State of the Structures and Bridges Report Fiscal Year 2016

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Virginia Department of Transportation

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INTRODUCTION

This annually produced report summarizes the condition of the bridges, large culverts and ancillary structures (traffic control devices) that comprise the inventory of the Structure and Bridge (S&B) Division of the Virginia Department of Transportation (VDOT). The report also summarizes the bridge and large culvert inspection program, the ancillary safety inspection program, as well as bridge-related financial information for the Commonwealth of Virginia. The report reflects the accomplishments for the 2016 Fiscal Year (FY2016) for VDOT and provides some historical trends. The Fiscal Year for FY 2016 ran from July 1, 2015 through June 30, 2016.

VDOT inspects bridges and culverts that are part of the National Bridge Inventory (NBI), which includes structures on public roadways exceeding 20 feet in length. VDOT's S&B Division also inventories and inspects structures that do not meet the definition of NBI structures (referred to as "non-NBI" structures in this report). Non-NBI structures include bridges with a total length of 20 feet or less, and culverts with a total width of 20' or less and a total opening in excess of 36 square feet. Culverts meeting the NBI and non-NBI requirements are called "large culverts" and as such are part of the S&B Inventory. Smaller culverts not meeting the above criteria are maintained and inspected by other VDOT Divisions and are not addressed in this report. All information in this report is based on data as of June 30, 2016, which was the last day of FY2016.

There are currently 21,090 structures (bridges and large culverts) located throughout the Commonwealth, of which 13,492 are NBI structures and 3,649 are NBI structures on the National Highway System (NHS). VDOT maintains 19,458 of these structures, and 1,632 are maintained by localities and other owners. The inventory experienced a net increase of 6 structures during FY2016. The structures in this report include all bridges and culverts currently open to traffic. It does not include those structures not yet open to traffic or those that have been closed to traffic. It also does not include parking decks, footbridges, wharfs, pedestrian overpasses, railroads, scales, tunnels and those structures that are not reported via VDOT to FHWA.

The majority of Virginia's bridges were designed with an anticipated design service life of 50 years, but with the adoption of new design guidelines and construction materials the anticipated service life for newly constructed bridges is 75 years. About sixty four (64.0%) percent of the structure inventory is 40 years or older, and thus are within or beyond the final 10 years their anticipated service design life. The anticipated service life of structures can be extended though preventive, proactive maintenance, major repairs and rehabilitation.

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 inventory at the end of the Fiscal Year was 1,116 (5.29%), of which 823 are NBI structures. During the Fiscal Year, the percentage of SD structures was reduced by 0.92% (using number of structures) or 0.02% (using deck area of structures). Nationally, 9.6% of the NBI structures were SD as of December, 2015.

A structure is defined as SD if one or more of its major components (deck, superstructure, substructure, or large culvert) has a General Condition Rating (GCR) less than or equal to four (4) or if it has an appraisal rating of 2 or less for Structural Evaluation or Waterway Adequacy. Structural deficiency requires the structure to be monitored and/or repaired. 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.

VDOT uses several performance indicators in the overall management of the structural inventory. These include the following: functional obsolescence (FO), SD, number of posted structures, deficient deck area and the Health Index (HI). These performance indicators are discussed in greater detail in the body of the report.

Structure Type	Percentage By Major Components in Good or Fair Condition			
	Deck	Superstructure	Substructure	Culvert
Bridges	97.9%	94.3%	97.5%	N/A
Large Culverts	N/A	N/A	N/A	97.9%

The Commonwealth's inventory includes 5,054 bridges and large culverts (24.0%) that are at risk of becoming SD. These structures have one or more major components with a GCR of five (5).

The bridge safety inspection program provides the basis for most of the Commonwealth's bridge maintenance and management decisions. During FY2016 VDOT inspected 10,321 bridges/large culverts at a cost of $34.20 million. Inspections on the majority of the structures are performed on a two year cycle. Data collected from inspections are used to evaluate each structure's safety and are used for decisions on planning, budgeting, and performance of maintenance, repair, rehabilitation and replacement of our structures. The Federal Highway Administration (FHWA) conducted an annual National Bridge Inspection Standards (NBIS) Compliance Review from April 1, 2014 to March 30, 2015 and reported the findings on December 31, 2015. The Compliance Review consisted of a review of the statewide structures (bridges and large culverts) inventory/database and organization/procedures for safety inspections and a QA review of a sample of structures records and structure field reviews of the Lynchburg and Northern Virginia Districts. The review found that the Department was in compliance with 21 of the 23 NBIS metrics, substantially compliant with 1 metric, and conditionally compliant with 1 metric.

VDOT is also responsible for the inventory and inspection of 34,394 ancillary structures. VDOT's inventory includes five types of ancillary structures: Signs, Luminaires, Signals, High Mast Lights, and Camera Poles. VDOT inspected 5,192 of these structures in the fiscal year, at an approximate cost of $6.30 million. VDOT utilizes an inspection program to evaluate and monitor the condition of its ancillary structures. The data collected during inspections is the primary source of information for determining maintenance, repair and replacement needs for structural components. Inspections of the majority of the ancillary structures are performed on a five year cycle, but the required inspection interval varies depending on the purpose, condition, and type of the structure. It is important to note that inventory and rating data reflect the

condition of the structure as of its most recent inspection, and because there is a lag time of five or more years between inspections, the inspection data available at any given time does not necessarily provide a present indication of current conditions due to deterioration rates and possible repairs that occur in between.

