lighting, and other physical security equipment or protective measures and services.

VDOT Statewide Security Systems Maintenance (SSSM) Program

The SSSM program is conducted through a yearly re-occurring task order issued under the VIPREP contract by the Agency Security Program Area to maintain operations of VDOT's Statewide Security Systems at all facilities and structures. Additionally the SSSM program includes a preventative maintenance component, installed and spare parts inventory tracking, and individual site security systems location diagrams. This program operates 24 hours a day, every day of the year.

Critical Infrastructure, Protection and Resiliency

Critical Infrastructure (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. The Agency Security Program Area works directly with the facility managers and operators that run these infrastructures and other VDOT facilities, to ensure CI protection, promote resiliency, and identify and prioritize related projects.

Security Systems Oversight
Agency Security Program Area provides a single point of contact for the design, type and performance for security projects, policies and security management systems (SMS). SMS include all systems and equipment that directly and indirectly relate to the physical security of facilities and structures. As an example, the section works directly with its traditional procurement offices and the Virginia Office of Public-Private Partnerships to ensure consistent and continuous application of VDOT SMS, their maintenance, and related policies.

Coordination continues as needed with the Elizabeth River Tunnels (ERT) project, the Interstate-95 HOV/HOT Lanes project, as well as, VDOT's Interstate-66 improvement project. This interaction promotes integration of existing and future CI sites and security programs to form a common and consistent level of security for our customers.

Statewide Security Guard Contract
Professional uniformed security services, unarmed and armed, are provided to VDOT through a contractor to assure the safety and protection of specific VDOT buildings, occupants, real and personal property. The contractor provides security officers who are responsible for performing all tasks related to securing specific VDOT assets and additional duties designated within their site's security post orders. The Agency Security Program Area is responsible for providing support and oversight to this program.

Criminal History Records Check Program (CHRC)
The Criminal History Records Check Program is designed to ensure that suitable individuals are authorized and assigned to perform work for the Virginia Department of Transportation (VDOT), conduct business on behalf of VDOT, and/or are granted access to VDOT's Critical Infrastructure (CI), systems, or information which has been deemed "sensitive". The Agency Security Program Area manages the CHRC process established for VDOT personnel through the implementation of VDOT Department Memorandum (DM) 1-25, which provides a framework for the administration and maintenance of VDOT's Criminal History Records Check Program. The CHRC staff is the central point of contact for coordinating statewide fingerprint-based criminal history records checks at VDOT.

Department Memorandum 1-25 is issued pursuant to § 19.2-389 and § 2.2-1201.1 of the Code of Virginia, Virginia Information Technologies Agency Policy No. SEC519-00 Information Technology Security, and the Department of Human Resources Management (DHRM) Policy 2.10, Hiring. In those instances where this Department Memorandum is broader than DHRM Policy 2.10, this Department Memorandum governs.

Foreign Visitor Clearance Coordination Program
In accordance with the Federal Highway Administration Office of International Programs, VDOT confirms the suitability of foreign visitors and delegations, which are visiting VDOT facilities and assets, to ensure the visit does not contravene US restrictions on interaction with officials from a particular country.

Physical Access Control System (PACS) Program
VDOT's PACS is managed by the Agency Security Program Area. This program area covers the statewide monitoring and oversight and support to District level PACS operators to ensure consistent PACS operations and to ensure proper data entries for credentials, user group's establishment, and that access levels are granted or terminated as needed to maintain business operations.

Credentialing Program (Access and Identification Cards)
VDOT issues Access and Identification Cards (AIC) primarily to employees and contractors who have been deemed suitable through VDOT's CHRC process. The Agency Security Program Area issues these cards locally for VDOT's Central Office operations and monitors and provides oversight and support to District level AIC issuing staff to ensure equipment and supplies are maintained, AIC's are issued in standardized formats and to ensure revoked AIC information is removed from the PACS system so that unauthorized access does not occur.

Security Response Plan Program
Agency Security Program Area continues work on Security Response Plans (SRPs). The SRPs are comprehensive documents that focus on specific tunnel facility responses to various manmade security threats or incidents. The SRP program is on-going and includes a yearly update process to capture any facility point of contact or operational process changes.

In addition, the SRPs comply with National Fire Protection Association (NFPA) 502 requirements.[17] The NFPA 502 is the standard adopted by the Commonwealth Transportation Board that provides fire protection and safety requirements for tunnels and bridges. The SRP serves as the controlling security response document for all nine NFPA 502 regulated tunnel structures in the Commonwealth, these include:

- the four underwater tunnels, Hampton Roads Bridge Tunnel (HRBT), Monitor Merrimac Memorial Bridge Tunnel (MMMBT), Downtown Tunnel (DTT), Midtown Tunnel (MTT), and the I-564(Runway) tunnel, located in the VDOT Hampton Roads District;
- the Rosslyn Tunnel located in the Northern Virginia District;
- the Montgomery County Route 460 Tunnel located in Salem District; and
- the two mountain tunnels, Big Walker Mountain Tunnel (BWMT) and East River Mountain Tunnel, (ERMT), located in the Bristol District.

[17] The National Fire Protection Association (NFPA) is an international nonprofit organization "devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards. The association delivers information and knowledge through more than 300 consensus codes and standards…" [NFPA website http://www.nfpa.org/about-nfpa] The NFPA 502 document promulgates standards for fire protection and fire life safety requirements for limited access highways, road tunnels, bridges, elevated highways, depressed highways, and roadways that are located beneath air-right structures.

Training Program
The Agency Security Program Area provides coordination, as needed, with facility managers and staff in an effort to maintain awareness of the latest security topics and practices. Training courses are sponsored or coordinated with outside agency stakeholders to support facility requests for training. Previous 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. In conjunction VDOT also conducts and participates in resiliency based exercises sponsored through the Virginia Department of Emergency Management or federal agencies such as the Department of Homeland Security.

Continuing Efforts and Initiatives
In May 2015, the Agency Security Program Area initiated a project to replace VDOT's twelve year old Physical Access Control System (PACS) with a new PACS that meets current industry access control standards and federal standards for systems interoperability. The goal is to mitigate existing PACS security and operational vulnerabilities by replacing the current single server legacy based PACS with a modern system operating on a redundant server platform and to align VDOT's PACS with current federal standards for systems interoperability and credentialing. Final project completion is expected to occur in March 2016.

II.3 Improving Highway Operations, the Innovation and Technology Transportation Fund and Improving Incident Management

Highway Operations Program Overview

Operations pertain to managing the Commonwealth's roadways. As stated in VDOT's Business Plan, operations ensures efficient use of the existing transportation system and services to meet customer demand and expectation of a system that is safe and reliable, and to enable the easy movement of goods and people across all modes. Operations involve 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) statewide incident management programs, traveler information services, highway monitoring systems, and active traffic management systems; and (2) safety systems and traffic signal systems. In both areas, VDOT have developed and monitor relevant performance measures.

Improvements to the operations program are achieved by both using transportation technologies to improve traffic flow and by reducing the impact of incidents. Technology development is supported by the Innovation and Transportation Technology program. The Incident Management program focuses on initiatives to prevent and mitigate incidents. The following sections present an overview of each program's strategies and activities.

The Innovation and Technology Transportation Fund

Innovation and Transportation Technology Program Strategies
The Innovation and Transportation Technology program consists of eight technologies strategies.

1. **Operations traffic management –** to improve corridor efficiency through active traffic management across multiple parallel freeways, arterial highways and transit systems.
2. **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.
3. **Multimodal travel promotion –** to increase multimodal travel by increasing access and improving its efficiency.
4. **Arterial highway management –** to optimize the performance of arterial roadways through signal operations improvements and performance monitoring.
5. **Traveler information –** to provide real time, multi-corridor and multimodal travel information to enable pre-trip and in-route trip planning.
6. **Commercial vehicle/freight –** to manage and support freight mobility.
7. **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/pedestrian programs.

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

Innovation and Transportation Technology Program Activities

Funding for the Innovation and Transportation Technology program will become available per Code of Virginia § 33.2-1531 which established the Innovation and Transportation Technology Fund (ITTF). One million seven hundred thousand dollars from the Smart Roadway Technology program was used to begin developing design plans for various projects and to begin installing traffic monitoring equipment at the I-64 Mercury Boulevard interchange.

Besides using the Smart Roadway Technology funding, VDOT advanced several transportation technology projects using other funding sources. The activities by technology program strategy are as follows:

Operations Traffic Management

- **I-66 Active Traffic Management –** Installed lane control signs, traffic surveillance cameras, Dynamic Message Signs (DMS), traffic detectors, and ramp metering upgrades on various portions of I-66 between the District of Columbia and US 29 in Gainesville. This system will enable VDOT to manage specific travel lanes to reduce the impact of incidents and improve travel flow. This system became operational in September 2015.
- **Active Traffic and Safety Management Systems –** Awarded two design-build contracts to deploy Active Traffic and Safety Management Systems, which include surveillance and enhanced traveler information systems to manage traffic and weather events on I-77 at Fancy Gap Mountain and I-64 at Afton Mountain.
- **I-395 Ramp Metering –** Completed design plans to upgrade ramp metering capabilities at feeder ramps to I-395 to improve traffic flow in merge areas.

Incident and Emergency Response

- **I-64 Mercury Boulevard Interchange Monitoring –** Expanded traffic monitoring capabilities at one of the busiest interstate interchanges in Hampton Roads.
- **I-77 Fancy Gap Traffic Surveillance –** Installed and integrated 23 new cameras along I-77 on Fancy Gap Mountain, an area with frequent weather incidents.
- **Camera Integration –** Provided connections to integrate 143 cameras from local jurisdictions to improve situational awareness at VDOT's Traffic Operations Centers and through 511 Virginia.
- **I-95 Traffic Surveillance and Traveler Information –** Started the development of engineering plans to provide greater traffic surveillance and to provide traveler information along I-95 between Richmond and Northern Virginia.

Multimodal Travel Promotion

- **I-95 Multimodal Trip Planning** – Expanded trip planning capabilities on 511 Virginia by including information on general purpose travel lanes, express travel lanes, and multimodal options in Northern Virginia.

Arterial Highway Management:

- **Arterial Monitoring –** Developed a master plan for arterial highway traffic camera placement that enable engineers to identify issues regarding signal timing, verify improvement strategies, and enable integrated corridor management. Additional benefits include verification of snow removal operations progress and traveling public access to road condition via 511 web and smart phone applications. Completed design plans to deploy 15 traffic cameras on arterial corridors.
- **Adaptive Signal Control and Pilot Deployment –** Identified multiple adaptive signal control technologies for use in Northern Virginia to improve corridor throughput through improved traffic light synchronization. Evaluated the Adaptive Signal Control Technology pilot project that was deployed at 113 intersections across 13 corridors. A 17% reduction in crashes was noted.
- **Real-time, Advance Signal Control** – Two VDOT Regions have installed advanced traffic signal controllers to measure the performance of signal and corridor operations.