The number of ancillary structures per district varies widely, from 14,797 (43.0% of the inventory) in the Northern Virginia District to 564 (1.6%) in the Culpeper District. Each ancillary structure is comprised of primary components that describe the structure and its support but not the attached appurtenances (sign panels, signals, lights, etc.). The percentages of the primary components that are in good or fair condition (statewide) are shown in the table below.

Structure Type	Percentage of Primary Components in Good or Fair Condition		
	Foundation	Parapet	Superstructure
Sign	84.3%	91.8%	93.2%
Luminaries	76.9%	68.5%	88.3%
Signal	85.8%	N/A*	82.7%
High Mast and Camera Poles	92.4%	N/A	98.3%

*1 structure exists in the inventory that is currently in Poor condition

Whenever a primary component of an ancillary structure is assigned a poor rating, the inspector provides a descriptive note indicating the most significant cause for the rating. Anchor bolt problems and loose nuts are the most common reasons for foundations receiving poor condition ratings. For the parapet mounted signs and luminaires, the most frequently identified problems are the attachments of the ancillary structure to the bridge structure. There is a much broader set of conditions that cause superstructures to be rated as poor, but “damaged chord members” is the most common reason.

For 2016, VDOT’s overall Construction (603) program was $1.4B and the Highway System Maintenance (604) Program was $1.9B. The Structure & Bridge Division was allocated approximately $124M in bridge specified funding in FY16 from the Construction (603) program, or about 9% of the total program. Expenditures in FY16 for the S&B Construction (603) Program were approximately $286M. Expenditures generally do not fully match allocations since allocations are provided primarily for expenditure of future years and expenditures represent money spent on projects due particularly to previous allocations.

The S&B Division’s initial allocation from VDOT’s Maintenance (604) Program was $199M, or roughly 10% of total program funds. An additional $13M of bonus obligation authority funds were provided during the year. The Maintenance (604) Program funds are used for both maintenance of the structure inventory and the bridge and ancillary structure inspection programs. Expenditures for the S&B Maintenance (604) program were $212M.

The calculated monetary need for bridge maintenance and construction significantly exceeds available funding. The Structure and Bridge Division performs an annual analysis of monetary needs and the analysis calculated that $748M is needed to meet all performance measures. This monetary value is considerably greater than the $323M of funds provided through the Construction (603) and Maintenance (604) Programs.

VDOT's performance measures were established using thresholds that, if met, would keep the inventory of the S&B Division steady at their current average overall condition ratings. The performance measures were determined through an analysis of the entire inventory over a multi-year period. The analysis utilized condition data in addition to historical deterioration curves and action-effectiveness scenarios to determine the most cost-effective interventions and the associated costs necessary for maintaining and improving the condition of Virginia's structures.

The availability of funding is the most significant factor affecting the condition of the inventory of the S&B Division. In recent years, the percentage of SD (poor) structures has steadily decreased, reflecting an apparent improvement in conditions of bridges and large culverts. However, while the number of structures in Poor condition has indeed decreased, the overall condition of the inventory, as measured by average General Condition Rating (GCR) has remained essentially unchanged. Allocated funds are often used to address structures in immediate need of repair or replacement, leaving less money than required for preventive and restorative maintenance.

Another significant factor affecting long-term performance relates to the selection of structures scheduled for replacement or major rehabilitation. In recent years, available funding in the 603 Construction Program has often led to the selection of smaller structures for replacement. This has resulted in a notable reduction in the number of structures in Poor condition. However, we are developing a backlog of larger bridges and more extensive rehabilitations due to the following current practices:

- Selection of smaller, less expensive, structures for replacement and rehabilitation
- Performing only necessary, targeted repairs to larger bridges in order to maintain a minimum GCR of 5 and avoid the status of being SD

The percentage of SD structures was reduced by 0.92% using the number of structures while there was a reduction of 0.02% using deck area of structures. The higher rate using number of structures indicates that structures with a smaller deck area are being selected for repair, restoration, major rehabilitation or replacement.

Structure deterioration occurs over a period of decades rather than months or years, so the results of short-term funding deficiencies will not necessarily be readily evident in near-term trends of conditions. However, over the long-term, if the funding for bridge maintenance and replacement is not increased, we should expect to see significant degradation of the average structure conditions, particularly when evaluated through the metric of deck area as opposed to structure count.