Traveler Information:

- **Travel Time Signage:** Installed 7 new signs to provide real time travel information for alternative routes between Virginia Beach and Richmond and travel to the District of Columbia.
- **Traveler Information Data Expansion –** Obtained additional sources of traffic data to be able to provide real travel information for additional arterial highways.

Commercial Vehicle / Freight:

- **Truck Parking Information System –** Participated in a pilot project with the I-95 Corridor Coalition to provide real time truck parking information to improve safety.

Conduct Emerging Technology Research:

- **Connected and Autonomous Vehicles –** In partnership with the Virginia Tech Transportation Institute (VTTI), VDOT established the Virginia Connected Corridors (VCC) program, which includes a connected-vehicle (CV) Test Bed in Northern Virginia with over 50 roadside units to allow researchers to conduct CV research. Virginia continues to lead the national Connected Vehicle Pooled Fund Study, where peer DOTs identify and address challenges and solutions related to CV deployments.

Technology Infrastructure:

- **Fiber Optic Communication Expansion –** Developed design plans to provide fiber optic communications to transportation devices along I-95 in downtown Richmond and to

connect VDOT's Northwest Region Transportation Operations Center to the shared resource fiber network.

Improving Incident Management

Incident Management Program Strategies

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

- coordinating incident planning and training activities
- detecting and verifying incident 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

Specific strategies to support VDOT's roles include:

- **Develop Traffic Incident Management (TIM) programs** – The TIM program promotes a coordinated response among the different individuals and agencies. Coordinated responses support safer and quicker incident clearances to reopen travel lanes faster.
- **Provide Real Time Traffic Information –** Providing information about active incidents enables motorists to consider alternate routes which reduces traffic demand at the scene. Reduced traffic demand can prevent secondary crashes and provides a safer work area for the responders. There are 582 message signs across Virginia's interstates and arterial route to provide real time traffic information.
- **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. The SSP can assist changing flat tires, providing one gallon of fuel, directions, and traffic cones & message boards to provide traffic control. Highways that begin using SSP services experience a reduction in incident lengths. At this time, there are 47 patrols across Virginia providing 735 center lane miles of coverage.
- **Develop Towing and Emergency Relocation Programs –** By having an "instant tow" program, an incident's length is reduced by eliminating the time waiting for resources to arrive. With an "instant tow" concept, a towing services and law enforcement are dispatched simultaneously. The towing service no long waits for law enforcement to first verify the call. This process can reduce the incident length by 15 to 40 minutes.

- **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. Such resources include but are not limited to portable message signs, absorbents, sand, sweepers, loaders, crash attenuators, etc.
- **Defer Incident Cleanup to Off-Peak Hours –** In accordance with Code of Virginia § 46.2-1212.1, reasonable and prudent options to open a travel lane 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.
- **Provide Traffic Queue Warnings –** A vehicle and/or signage can warn motorists about an approaching traffic backup to prevent secondary collisions.
- **Detour Route Planning –** Alternative routes allow for continued mobility. Planning activities 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.

Incident Management Improvement Activities

In the past year, VDOT has increased the focus of incident management activities. VDOT has established a Business Plan goal to reduce the median incident duration time by 5 minutes in 5 years. Each quarter, the progress towards reaching this goal is reviewed in order to develop activities to improve the incident management program. These activities are discussed below:

<u>Develop Traffic Incident Management (TIM) Programs</u>

- Promote further development of area Traffic Incident Management meetings.
- Continue supporting TIM interdisciplinary training with all responders. Over 9,800 responders have attended TIM training. Virginia has the second highest TIM participation in the nation.
- Developed web-based TIM training to promote additional training opportunities.

<u>Provide Real Time Traffic Information:</u>

- Installed additional message signs along I-66 in Northern Virginia, I-64 on Afton Mountain, and I-77 on Fancy Gap Mountain to provide real time traffic information.

<u>Provide Safety Service Patrols</u>

- SSP routes have been modified to provide greater coverage of high incident events across Virginia focusing on peak periods and high incident areas.

<u>Develop Towing and Emergency Relocation Programs</u>

- Piloted an instant tow program on the Hampton Roads Bridge Tunnel during the peak summer travel periods.
- Developing three additional pilot quick clearance programs in the greater Richmond, Staunton and Roanoke areas.

Augment On-Scene Recovery Resources:

- Augmented on-scene recovery resources are implemented as appropriate.

Defer Incident Cleanup to Off-Peak Hours

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

Provide Traffic Queue Warnings

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

Detour Route Planning

- VDOT is developing and updating freeway traffic incident diversion plans across Virginia. This effort is a multi-year, multi-phase plan. Plans have been completed for:
    - I-64 between mile markers 200 (Richmond) to 273 (Virginia Beach).
    - I-66 between mile marker 40 to the District of Columbia.
    - I-95 between mile markers 104 (Hanover) and 170 (Beltway).
    - I-395 (entire route).
    - I-495 (entire route).

III.
Collaborating with the Private Sector

III.1 Collaborating with the Private Sector Overview

VDOT continues to outsource and privatize where supported by good business practices. More than half of VDOT's FY 2015 spending was with private sector vendors. This section summarizes VDOT's spending with the private sector and its ongoing efforts to be more efficient by working with the private sector while maintaining management oversight to help ensure effective delivery of services. This section also provides a summary of revenue generated from asset sales and leases.

III.2 VDOT Spending with the Private Sector

VDOT expenditures in FY 2015, excluding debt service and transfer payments, totaled $3.25 billion, of which $2.67 billion was with the private sector. Total agency expenditures were $4.93 billion. Included in the $2.67 billion of private sector spending was the outsourcing of over $278 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 2015, VDOT solicited bids for the management and maintenance of four new BIMS contracts. Three contracts were for Northern Virginia and one was for Fredericksburg. They were awarded by the CTB in January 2015 and commenced April 1, 2015. In FY 2015, the contract for the Woodrow Wilson Bridge was renewed through June 30, 2017. The annual value of the 9 BIMS contracts currently in place is approximately $34 million.

Safety Rest Areas and Welcome Centers

VDOT continues to administer property management contracts for the 24 hour, seven days a week staffing, preventative maintenance and repair of 43 Safety Rest Areas, and Welcome Centers (SRA/WC).

Regional Traffic Operations Centers

High-level screening of this project determined that services needed could be procured under the Virginia Public Procurement Act. The procurement was advanced by VDOT with assistance from the then Office of Transportation Public-Private Partnerships (OTP3), now known as the Virginia Office of Public-Private Partnerships. The CTB awarded the contract to Serco Inc. in

May 2013 for operation of the Transportation Operations Center and Statewide Advanced Traffic Management System at the state's five transportation operations centers and management of the Safety Service Patrol. At the time of award the six-year contract was worth $355 million.

III.3 Project Delivery Utilizing Transportation Public Private Partnerships

VDOT has identified advancing public private partnerships as an important component in pursuing the Department's Business Plan. In FY 2011, the Office of Transportation Public-Private Partnerships (OTP3) was created to facilitate the Commonwealth's Public-Private Transportation Act (PPTA) program across all modes of transportation. In 2014, the OTP3 was renamed as the Virginia Office of Public-Private Partnerships (VAP3). The VAP3 has facilitated the development of several PPTA projects since its creation and continues to work with VDOT's private sector partners to advance on-going and proposed PPTA projects.

Public Private Partnership projects completed and/or open to traffic:

1. I-495 Capital Beltway Express Lanes – Working with private sector partners Transurban/Fluor, this $1.9 billion project opened to traffic in November 2012. Nearly $1.5 billion in private equity and debt, combined with state investment of $409 million, added 14 miles of new high occupancy toll lanes with open road tolling, congestion pricing and high occupancy vehicle (HOV) lanes. The project supported 31,000 short and long term jobs, and infused an estimated $3.5 billion into the economy. The project also awarded over $545 million to small and disadvantaged businesses, the largest single project award in Virginia's history.

2. I-95 Express Lanes – Working with private sector partners Transurban/Fluor, this project, opened to traffic in November 2014, adding 29 miles of new high occupancy toll lanes with open road tolling and congestion pricing, including nine additional miles of HOV lanes into Stafford County. The project reached commercial/financial close in July 2012. A state contribution of $71 million leveraged a total project valued at $925 million. The project supported over 8,000 jobs, infused nearly $2 billion in economic activity, and awarded $191 million specifically to small and disadvantaged businesses.

Public Private Partnership projects under construction:

1. Midtown Tunnel / Downtown Tunnel / MLK Extension - Working with private sector partners Macquarie/Skanska, this P3 transaction reached financial close in April 2012 with construction completion scheduled for 2018. An initial state contribution of $ 309 million, combined with private sector investment, leveraged a total project valued at $2.1 billion, including a new immersed tube tunnel facility at the Midtown crossing, tunnel rehabilitation at the existing Midtown Tunnel and two Downtown Tunnels, as well as development of Martin Luther King Boulevard Extension to I-264. The project supports an estimated 1,700 jobs during construction with approximately $300 million in work to be awarded to small and disadvantaged businesses. In 2014, the Commonwealth increased the state investment in the

project to a total of $581 million. This project was awarded The "North American Toll Road Project of the Year 2012" by Project Finance. Roads and Bridge magazine named the project the No.1 Road Project in North America for 2014.

2. Coalfields Expressway - From its origins in an agreement executed in 2002, the Commonwealth, in 2006, began working with private sector partners Alpha Natural Resources and Bizzack, Inc. (formerly Rapoca Group) to advance the coal synergy concept. The project has since advanced planned sections of new roadway using coal synergy and large-scale earth-moving techniques to extract the coal, while leaving a road bed suitable for paving as funds become available. This innovative partnership with coal companies will allow Virginia to advance the project using coal synergy innovation for $2.8 billion, contrasted to an estimated cost of $4.1 billion using traditional road building methods without the coal synergy savings. Segments of Hawks Nest, Pound Connector and Doe Branch are currently underway, and negotiations for the Poplar Creek section are underway. During construction, the Project is estimated to create approximately 29,000 construction jobs over 17 years and $4.1 billion in economic impact. 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 2015, Alpha Natural Resources, a party to the P3 comprehensive agreement, filed for bankruptcy protection under Chapter 11. VAP3 and VDOT, in consultation with the Virginia Office of the Attorney General, and outside counsel, are examining legal and available options for next steps and understanding of implications of rights and obligations as well as impact to the Project.

3. Route 58 – VDOT is working with private sector partners Branch Highways on the next section of Route 58, referred to as the Tri-County (3.2 miles) and Laurel Fork (5 miles) sections. Work on the entire 8.2-mile section is expected to be completed by fall 2015. The contract for Route 58 closed in December 2003 and has a total project value of approximately $222.75 million. Phase 1 was completed in 2006, and Phase 2 was completed in 2011. Phase 3 is currently under construction. Phase 3 includes an eight-mile Laurel Fork/Tri-County Project in Carroll, Floyd and Patrick Counties, to be completed by December 2015.

4. Route 28 – This project reached close in 2002 with state funds and revenue bonds backed by the Route 28 Tax District to finance high capacity interchanges and widening projects in Fairfax and Loudoun Counties valued at $351 million. Working with private sector partners Clark/Shirley, construction has been completed at Innovation Avenue Interchange and Atlantic Boulevard. A number of bridges over Dulles Toll road were under construction by late 2013. Additionally, the Route 28 project scope included widening Route 28 to eight (8) lanes and constructing secondary road improvements on Centreville Road (complete), Atlantic Boulevard (under construction), Loudoun County Parkway (complete), Davis Drive (complete) and two (2) sections of Pacific Boulevard (complete).The partnership will continue to plan, develop and construct improvements in the corridor.

For illustrative purposes, Figure 41 shows the benefits associated with just three PPTA projects that have helped Virginia leverage over $4.925 billion in critical transportation infrastructure improvements with a state investment of $983 million. For 20% of the total project costs, Virginians are, or shortly will be, driving on these facilities and seeing new jobs, over $5 billion in economic growth, and increased travel choices.

Figure 41: Summary of Economic Impact of Selected PPTA Projects

Projects	Project Cost	State Investment	% of total cost	Jobs Supported	Economic Activity
495 Express Lanes	$1.9 billion	$409 million	22%	31,000	$3.5 billion[18]
95 Express Lanes	$925 million	$71 million	7.6%	8,000	$2 billion[19]
Midtown Tunnel / Downtown Tunnel / MLK Extension	$2.1 billion	$581 million	28%	1,700	$170-$254 million[20]
Total	**$4.925 billion**	**$1 billion**	**20%**	**40,700 jobs**	**$5.754 billion economic activity**

Public Private Partnership projects under procurement:

1. **I-66 Corridor** (Outside the Beltway) – Transform66 Corridor Improvements (VDOT/VDRPT; Northern Virginia District): in cooperation with VDOT and the VDRPT, VAP3 is advancing a combination of multimodal improvements that include 2 managed lanes in each direction, 3 general purpose lanes in each direction with auxiliary lanes where needed, enhanced bus service, park and ride lots with direct connections to managed lanes, and operational improvements to the general purpose lanes.

   The candidate project High-Level Screening Report (May 3, 2013) and Detail-Level Screening Report (June 21, 2013) were accepted by VDOT to advance the project into the development phase. On August 14, 2015, the Initial Finding of Public Interest was signed by the Commissioner of Highways and presented to the Transportation Public-

[18] Stephen Fuller, *Economic Impact of Construction Outlays for the Capital Beltway HOT Lanes*, George Mason University, November 2008.
[19] Virginia Economic Development Partnership – Sept. 28, 2011 IMPLAN Model Results; *Economic Benefits of Road Improvement of I-95 Toll Revenues,* Chmura Economics and Analytics, 2012 (10 projects, include HOV extension); *Population and economic projection of I-95*, Chmura Economics and Analytics, 2012.
[20] See "Downtown Tunnel/Midtown Tunnel/MLK Extension Project," presentation to the Hampton Roads Transportation Planning Organization by Frank Fabian, Virginia Department of Transportation, January 4, 2012, citing the Hartgen Group.

Private Partnership Advisory Committee on August 17, 2015 for a resolution that proceeding via PPTA procurement is in the public's best interest. VDOT distributed a request for qualifications (RFQ) and after receiving statements of qualifications from the private sector in response to the RFQ, VDOT decided to advance a design, build, finance, operate and maintain delivery alternative. A draft Request for Proposals was distributed to three shortlisted teams in December 2015. VDOT anticipates achieving commercial close on the project not later than October 31, 2016.

P3 projects under Development:

1. Air Rights (VDOT; Northern Virginia District & statewide) - in collaboration with VDOT and Arlington County, the VAP3 completed a High-Level Screening on August 27, 2012 and a Detail-Level Screening on June 7, 2013 that considered the desirability and feasibility of this project for possible procurement as a P3 project. The VAP3 has completed both high-level and detail-level screening that considered the desirability and feasibility of this project for possible procurement under the Public-Private Transportation ACT (PPTA) of 1995 as amended. Subsequently, it was determined that procurement of this project would be pursued as provided for in the Code of Virginia § 33.2-226.

VAP3, in coordination with VDOT, is exploring ways to maximize the value of existing public assets by making selected Air Rights available for development in and around transportation facilities in the Commonwealth. By leasing Air Rights to private developers, the Commonwealth may establish a revenue stream to fund future transportation projects or generate value for transportation improvements.

A Request for Information (RFI) was released pursuant to the VPPA to seek private sector input to confirm the development communities' interest and feasibility. Respondents indicated significant interest, with potential value returned to the Commonwealth. The Request for Qualifications has been released and responded to in October; it is anticipated the decision regarding scope and procurement vehicle may be made by VDOT in late 2015 or early 2016.

2. Solar Energy Development (VDOT & the Virginia Department of Mines, Minerals and Energy) – in cooperation with VDOT, the Department of Mines, Minerals, and Energy and the VAP3 has developed this conceptual P3 project into the Solar Energy Development project. The candidate P3 project presents an opportunity to optimize the use of state-owned property, raise additional monies and become more environmentally responsible. Potential land lease collections, electricity savings and/or revenue sharing provisions are possible sources of value that can be captured from the project. VDOT, as well as other Virginia agencies, administer a variety of state-owned properties and real estate parcels (sites) across Virginia. Solar energy systems can be placed on a variety of sites. VDOT sites could include, but are not limited to: rooftop solar systems; ground mounted solar systems on underutilized space; solar canopies over park and ride lots; and solar sound barrier walls.

The High-Level Screening Report was completed by VAP3 and accepted by VDOT on July 18, 2014. VAP3 issued a Request for Information (RFI) on January 15, 2015 to determine private sector interest in the project. The Detail-Level Screening Report was completed by VAP3 and accepted by VDOT on June 1, 2015.

P3 Projects undergoing Screening for Development as P3s:

1. Broadband within Right of Way (VDOT; Statewide) - Virginia operates the third largest state maintained highway system in the country. The ROW associated with the highway system presents opportunities for the location of communication infrastructure to provide enhanced capabilities in the operation of highway networks and to provide additional communications connectivity. Advances in communications technology has seen greater demand and use made of both cabled (fiber optic) and wireless forms of communication. The High-Level Screening Report was accepted by VDOT on September 3, 2014 and the Detail-Level Screening will be completed in late 2015 or early 2016.

2. Increased Cell Tower coverage (VDOT; statewide) – VAP3 is exploring the feasibility of expanding the cell tower program on VDOT right of way. Effectively expanding the current VDOT-administered Shared Resources Communications Facility arrangements for the deployment of cell towers on VDOT right of way under a P3 delivery model, has the potential to serve the public need and provide public benefits.

Engaging a private sector partner to finance, install, market, manage, operate and maintain cell towers may have the potential to generate substantial additional revenue for VDOT, increase the value and maximize the use of state-owned property, increase connectivity, and expand wireless communications capacity throughout the Commonwealth. A High-Level Screening was completed on August 22, 2015.

Appendix A
VDOT's Asset Management Process

Appendix A provides a detailed summary of the methodology used to determine maintenance and operations needs within the context of VDOT's asset management processes.

1. Definitions

1. Asset Management Process

Asset management process is a systematic process based on economic, engineering and business principles that monitors the performance of transportation assets. It utilizes accurate data for managing various assets within the transportation network and aides in making 'informed decisions' about managing your network over the assets entire lifecycle as it relates to network performance. One major focus of the asset management process is improving decision-making strategies for resource allocation purposes within the transportation infrastructure framework.

2. State of Good Repair

A state of good repair refers to a desirable operating condition of an asset or system. State of good repair requires timely repair and replacement to be performed on assets, that is, maintenance be performed at critical midlife points and replacements be performed at the end of their useful lives.

According to the Code of Virginia § 33.2-369, the state of good repair refers to the reconstruction and rehabilitation of structurally deficient bridges and the reconstruction of pavements.

3. Pavement Condition

Each year, pavement condition data is collected on the entire interstate and primary systems and approximately 20 percent of the secondary network. The annual pavement inspection which generally takes place during late fall through winter, uses automated and nationally recognized state of the art data collection equipment. The data collected are processed and interpreted according to the methods detailed in the VDOT Pavement Distress Identification Manual and are summarized to produce the Critical Condition Index (CCI).

CCI values are presented on a scale of 0 to 100 with 100 being a pavement with no visible distress. As shown below in Figure 42, CCI values are grouped into five ranges corresponding to pavement condition categories: excellent, good, fair, poor, very poor. In general, pavement sections rated with a CCI value below 60 are considered 'deficient' and should be further evaluated for maintenance and rehabilitation activities. Pavement sections with CCI of 60 or above are considered 'sufficient'.

Figure 42: Pavement Condition Category Based on CCI

Pavement Condition	Index Scale (CCI)
Excellent	90 and above
Good	70-89
Fair	60-69
Poor	50-59
Very Poor	49 and below

4. National Bridge Inventory (NBI) and Non National Bridge Inventory (Non-NBI)
NBI includes bridges on public roadways exceeding 20 feet in length. The NBI also includes large culverts with a width (as measured along the centerline of the roadway) greater than 20 feet. Federal regulations require NBI structures to receive detailed inspections at regular intervals not exceeding 24 months.

Non-NBI includes: bridges measuring 20 feet or less in length and large culverts having an opening of 36 square feet or greater with a width (as measured along the centerline of the roadway) of 20 feet or less. VDOT policy requires that non-NBI bridges be inspected at intervals not exceeding 24 months and non-NBI culverts be inspected at intervals not exceeding 48 months.

5. Structure Condition
VDOT defines structure conditions by identifying structurally deficient structures using FHWA's criteria.

VDOT's global performance measure for structures is based on the percentage of Structurally Deficient (SD) structures in the Department's inventory. VDOT's goal is to have no more than eight (8%) percent of the structure inventory rated as SD. The number of SD structures in the VDOT NBI/non-NBI inventory at the end of FY 2015 was 1,310 (6.2%), of which 949 are NBI structures. During FY 2015, the percentage of SD structures was reduced by 0.69% (using number of structures) or 0.43% (using deck area of structures). Nationally, 10.0% of the NBI structures are SD as of December, 2014.

A structure is defined as SD if one or more of its major components (deck, superstructure, substructure, or culvert) is deficient which requires the structure to be monitored and/or repaired, or if it lacks adequate strength or waterway clearance. When one or more of a structure's major components have a General Condition Rating (GCR) of four (4) or less it is defined as an SD structure. The GCR is a nationally established numerical grading system with values that range from 0 (failed condition) to 9 (excellent condition). GCRs are assigned to each major component of each structure during regular inspections and are reported in inspection reports.

6. Needs Assessment
Needs refer to funding required for an asset or infrastructure system to achieve and/or sustain a state of good repair over time. It also accounts for the issue of how to set priorities by asset class and activity if funds are limited.

Unconstrained Needs
100% needs are unconstrained needs that include (1) cost to correct deteriorated pavements and structurally deficient structures (to achieve state of good repair). This requires reconstructing and rehabilitating structurally deficient bridges and to reconstruct pavements determined to have a combined condition index of less than 60; (2) costs to cover preventive, corrective, and restorative maintenance on the sufficient pavement and restorative maintenance on bridges.

Needs to reach performance targets
These are the costs to achieve pavement and bridge performance targets by districts in FY 2017.

Needs to maintain steady state
These are the costs to maintain assets at a steady state once performance targets for pavements and bridges are achieved.

Other service and repair needs
These are costs to maintain and operate other essential assets and services

2. Methodology to Determine Paving Needs

VDOT currently maintains 127,246 total lane miles of network. Each year, 100 percent of the interstate and primary system mileage and approximately 20 percent of the secondary system mileage is inspected and rated. The data collected are used to produce the Critical Condition Index (CCI). CCI values are then used to determine pavement condition ratings of excellent, good, fair, poor and very poor. In general, pavement sections with a CCI value below 60 (poor and very poor) are considered 'deficient' and should be further evaluated for maintenance and rehabilitation activities. Pavement sections with a CCI value of at least 60 (fair or better) are considered 'sufficient'.

The pavement condition data are an important input to develop estimates of pavement maintenance and rehabilitation needs through an optimization analysis. In this report, two types of pavement needs are presented: 1) needs to reach pavement performance targets; and 2) unconstrained pavement needs (or unconstrained needs) for maintenance and rehabilitation activities to correct existing conditions.

a. Needs to Reach Pavement Performance Targets

Performance target based needs are estimated costs to perform different categories of maintenance work to achieve pavement performance targets by districts. VDOT has three performance measures for pavements. The performance goals are:

- Interstate - 82% in sufficient (fair or better) condition
- Primary - 82% in sufficient (fair or better) condition
- Secondary - 65% in sufficient (fair or better) condition

Needs for four categories of maintenance work are assessed for pavement assets: preventive maintenance (PM), corrective maintenance (CM), restorative maintenance (RM), and reconstruction (RC).

Interstate and Primary Pavement Needs

To develop the Interstate and primary pavement needs, the pavement condition data are loaded into the Pavement Management System (PMS) which then optimizes the selection of pavement maintenance activities on the Interstate and primary network. These needs estimates are provided through a process called multi-constraint optimization analysis, which develops an optimal work plan (a series of pavement maintenance activities applied to specific sections on the total network) to achieve a single objective (minimizing cost) against multiple condition-based constraints (performance targets) in a given year of the total six year analysis.

Secondary Pavement Needs

Secondary system hard surface pavement needs are derived by multiplying the number of lane miles in inventory by a "best estimate" deterioration rate to estimate the number of lane miles that will be in different maintenance categories in the next period if no treatments are applied. The deterioration rates represent the percent of lane miles that are expected to move into a maintenance category annually. The change in lane miles in each maintenance category from one period to the next represents the number of lane miles that must receive treatments in order to maintain the same distribution in condition over time. The distribution of condition can be changed from one period to the next by increasing or decreasing the recommended number of lane miles receiving each treatment type.

Using deterioration rates, the number of lane miles in each maintenance category/pavement type, and the unit cost of each treatment type, the needs to maintain or improve the current condition of the hard surfaced secondary pavement from one year to the next are calculated using the following formula:

$$SPaveNeeds^{j+1} = \sum_i Inventory_i^j * (Deterioration\ Rate_i^j + Improvement\ Rate_i^j) * Unit\ Cost_i$$

Where:

- $SPaveNeeds^{j+1}$ = Cost of treatments necessary to maintain the condition of Secondary hard surfaced pavement from period *j* to period *j+1*
- $Inventory_i^j$ = lane miles in maintenance category *i* in period *j*.
- $Deterioration\ Rate_i^j$ = percent of lane miles in period *j* that are expected to drop into a maintenance category *i*
- $Improvement\ Rate_i^j$ = percent of lane miles in period *j* that are required to improve in order to meet performance goals. Improvement rates vary by district depending on paving condition and any remaining gaps in funding needed to reach the district's performance goals.
- $Unit\ Cost_i^j$ = the unit cost of treatment for maintenance category *i* in period *j*.

The summation, $\sum_i$, is across all combinations of pavement types (plant mix and non-plant mix) and maintenance treatments (PM, CM, RM).

Other Added Factors

Pavement needs account for maintenance of traffic (MOT), Construction Engineering Inspection cost (CEI) and contingency along with a number of other added costs, including needs for ramp, patching prior to paving, paving related traffic engineering asset work, and the pavement portion of Turnkey Asset Maintenance Services (TAMS) contract costs. Specifically,

- Ramp needs were reported in the CY 2014 needs assessment. They were determined as 15% of the Interstate mainline hard surface needs.

- Patching prior to paving needs was reported in the CY 2014 needs assessment. They were determined as 10% of the mainline hard surface needs for Northern Virginia district and 7% for the rest of the state

- Paving related traffic engineering items such as pavement markings, guardrail, rumble strips, and signal loops affected by pavement treatments, etc., were not included in the pavement needs analysis. Needs for these assets are accounted for through their own needs analysis.

- Starting from CY 2014, needs for paving related traffic engineering assets were reported separately from the rest of asset needs. Needs for paving related traffic engineering items were determined based on estimated mileages of paving to be treated and assumptions regarding the frequencies or quantities of traffic assets to be affected or replaced as result of the paving projects. The details are discussed in the traffic asset needs documentation.

- Needs for TAMS covered paving work are determined based on contract values. In order not to double count interstate pavement ordinary maintenance needs, tasks assumed to be covered by the TAMS scope are excluded.

b. Unconstrained Pavement Needs

Pavement condition data are also used to feed the maintenance decision trees to determine the unconstrained maintenance needs for the pavement assets. Unconstrained needs analysis establishes the maintenance and rehabilitation needs to appropriately correct the existing pavement conditions assuming funding is not a constraint. It provides an idea of the amount and type of work needed on the whole network. To determine the needed treatment for a particular section, the decision trees are used in conjunction with distress quantity and severity, and the condition index as inputs from the condition data. Also, traffic level, structural condition, and maintenance history are provided as additional inputs wherever these are available for the selection of treatment. Unconstrained needs are also used in many cases as the first indicator of the needed treatment which is further refined by field inspections, detailed project level analysis, overall needs of the network and available budget.

3. Methodology to Determine Bridge Needs

Bridge needs include needs for the following two types of assets

- Bridge and large structures

- Non-structure portion of movable bridges

a. Bridge and Large Culvert Structures

As of CY 2015, VDOT is responsible for the inventory and inspection of 21,084 structures (bridges and large culverts) across the Commonwealth's roadway systems. Of these structures, VDOT is responsible for the maintenance of 19,466, while localities and private owners (Non-VDOT) maintain the other 1,618. Statewide, there are 13,467 structures that are part of the NBI, the vast majority of which are maintained by VDOT.

The needs for the statewide bridge program are analyzed and developed to include two types: (1) costs to meet bridge performance goals; and (2) funding required to replace all structurally deficient structures and to repair remaining structures.

Needs Based on Meeting Bridge Performance Goals

VDOT reports performance based needs for the amount of money required to meet its performance goals. The bridge performance target is for 92 percent of structures to be in fair or better condition. The target is further broken down as the follow:

- Interstate - 97 percent in fair or better condition (not structurally deficient)
- Primary - 94 percent in fair or better condition (not structurally deficient)
- Secondary - 89 percent in fair or better condition (not structurally deficient)

VDOT reports performance based needs for the following categories:

- Bridge inspection
- Planned Preventive Maintenance (PPM)
- Restorative Maintenance (RM)
- Major Rehabilitation and Full Replacement
- Special Structures Maintenance
- Hauling Permit

Bridge Inspection needs

Safety inspection activities are performed at the district level by both state forces and consultants and cost estimates for inspection activities are developed annually by each district based on projected quantity of structures due for inspection and the cost to perform the inspection. Inspection needs also include costs for safety inspections on VDOT maintained tunnel facilities.

Planned Preventive Maintenance (PPM)

PPM is a general term for maintenance tasks that slow deterioration and prolong the life of a maintainable structure. It includes any planned activity performed in advance of a need for repair or in advance of accumulated deterioration so as to avoid such occurrences and reduce or arrest the rate of future deterioration. It does not include corrective repairs to existing damage. The activities, however, may correct minor defects as a secondary benefit. Preventive maintenance is: 1) planned, 2) cyclical, and 3) not condition-based. Examples of PPM include: joint replacement, deck washing, drain cleaning, thin-bonded deck overlays, vegetation removal, bearing cleaning and spot or zone painting. Ideally, these tasks should be

performed at regularly scheduled intervals. PPM is performed on bridges with GCR of six or more and is an important investment in the life of existing assets.

The approach to assessing PPM needs begins with a set of criteria used to identify which bridges are candidates for PPM. The number of bridge components meeting the requirements for treatment across all bridges meeting the selection criteria are summed by system and by district, and then multiplied by the unit cost of PPM. Finally, a frequency factor was applied that represents the fraction of the candidates that should be treated each year in order to ensure PPM treatments occur on every bridge with fixed regularity.

As an example, if District "A" has 1000 LF of pourable joints meeting the selection criteria, pourable joints cost an average of $68.74/LF to replace and they should be replaced every 6 years, the annual preventive maintenance need for pourable joints for District "A" would be determined as follows:

(1000 LF * $68.74/LF)/6 year frequency = $11,457)

Restorative Maintenance (RM)

RM tasks are performed to repair damaged bridge elements and thereby restore or improve their condition. Restorative maintenance tasks are recommended for bridges in fair or satisfactory (GCR 5 or 6) condition. These tasks are performed on an as-needed basis based on field inspections.

Although it is ideal for all the identified structures to receive RM, only a portion of the list can receive RM due to funding limitation. VDOT applies a performance target in order to determine the target number of structures to receive RM in each district, that is 6% of fair structures (with minimum GCR of 5) and 2% of structures with minimum GCR of 6 in each district should be improved each year.

Once the number of structures to receive RM is determined, the most important structures out of the list Pontis recommended for RM are selected in each system for estimation of needs. Structure importance is determined with an Importance Factor formula that provides a relative ranking of all structures in the inventory based on factors such as traffic volume, and access impacts.

Major Rehabilitation and Full Replacement

Replacement and rehabilitation (replacement of one or two major components such as deck and superstructure) needs are computed by determining the number of structures that require replacement or rehabilitation. This is done by comparing the number of poor structures with the performance targets for each highway system, that is, 92% of the entire inventory not structurally deficient and 97% of the interstate bridges, 94% of the primary bridges and 89% of the secondary bridges not structurally deficient.

The needs effort begins by determining the number of structures that need to be rehabilitated or replaced in order to meet these targets by the end of the fiscal year. This number is based on the projected number of SD structures at year's end less the allowable number per the

above-mentioned targets, less the number of bridges that will be taken out of SD status due to VDOT's construction and maintenance efforts.

Using the list of specific bridges and the recommended actions for each bridge a square foot unit cost for each structure requiring work is applied based on the nature of the work required. The unit costs for each work action are developed from bid prices from the previous year(s) with appropriate multipliers applied. The square footage of each structure is determined by using the current deck area as listed in the inventory and adding a "growth factor" for replacement projects under the recognition that replacement structures are generally significantly larger than the original structure that is being replaced.

The decision to replace a bridge rather than undergo a major rehabilitation or repair is based on the net present value of the cost of rehabilitation or repair and projected future maintenance expenses versus the net present value of the cost to replace the bridge.

Special Structure Needs

Starting with the CY 2015 needs assessment, the needs for a small group of special structures are reported separately. These are structures that are important, older and generally very large. For CY 2016 needs assessment, a list of those structures was identified to be addressed within FY 2017 based on structure condition and agency priority. Needs were then determined based on the condition states of the specific structures, action required and estimated costs to perform the needed actions. VDOT is currently assessing the needs and strategies to address the maintenance and replacement requirements associated with special structures that are approaching the end of their service lives. This may lead to considerable investment in the future.

Hauling Permit Needs

These are VDOT's staffing needs to perform hauling/overweight vehicle permit analysis. In addition, VDOT performs route analyses for all structures crossed by all overweight single trip permit vehicles. This includes load rating analyses for the vehicles. Hauling permit needs were determined based on personnel costs along with an additive to cover overhead costs. Currently, there are three full-time positions 100% dedicated to the program with support from two other positions.

Needs to Replace All Structurally Deficient Structures and Repair Remaining Structures

The performance based needs presented above do not represent the total funding required to improve all of the structures. Rather, VDOT reports needs for the amount of money required to meet its performance goals. VDOT has implemented performance goals that address structures in "good", "fair" and "poor" condition. The total funding required to improve all of the structures is considerably higher than the amount required to meet the above referenced performance goals.

b. Movable Bridges (Non Structure Portion)

A movable bridge is one that allows for passage of large boats or barges by lifting, swinging, or turning thus providing additional vertical clearance between the waterway and the bridge deck. VDOT has eight movable span bridges across the state; five in the Hampton Roads area and

three in Central Virginia. A ninth bridge, the Woodrow Wilson Memorial Bridge which spans the Potomac between Virginia and Maryland, is under joint operation between the two states. VDOT is only responsible for utilities for Woodrow Wilson Memorial Bridge. Movable bridge needs are divided into three separate categories: overarching program needs, fixed cost needs, and facility project needs.

Overarching Program Needs

Overarching program needs are assigned to the Central Office, which has programmatic oversight for all special facilities. Included in this category is the development of Emergency Response Plans (ERPs) for movable bridges. The overarching movable bridge needs are recommended improvements based on the latest movable bridge risk assessment.

Fixed Cost Needs

Fixed cost needs include personnel, overhead, equipment, materials, and essential services and contracts. Those needs are further broken down into preventative maintenance, corrective maintenance, movable bridge operations and project administration. The majority of the needs in the maintenance and operations categories are based on contract values. The remainder, including management and direction and utilities are based on budgeted positions and historical expenditures.

Facility Project Needs

Facility project needs were based primarily on the preliminary movable bridge risk assessment, along with some additional needs identified by the regions. Projects identified as "high-risk" in the risk assessment were given priority. High risk projects have a high probability of occurrence and/or moderate to severe impacts.

4. Methodology to Determine Needs for Other Assets or Services

Besides pavements and bridges, there are a wide range of essential transportation assets and services that must be maintained and improved for which condition data are not collected and performance targets are not established in the manner targets are set for pavements and bridges. These include but are not limited to 7 tunnels, 43 safety rest areas, 11 welcome centers, and 6 ferries in addition to assets such as sign assemblies, signalized intersections, guardrail and thousands of other highway assets in the VDOT maintained network. The costs to maintain and operate other essential assets and services are determined based on engineering principles and business practice or historical expenditures. A breakdown of methods used to determine needs for the various non pavement or bridge assets and service areas are provided below.

a. Tunnels

VDOT maintains and operates seven tunnel facilities. Figure 43 summarizes the names and locations of the tunnels. A 2012 Tunnels Baseline Assessment, Risk Analysis, and Investment Plan provides a high level review of operating conditions for all river and mountain tunnels. As part of the project, available inspection reports were reviewed and maintenance projects were recommended.

Figure 43: Virginia Tunnels

Tunnels	Route	Linkage	Year Constructed
Eastern Region			
Hampton Roads Bridge Tunnel (HRBT)	I-64	Hampton/Newport News to Norfolk/ Virginia Beach	
West Bound Lane (WBL)			1957
East Bound Lane (EBL)			1976
Monitor Merrimac Memorial Bridge Tunnel (MMMBT)	I-664	Hampton/Newport News to Suffolk /Chesapeake	1992
I-564 Runway Tunnel	I-564	Under runway at Norfolk Naval Station	1977
Elizabeth River Downtown Tunnel (DT)[1]	I-264	Norfolk and Portsmouth	
West Bound Lane (WBL)			1952
East Bound Lane (EBL)			1987
Elizabeth River Midtown Tunnel (MTT) [1]	Rt 58	Norfolk and Portsmouth	1962
Northern Region			
Rosslyn Tunnel	I-66	Arlington	1983
Southwestern Region			
Big Walker Mountain Tunnel (BWMT)	I-77	Bland to Wytheville	1972
East River Mountain Tunnel (ERMT) [2]	I-77	Rocky Gap, Virginia to Bluefield, West Virginia	1974
Extended Overpass Tunnel	US-460	Montgomery, under ramps near I-81 interchange	2002

[1] On July 13, 2012, VDOT transferred maintenance and operation of Elizabeth River Downtown Tunnel and Elizabeth River Midtown Tunnel to the Elizabeth River Consortium in a Public-Private Transportation Act project. VDOT maintains ownership of these facilities.

[2]East River Mountain Tunnel is jointly owned by Virginia and West Virginia. The facility is operated by VDOT.

Tunnel needs are divided into three separate categories: overarching program needs, fixed cost needs, and facility project needs.

Overarching Program Needs

Overarching program needs are reported under the Central Office, which has programmatic oversight for all special facilities. Included in this category is a ventilation analysis covering multiple facilities, development of training and inspection programs, and installation of a Computerized Maintenance Management System (CMMS). All overarching tunnel needs are part of the tunnel investment plan included in the Tunnels Baseline Assessment, Risk Analysis, and Investment Plan completed in March 2012. Due to funding shortages, implementation of the plan was delayed. The needs represent the FY 2017 Overarching Tunnels Projects plan contained in the Risk Analysis.

Fixed Cost Needs
Fixed cost needs include personnel, overhead, equipment, materials, and essential services and contracts.

Facility Project Needs
Facility project needs were based primarily on the tunnel investment plan included as part of the Tunnels Baseline Assessment, Risk Analysis, and Investment Plan along with some additional needs provided by the VDOT Operations Regions. Projects identified as "high-risk" in the Tunnels Baseline Assessment, Risk Analysis, and Investment Plan were given priority. High risk projects have a high probability of occurrence and/or severe to moderate impacts. The majority are associated with fire safety.

b. Emergency and Incident Response

Emergency and incident management needs include needs related to the operation of the traffic operations centers (TOCs), maintenance and operation of technology assets such as traffic cameras, electronic message signs, and other traffic management systems, as well as incident response and snow and ice operations.

Transportation Operations Centers (TOCs)
TOCs were created in order to enhance traffic flow and safety on Virginia's roadways. VDOT is responsible for centers in five geographic locations that monitor traffic conditions via cameras and other technology. TOCs are located in Northern Virginia (NOVA), Richmond, Hampton Roads (HR), Salem and Staunton. The five operations regions are responsible for the maintenance of these centers. The primary functions of the TOCs include:

- Regional traffic management and congestion management
- Incident management and emergency operations
- Intelligent Transportation System (ITS) device monitoring
- Traveler information

Also included in TOC operations are management of the Advanced Traffic Management System (ATMS) and the Safety Service Patrol (SSP) program.

An ATMS is a computerized transportation communication system that gathers data from the various ITS devices deployed in the field. The system enables the TOCs to detect traffic incidents and congestion rapidly, dispatch resources to the incident scene and smooth the flow of traffic. The ATMS is also able to disseminate real-time information to motorists using devices such as dynamic message signs, and highway advisory radio.

The SSP assists stranded motorists and provides traffic control during various incidents, including traffic accidents and road work. Services provided by the SSP include:

- Jump starts, tire changes, and water for overheating radiators
- One gallon of gas for motorists who have run out of fuel
- Access to a telephone to contact a wrecker service, directions and a state map
- Removal of roadway debris

- Limited first aid services

TOC needs consist of both TOC contract needs and internal VDOT needs. The needs are determined at the regional level.

TOC Contract Needs

VDOT manages TOC operations through contract services. TOC contract needs are determined at the regional and statewide program levels. TOC contract needs include seven components: TOC floor operations, statewide ATMS, SSP, program management and governance, ITS field maintenance, general support services (GSS), and innovative solutions. The first five components are considered core services (CS), or the services that must be performed and the remaining two are other services, which may be added to the contract through task orders.

VDOT Internal TOC Needs

Although a contractor is responsible for daily TOC operations, VDOT retains the responsibility for facility maintenance and overhead, program development and expansion and oversight of the statewide TOC programs. Internal needs are based on known salaries of personnel assigned to TOC programs, existing contracts, and historical expenditures.

At the statewide level, the overarching program needs associated with TOC operations are reported. These include TOC program oversight, maintenance of the existing ATMS, and expansion of the SSP.

At the regional level, needs for facility maintenance, utilities, telecommunications, software maintenance, towing contracts, supplies and equipment are reported under the operating regions to include costs related to personnel, equipment, TOC control room operations, overhead, program administration and ITS architecture.

Technology Assets

Technology assets include Intelligent Transportation System (ITS) assets, such as cameras, traffic sensors, dynamic message signs (DMS), high occupancy vehicle (HOV) gates, lane control systems, dynamic ramp metering, active traffic management systems, and communications infrastructure such as agency-owned copper, coaxial, ethernet, and fiber optic cables and associated conduit systems. Technology assets are used extensively by VDOT's five traffic operations centers (TOCs) to monitor traffic conditions and manage traffic flow and incidents. Regular preventative maintenance and quick responses to disabled components are essential for the effective, uninterrupted operation of traffic signals, and freeway surveillance and management systems.

In 2013, VDOT entered into a statewide contract to manage the TOC operations. The contract covers ordinary and preventative maintenance on ITS assets as well as emergency maintenance. These activities fall under the ITS Field Maintenance service category of the TOC contract, which includes preventative, repair, and emergency maintenance activities on all ITS assets on VDOT maintained network. The contract does not include replacement of components that have reached the end of their useful lives. Lifecycle replacement of ITS assets remained an internal

VDOT function. Needs for technology assets include two components: the ITS field maintenance component of the TOC contract and lifecycle replacement of ITS assets.

ITS Field Maintenance

ITS field maintenance needs are determined based on the TOC contract pricing. The pricing is estimated based on the cost to maintain the current ITS asset inventory in each region for one year. This baseline estimate includes the cost of parts up to $250 per repair.

In addition to the contract price, the reported needs also include an estimate for the cost of parts beyond $250 per repair. Based on past expenditures, an eighteen percent (18%) additive was included in the needs assessment to account for anticipated invoices for parts that exceeded $250 per repair.

Lifecycle Replacement

In addition to ITS field maintenance needs, lifecycle replacement needs are assessed for the following assets: changeable message sign (CMS), portable changeable message sign (PCMS), and traffic cameras.

The lifecycle replacement analysis assumes the components, rather than the complete asset assemblies, will be replaced at the end of their expected lives. Therefore, the component level replacement costs and lifecycle replacement assumptions are extracted from on-going contracts, field practices and industry standards. Management of Traffic (MOT) costs have been factored into replacement unit costs.

The lifecycle replacement needs are estimated using the following equation:

$$RPNeeds_j = \sum_i RPCost_i * RPR_i * INV_{ij} * Inflation_j$$

Where:

RPNeedsj = replacement needs in year j
RPCosti = replacement cost of component i
RPRi = replacement rate of component i (or 1/Expected Service Life of Component i)
INVij = inventory of component i in year j
Inflationj = inflation factor to adjust needs to fiscal year j dollars

<u>Incident Management</u>

Incident management needs include costs of state or contract labor and support services for unexpected or unplanned events that impede traffic flow. VDOT responds primarily to four categories of incidents: weather-related, major or minor crashes, hazardous material spills and terrorist attacks. Incident management does not include dead animal removal, planned traffic control events, tree or storm debris removal, or motorist assistance safety patrols.

VDOT's maintenance crew and highway operations staff are responsible for incident clearance and management jointly. The operations staff focus primarily on initial response, internal and external agency coordination, and public communication. Operations staff perform these activities in conjunction with the regional TOCs. Maintenance personnel focus primarily on emergency repairs to protect life and prevent additional damage, and re-establishing reasonable temporary access and performing permanent restoration to repair or replace damaged assets so that they may function as well as they did prior to the incident.

Maintenance and operations aspects of incident management are based on different methods for calculating their respective incident clearance and management needs. On the maintenance side, incident clearance and management needs are reported for districts only and are determined based on a three year average of historical expenditures. On the operations side, incident clearance and management needs were estimated based on costs to cover personnel, overhead and equipment expenses.

Snow and Ice

The total needs for snow and ice are established by executive management based on the recent historical expenditures for snow and ice removal. This total minus a $30 million reserve is then distributed to the districts based on a model developed by the Virginia Transportation Research Council (VTRC) which takes into account the average annual snow fall, lane miles, traffic density, topography, and unit costs for snow removal. In addition, the cost of enhancing Automated Vehicle Locating (AVL) capabilities of the fleet to support snow and ice activities is also included.

Operations Programs

Needs for the following operations programs are reported in addition to the above categories:

- Disaster support operations
- Program Development
- Call Center Operations
- Field Operations Support
- Engineering Program
- 511 program for Virginia Traffic and Travel Information System
- Facility Security Management

Disaster Support Operations

Disaster support operations are VDOT operations to aid in disaster clean up and recovery. These activities include Emergency Operations Center (EOC), traffic control to mitigate hazards such as downed trees or power lines, or to close roads, storm damage assessment and inspections in conjunction with the Federal Emergency Management Agency and the Federal Highway Administration, clean up and disposal of debris such as branches, trees, mud, silt or building wreckage, operations support such as answering phones and logging data, and assistance provided to the Department of Emergency Management.

The needs for disaster support operations are highly variable. Currently VDOT has no assessment tool which allows for prediction of these types of events. Therefore needs are based largely on historical expenditures. Central Office needs were tied directly to the

previous fiscal year's expenditures. District needs were calculated by distributing the past year statewide expenditure (less the Central Office expenditures) equally across the nine operational units. The equal distribution approach ensures that all districts have needs assessed even if no expenditures were recorded in that district in the prior year.

Program Development

Program development includes researching and analyzing available technologies for use in conceptual ITS projects which may be implemented in the future. The program includes activities such as:

- Management of the ITS Architecture Program and an ITS Project Estimating System
- Creating long term operations/ITS strategies for project development in the statewide operations investment plan
- Overseeing operations asset management for needs based budgeting
- Expanding new operations technology development (i.e., active traffic management systems and integrated corridor management efforts)
- Supporting the planning and project management activities of the Statewide Tunnels Oversight Committee
- Development and analysis of transportation system performance measures to support the Moving Ahead for Progress in the 21st Century Act (the current federal transportation program)requirements and to improve the performance of the transportation system

The needs are captured based on the latest reported budget for essential services and contracts related to ITS program development objectives and initiatives. These include projects, studies and initiatives related to enhancement of the statewide ITS system and compliance with FHWA and MAP-21 requirements.

The needs are also based on a list of services and initiatives such as:

- Recurring annual costs for certain services
- Estimates from previous similar efforts
- Specific financial commitments

Call Center Operations

VDOT operates two Customer Service Centers (CSCs). The primary facility is located in the Salem district with a backup facility located in Northern Virginia. The CSCs were first opened in April of 2010 and were designed to combine traffic, maintenance and public information calls in one overarching information system. These facilities provide the public with access to a customer service representative to answer questions, direct maintenance requests, and initiate a call-back when necessary. CSCs are staffed and operated 24 hours per day, each day of the year. The needs are captured based on the latest budget and reflect the following costs:

- Personnel
- Overhead (office supplies, utilities, satellite and phone service, etc.)
- Contracts

Field Operations Support
Field operations support includes activities which enhance the efficiency, productivity or safety of operations on or in VDOT roadways or facilities. These activities include maintenance of critical information software and equipment, weather monitoring, securing critical infrastructure, incident simulation exercises and incident response. Superload Program Planning for oversize or overweight loads traversing Commonwealth roadways is also included in this needs category. The needs are based on the latest budget and account for a combination of:

- Historical expenditures
- Existing contracts
- Information provided by industry vendors
- IT requirements and resources required from the Virginia State Police

Engineering Program
Engineering program includes all project costs involved in the deployment of ITS assets, supporting communication, software and systems. It also includes developing specifications and request for proposals (RFPs) as well as procurement services for deployment. When regional projects are developed, the preliminary work conducted prior to the establishment of a UPC by non-VDOT resources (e.g. consultants or contractors) is covered under this program. The needs are based on the latest budget and account for essential services and contracts related to ITS program objectives and initiatives.

511 Virginia Traffic and Travel Information System
511 Virginia provides free real-time information about road conditions, construction delays and other incidents to the traveling public via phone, web, mobile, e-mail or SMS text. In 2013 VDOT contracted Iteris, Inc. for the design, development, operation and maintenance of a new enhanced phone and web-based system. The enhanced 511 Virginia traffic and travel information system initiative includes all project costs involved in the maintenance, operation and deployment of 511 software and systems. The contract also calls for Iteris to establish sponsorships for VDOT assets associated with 511 Virginia including road signs, traffic video feeds and website. These revenue-generating sponsorships are expected to offset the cost to Virginia taxpayers of operating the 511 Virginia system after five years.

The needs are based on the latest budget and account for essential services related to the 511 Virginia program objectives and initiatives. Needs also include the following upgrades and enhancements in addition to regular operations and maintenance:

- Improved voice recognition software to enable better communications using the latest technology
- Easy-to-use menu with more functionality to enable quicker access to desired traffic information
- New features that use “push” notification technology to deliver personalized, real-time traffic information on roads of interest
- Mobile solutions to include apps for iPhone, Droid and Blackberry
- Enhanced, more robust 511 Virginia website

c. Traffic and Safety

Traffic needs include the cost of striping roads, maintaining and operating traffic signals and lighting, and maintenance of assets such as traffic signs and guardrail.

Guardrail and End Treatment

Guardrail is a barrier installed on the right-of-way to reduce the potential for, and severity of, accidents involving vehicles running off the road. Guardrail is designed to gently contain, hold and redirect a vehicle back onto the roadway if it should leave the travel lane. Guardrail may also be used to separate two-way traffic.

End treatments, or guardrail terminals, are safety devices designed to fit at the end of a run of guardrail. The purpose of the end treatment is two-fold: (1) to maintain the tension necessary for the run of guardrail to function properly, and (2) to minimize damage to a vehicle and its occupants if the end of the run of guardrail is hit. The type of end treatment used corresponds with and works in conjunction with the guardrail type used.

VDOT maintains an estimated 7,405 miles of guardrail, and 152,105 end treatments on the state maintained network. Needs for guardrail and end treatment covers the following areas:

- Condition assessment
- Hit replacement, and
- Lifecycle replacement

Needs are determined based on estimated inventory, replacement frequency and unit costs.

Two types of guardrail and end treatment needs are reported: paving-related needs vs. the remaining maintenance and operations needs, which are labeled as lifecycle needs. Along this line, inventories, unit costs, and activity frequencies for each of the two needs categories were identified and estimated separately.

Pavement markings, markers, and messages

VDOT uses three separate asset types to classify and track traffic control markings, markers and messages on pavement. For all three asset types, the needs are established based on (1) estimated inventory, (2) frequency of replacement based on a combination of asset lifecycle and needs for replacements triggered by paving related activities and (3) unit costs based on an analysis of recent construction costs.

Pavement Markings

Longitudinal lines which delineate vehicular paths of travel along the roadway by marking the center line of the road, lanes of travel, edges of pavement, etc. Center lines delineate the lanes of an undivided roadway and separate traffic flowing in opposite directions. Lane lines separate lanes that flow in the same direction. Pavement markings also include no-passing zone markings and channelizing markings.

Pavement Markers

Metal castings that are glued (epoxied) onto the pavement and hold lenses that may protrude slightly above the pavement surface providing increased visibility. The casting

is set at an angle, so that snowplow blades will not cause damage. Pavement markers provide improved retro-reflectivity (amount of light reflected back from the surface) during wet, night time conditions.

Pavement Messages
Transverse lines such as stop bars, cross walks and yield lines, and any words or symbols that convey important regulatory, warning or guidance information. Pavement messages can be pre-formed or marked on site.

Lighting
Highway lighting is a raised light source with one or more fixtures on a single pole along the side of the road or in parking areas. Highway lights provide illumination for travel ways, parking lots, and pedestrian walkways. The primary purpose of highway lighting is to promote safety at night by enhancing visibility, improve traffic flow by helping drivers delineate roadway and surroundings and to illuminate long underpasses and tunnels.

A highway lighting asset consists of the lighting fixture, photocell or photoelectric control, structural system-mounting brackets, pole, mast arm, transformer base and foundation. There is also electrical equipment including the electric service cabinet, junction box, conduit and wiring. A luminaire is a complete lighting unit (or fixture), including the light source, reflector(s), lens, and housing.

VDOT owns approximately 30,000 conventional (cobrahead, offset, or shoebox), 1,300 high mast, under deck, and over 18,600 sign lights, that are located in the right of way. VDOT also owns marine navigational and aviation lights on bridges, pedestrian tunnel lights and the lights at rest areas, park and rides and scale facilities.

The CY 2014 highway lighting needs assessment accounted for the following activities and/or needs categories:

- Re-lamping and electronic repairs
- Lifecycle replacements
- Lighting operations (power bills)
- Structure repairs
- Underground utility infrastructure replacement along I-395/495 and I-66 in the Northern Region

Ordinary maintenance and repair activities for lighting include replacing lamp bulbs, fuses, ballast, and electrical repairs. Replacement is far more involved and costly, typically consisting of complete light, pole and wiring system change out.

Lighting maintenance is delivered through a combination of service contracts and in-house VDOT staff. Some regions have contracts for “as needed” maintenance, to include labor, materials, equipment, traffic control and supervision and 24/7emergency response capabilities. Regions also have lighting repair crews staffed with VDOT employees for nighttime inspection and repair activities. On the interstate roadways, Turnkey Asset Maintenance Services (TAMS)

contractors are responsible for repair activities, including bulb replacement and minor electrical repairs.

Lighting needs are modeled using a lifecycle approach for re-lamping, repair, and replacement. Repairs to components other than the structure (i.e. ballast, wiring, fixture, etc.) are made on an as needed basis, generally when a failure is detected. Repair and replacement needs for non-structure lighting components are based on an assumed frequency of repair work, estimated actual work history data or field staff knowledge.

In addition to lifecycle replacement needs, the following lighting needs are also included:

Operations Needs:
Highway lighting electric service needs are determined based on historical expenditures. For the FY 2016-2017 assessment, FY 2014 expenditures for highway lighting power bills were used to determine utility needs.

Structure Repair Needs:
Structure repair needs were based on inspection data provided in accordance with VDOT's ancillary structures program requirements.

Signal

VDOT defines traffic signals as signalized intersections and flashers. Traffic signals are not just the signal heads mounted on mast arms or span wires. Each "signal" in the signal inventory represents a signalized intersection with all the components that make that intersection work properly. According to the Manual on Uniform Traffic Control Devices for Streets and Highway, section 1A.13, item 86 (MUTCD, 2009), a traffic signal is a power-operated traffic control device by which traffic is warned or directed to take some specific action. These devices do not include signals at toll plazas, power-operated signs, illuminated pavement markers, warning lights, or steady-burning electric lamps.

Traffic signals help manage intersecting streams of automobile and truck, pedestrian, and cyclist traffic by assigning the right-of-way to individual streams in turn. They are placed where volumes of traffic or crash histories justify their need, where crossings near schools require signal control, or as part of a coordinated signal plan to ensure a smooth, progressive flow of vehicles. A signalized intersection consists of both structural and non-structural components. The signal structure consists of a pole, foundation, and either span wires or a mast arm (the latter being the current standard). Most intersections will have four signal structures.

The needs for signals are derived from a statewide modeled approach that takes into consideration the following aspects of the signalized intersections:

- Preventative Maintenance
- Repair
- Lifecycle replacement
- Operations
- Payments to Others (Arlington)
- Paving related replacement of signal detector loops

Preventative Maintenance
Preventative maintenance activities include a set of checks and procedures performed at regularly scheduled intervals for the upkeep of signal equipment. They include inspection, record keeping, cleaning, and replacement depending on the function and rated service life of the components. The needs for preventative maintenance are based on the estimated inventory, anticipated frequency of the activities and annualized unit cost estimated based on existing contract.

Repair
Repair or corrective maintenance includes work required to restore a damaged or deteriorated asset to design, functionality and capability. The needs for repair maintenance are based on the estimated inventory, anticipated frequency of repair maintenance, and the annualized unit cost.

Lifecycle Replacement
Lifecycle replacement refers to the replacement or complete restoration of assets that cannot be repaired. If the asset no longer functions, is obsolete, or does not conform to current federal or state mandates for design performance, then it must be replaced or overhauled. For the purposes of the needs assessment, replacement is assumed to occur at the end of the estimated service life or when a component is rendered inoperable by pavement activities. Replacement can be broken out into three categories:

- structural replacement
- non-structural replacement
- paving-related replacement

The replacement needs for signals are based on the anticipated inventory, frequency of replacement and cost of the replacement.

Operations
Operational needs include electrical and communications services necessary for the signal system to function properly, reviewing and updating timing plans, monitoring signal operations (through signal control software), and dispatching crews to address operating concerns, etc. Examples of operating costs include:

- Metered electric costs
- Phone bills
- Network communications costs
- Software licensing agreements
- Signal Optimization

The operations needs for signals are largely based on the historical costs of utilities and the other operational aspects of the signal which are annualized into a unit cost and then applied to the inventory of signals.

Payments to Arlington County

VDOT makes payments to Arlington County for maintenance and operations of the VDOT owned signalized intersections within the county. The needs for payments to Arlington are based on the anticipated payments per signalized intersection and the number of signalized intersection for which payments are received. Both the operational and replacement component of this need are calculated.

Sign

Traffic signs are devices mounted on a support above the level of the roadway with images or messages intended to communicate specific information to road users. Standard traffic signs are regulated in size, color, shape, and message by the federal government, and conform to the Federal Highway Administration (FHWA)'s Manual on Uniform Traffic Control Devices (MUTCD).

VDOT signs are typically made of 0.100 gauge aluminum, covered with reflective sheeting, and contain either a silk-screened or pressed-on reflective message or image. VDOT uses over 900,000 standard and custom signs on the roadway ranging from deer crossing to speed limit signs. A single sign asset includes the support and any panels hanging on the support. The asset consists of the entire sign assembly. Sign supports can be made of metal, wood, or concrete. In addition, there are overhead signs, which are bridge parapet mounted or mounted over butterfly, cantilever, high mast, or overhead span structures.

Maintenance activities for signs include the replacement of ground mounted signs, overhead signs, and parapet mounted signs, as well as repairs to sign panels and structures, resetting sign posts, and sign condition assessment.

Sign needs are assessed using a repair and lifecycle replacement modeling approach which determines needs as the product of estimated inventory, frequency of maintenance activity and the unit cost of maintenance activities.

Traffic service

Traffic Engineering needs also include needs for services provided such as:

- Traffic System Planning and Engineering
- Traffic Counts Program
- Traffic Engineering Studies
- Integrated Directional Signing Program (IDSP)
- Payments to Railroads

Traffic System Planning and Engineering

This program covers signal system planning, analysis, and engineering activities, including but not limited to signal system planning and engineering related to the development of new signal installations or the replacement of existing signals, and signal preliminary engineering (PE). These needs are largely historically based and reflect:

- Projected staffing levels
- Contracted projects

- Operations engineering supplies, equipment and signal operating system contract (e.g. Management Information System for Traffic [MIST] contract)

Traffic Counts Program

VDOT conducts a traffic monitoring program where traffic count data are gathered from sensors in or along streets and highways and other sources. The mission is to systematically collect traffic data to meet VDOTs data needs and external reporting requirements. Some of the major data uses are:

- To support required reporting to the Federal Highway Administration
- Calculation of Annual Average Daily Traffic (AADT) estimates on major public roadways
- Calculation of Vehicles per Day (VPD) estimates on the state maintained local road network
- Calculation of Vehicle Miles of Travel (VMT) and generation of VMT reports for state public roadways
- Support travel demand modeling and long range transportation planning
- Support engineering and development for a wide range of project types

The needs are largely based on historical expenditures. The needs reflect the following:

- The program's staffing level
- Use of consultants to deliver program objectives
- Contractual and data procurement prices

Traffic Engineering Studies

The traffic engineering studies program covers the oversight of traffic control device specifications and standards, highway operations studies and highway network performance evaluations activities related to traffic engineering. The needs are largely based on historical expenditures and reflect the following projected staffing levels:

- Consultant fees for traffic studies (traffic signal studies, speed & safety studies, corridor safety & capacity assessment/implementation, intersection improvements, etc.)
- Office overhead (mobile phones, office supplies, office incidentals, janitorial contract, custodial purchases, staff professional memberships, reference materials, safety shoes & apparel, etc.)

Integrated Directional Signing Program (IDSP)

The Integrated Directional Signing Program (IDSP) was developed to provide Virginia motorist service businesses, attractions, tourist destinations and other specific points of interest with a single contact if they desire to have their location identified on a road sign along the state controlled and maintained roadway system. Signs under this program provide motorists with directional guidance and information about travel service businesses or particular points of interest. Four types of signs or Signing Programs are included in the IDSP. They are as follows:

- Specific Travel Service (Logo) Signs
- Tourist-Oriented Directional Signs (TODS)
- Supplemental Guide Signs (SGS)

- General Motorist Service Signs (GMSS)

The needs are derived largely from historical expenditures and include an administrative and field component.

Payments to Railroads
VDOT tracks its payments to railroads and the needs associated with these are historically based.

d. Routine Maintenance

Routine maintenance category includes drainage, vegetation management, sound barrier management and incidental management needs.

Drainage

Drainage assets are integral components of a safe and structurally sound roadway infrastructure. Inadequate or improperly maintained drainage assets are responsible for most pavement failure and soil erosion. Failure of the drainage system can flood roadways and result in failure of pavement and other critical assets. Hence, one of the most important duties of maintenance personnel is the repair and maintenance of the highway drainage system. The highway drainage system includes pipes, ditches (paved and unpaved), edge and under drains, gutters, inlet and outlet structures, catch basins, drop inlets, manholes, storm sewers and storm water basins. However, only the needs for cross pipes, ditches, curb and gutter, drop inlets, and storm water basins are broken out separately. For cross pipe, ditches, drop inlets, and curb and gutter, needs are based on an analytical approach considering estimated inventory, frequency of work activities and unit cost of those activities. For Storm water basins, needs are based on historical expenditures. The needs for the other components of the drainage system are captured in the incidental maintenance needs.

Vegetation Management

The primary function of managed vegetation (roadsides) is the prevention and control of erosion in direct support of the traveled roadway. Roadsides delineate pavement edges, ramps, merging and opposing lanes; act as a background for signs or signals; screen out conflicting or unsightly views; function as a crash barrier; reduce headlight annoyance; perform as snow fence; and will also dampen noise levels through[out] urban areas. Roadside vegetation management ensures that the above functions are realized. The vegetation management program works to ensure that ditch lines are not clogged with vegetation; heavy cuttings do not clog grates, inlets and pipe lines; and the roadside vegetation is not a fire hazard. The control of vegetation is also essential in providing adequate sight distance on the roadway and unobstructed views of signs and other roadside appurtenances. The needs for vegetation management are broken down into the needs to manage:

- turf
- brush and trees
- wildflower program

Turf
Turf needs are based on a modeled approach that takes into consideration estimated inventory, frequency of work activities and unit cost of those activities.

Brush and Tree
Brush and tree needs are primarily based on a modeled approach that takes into consideration estimated inventory, frequency of work activities and unit cost of those activities p. The need for the management of trees also includes a component for the removal of trees which is based on historical expenditures.

Wildflower Program
The wildflower program is directly funded from the proceeds of license plate fees from the Virginia Department of Motor Vehicles. As such the needs are based on the anticipated revenue from these fees.

The needs to manage other components of vegetation management such as the use of inmate labor, management of roadside flowers and ornamental plants are included in the Incidental Maintenance needs.

Sound Barriers
A sound barrier, also known as a noise barrier or sound wall, is a structure that is designed to reduce highway traffic noise experienced by homeowners, businesses and pedestrians. A sound barrier, also known as a noise barrier or sound wall, is a structure that is designed to reduce highway traffic noise experienced by homeowners, businesses and pedestrians. A condition assessment was recently performed through an engineering consulting service provided by the firm CH2MHill. Based on the condition assessment, VDOT identifies and reports the needs for addressing all locations with condition rating of poor (<45). These locations are assumed to receive total replacements and estimated using costs estimated based on contract prices.

Incidental Maintenance Needs
This category includes assets previously assessed based on historical expenditures that are no longer tracked in VDOT's current financial reporting system. Examples include sidewalks, bike paths, retaining walls, and waysides. In previous iterations of the needs assessment, those assets that were not migrated to the Cardinal financial management system with dedicated cost centers were estimated using the historical data that was available and making an adjustment for inflation. However, beginning with the CY 2014 needs assessment, this data was recognized to now be over five years old and a new method to account for the cost of maintenance work on these assets was sought. The other roadside needs assessment cost centers were created to account for assessing needs for these components of the Maintenance and Operations Program. The other roadside needs assessment cost centers include seventeen of the assets formerly captured with dedicated cost accounting codes. All of these are now captured under several different cost centers within the Cardinal System. Analysis of the previous expenditures captured for these assets indicated that they comprised approximately 1.65% of the Maintenance and Operations Program; therefore they are now accounted for by allocating 1.65% of the total needs assessment for the Maintenance and Operations Program to this category.

e. Facility and Others

Facility and other needs include all needs not captured in the previous categories. This category includes ferry management, rest area, permitting, facility security management, and management and direction. The following discussion summarizes needs for the main items under this category.

Management and direction

Management and direction refers to the cost to provide program management, oversight and program administration. It includes salary and overhead expenses for staff providing the management and direction function. The FY 2017 needs for management and direction are determined based on the FY 2016 budget.

Ferry

A ferry is a boat or ship used to transport vehicles and/or people across a body of water. VDOT operates three ferry services, all in the Eastern part of the state. The Jamestown-Scotland Ferry is the largest ferry service in VDOT's network. It provides 24 hour a day service with a four vessel fleet. The Merry Point and Sunny Bank Ferries each operate limited hours with one vessel each. Figure 44 lists VDOT's ferry services and their locations.

Figure 44: Virginia Ferry Service

Ferry Service	Water Crossing	Vessel	Type	Capacity	Route	County	Initial Service Year
Eastern Region*							
Jamestown-Scotland	James River	Pocahontas	Motorized Double Ended	70 cars	31	James City / Surry	1995
		Surry		50 cars			1979
		Williamsburg		50 cars			1983
		Virginia		28 cars			1936
Central Region**							
Merry Point	Corrotoman River	Cable Operated		6 Passengers	604	Lancaster	1983
Sunny Bank	Little Wicomico River	Northumberland	Cable	6 Passengers	644	Northumberland	1985

* Hampton Roads District

**Fredericksburg District

Ferry needs are divided into two categories: fixed and variable costs, and facility projects.

Fixed and Variable Cost Needs

Fixed costs for the Jamestown-Scotland Ferry include equipment, lease payments (for parking lots), and fixed cost services and contracts. Equipment costs include rental rates for the four ferry vessels as well as various types of trucks including a pick-up, bucket and utility truck. Rental is paid on these pieces of equipment regardless of whether ferries are in service. Fixed cost services include water and power utilities at the terminals, and other costs that must be paid regardless of whether the ferry is operating or not.

Variable costs for the Jamestown-Scotland Ferry include ferry operations personnel, terminal and ferry maintenance, services related to ferry operations and materials. Operations personnel includes staffing for the 24/7 operation including vessel captains,

deck hands, crew members, maintenance staff and other positions essential for safe operation of the ferry.

Facility Project Needs

Facility project needs were based primarily on the ferry investment plan, which at the time of the 2014 needs assessment was in draft form. The Merry Point and Sunny Bank ferries only had projects identified through FY 2015 in the ferry investment plan.

Safety rest area management

Safety rest areas provide traveler services and short-term car and truck parking for drivers to rest. These facilities include buildings, pavements, shelters, tables, water/waste water treatment systems, utility infrastructure, HVAC systems, parking lots, ramps, curb and gutter, lighting, fencing and landscaping. At safety rest areas services include ensuring that all property and amenities are open and available 24 hours a day, each day of the year and that the rest areas are safe, clean, fully functional, adequately supplied and compliant with all current federal and state regulations governing limited access highways and buildings in the Commonwealth. Currently, there are 43 open facilities, eleven of which are Welcome Centers with supplemental staff provided by the Virginia Tourism Corporation. Of the 43 safety rest area locations, 41 are staffed 24/7. The needs for safety rest area management come from the Safety Rest Area and Welcome Center Program Management Plan prepared by VDOT. The needs are broken down according to the following categories:

- Operations, including Payments to the Virginia Tourism Commission, Program Overhead, Property Management and Maintenance, Site Inspections, and Site Utilities
- Pavement Rehabilitation and Reconstruction
- Pedestrian Safety and Security, including Americans with Disabilities Act Compliance, Lighting, and Security Video Management System
- Preservation of Assets, including Drainage/Storm water System, Electrical, HVAC, Pavement Preventative Maintenance, Shoulder Maintenance, Wastewater Works, and Waterworks
- Program Administration, including Architectural, Engineering and Environmental Services and Program Support Services, Comment Card Program, and Construction Inspections

Permitting

Needs for land use permits are determined based on past-year expenditures.

Facility security management

The facility security management program intends to protect VDOT's critical infrastructure. It is a new category of needs separated from the Emergency and Incident Management area since FY 2016. This needs category covers costs for security at designated CI locations as well as maintenance of security equipment and maintaining agency compliance with state and federal CI regulations. The needs were primarily based on actual statewide security systems maintenance program needs as well as critical infrastructure mandated projects and initiatives, critical infrastructure security projects and estimated personnel needs.

Appendix B
Code of Virginia § 33.2-232 Annual Report by Commissioner of Highways

The Commissioner of Highways shall annually report in writing to the Governor, the General Assembly, the Joint Legislative Audit and Review Commission, and the Board no later than November 30 each year. The content of such report shall be specified by the Board and shall contain, at a minimum:

1. The condition of existing transportation assets, using asset management methodology pursuant to § 33.2-352;

2. 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;

3. Beginning with the November 2015 report through the November 2019 report, the allocations to the reconstruction and rehabilitation of functionally obsolete or structurally deficient bridges and to the reconstruction of pavements determined to have a combined condition index of less than 60 and beginning with the November 2020 report, the methodology used to determine allocations of construction funds for state of good repair purposes as defined in § 33.2-369 and any waiver of the cap provided for in subsection B of § 33.2-369;

4. The performance targets and outcomes for (i) the current two-year period starting July 1 of even-numbered years and (ii) the following two-year period starting July 1 of the next even-numbered year. The targets and outcomes shall state what is expected to be achieved, based on funding identified for maintenance and state of good repair purposes, over each two-year period;

5. Beginning with the November 2016 report, 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. The Department's (i) strategies for improving safety and security and (ii) strategies and activities 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 improved incident management; and

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