BACKGROUND

In accordance with the Code of Federal Regulations (CFR), The Virginia Department of Transportation (VDOT) inspects bridges and large culverts that are part of the National Bridge Inventory (NBI), which includes structures on public roadways exceeding 20 feet in length. In addition to the federal inventory and inspection requirements, VDOT's Structure and Bridge Division also inspects and inventories structures on public roads that do not meet the definition of NBI Structures, which are referred to as "non-NBI" structures in this report. Non-NBI structures include bridges with a total length of 20 feet or less, and culverts with a total width of 20' or less and a total opening in excess of 36 square feet. Culverts meeting the above NBI and non-NBI requirements are called "large culverts". Large culverts and bridges are addressed in this report.

VDOT also maintains a large inventory of smaller culverts that do not meet the above criteria. These smaller culverts are not maintained by the Structure and Bridge Division and have a separate maintenance and inspection cycle. Smaller culverts are not addressed in this report.

VDOT is responsible for the inventory and inspection of 21,090 structures (bridges and large culverts). Of these structures 13,492 are part of the National Bridge Inventory (NBI) and 3,649 are NBI structures on the National Highway System (NHS). VDOT maintains 19,458 of these structures and 1,632 are maintained by localities and other owners. All of the tables and figures in this report reflect the FY2016 accomplishments and are based on the inventory and condition data at the end of the Fiscal Year.

The estimated current value of Virginia's structure inventory for the Fiscal Year is approximately $45 billion. Note that this is not the same as the replacement value, which would be significantly higher. Chart 1A shows the distribution of bridges and large culverts by highway system.

Bridge and large culvert data in this report provide the condition and inventory information for all bridges and large culverts for which the Commonwealth of Virginia is responsible. VDOT is not responsible for non-NBI structures not owned and maintained by VDOT nor does it maintain information for these structures. Ancillary structures data provided is only for such structures that are owned and maintained by VDOT, as VDOT has very limited information on such structures that it does not own and maintain. Chart 1B displays the distribution of bridges and large culverts by the following custodians:

- VDOT (owned and maintained by VDOT)
- Localities (County, City and Town)
- Other (State Toll Authorities (CBBT), Other State Agencies (Game and Inland Fisheries, State Parks), Local Toll Authorities (RMA, DGT), Railroads, Private (Other than Railroads), and National Park Service

Chart 1A – Distribution of Bridges and Large Culverts by System

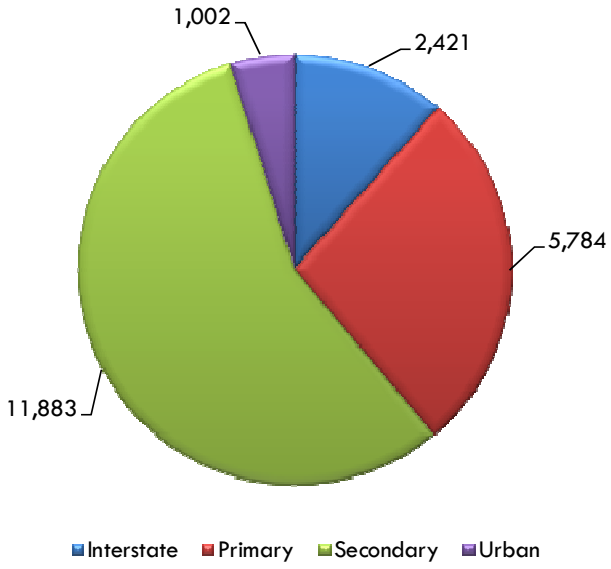
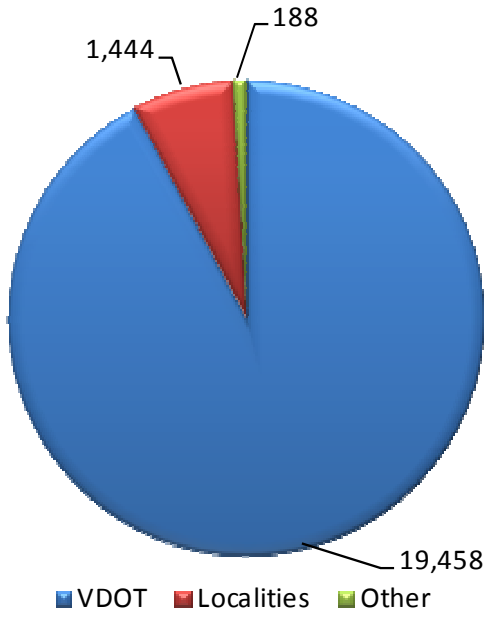


Chart 1B – Distribution of Bridges and Large Culverts by Custodian



VDOT is also responsible for the inventory, inspection and maintenance of 34,394 ancillary structures. VDOT's inventory includes five types of ancillary structures, three of which are further divided into subcategories:

1. High mast lighting structures
2. Camera pole structures
3. Signal structures
    - Span wire
    - Cantilever
    - Bridge-parapet mounted
4. Luminaires
    - Ground mounted (Luminaire)
    - Parapet mounted
5. Sign structures
    - Overhead span sign structures
    - Cantilever sign structures
    - Butterfly sign structures
    - Bridge-parapet mounted

Charts 2 and 3 indicate the distribution of the ancillary structures by District and type.

Chart 2 – Distribution of Ancillary Structures by District

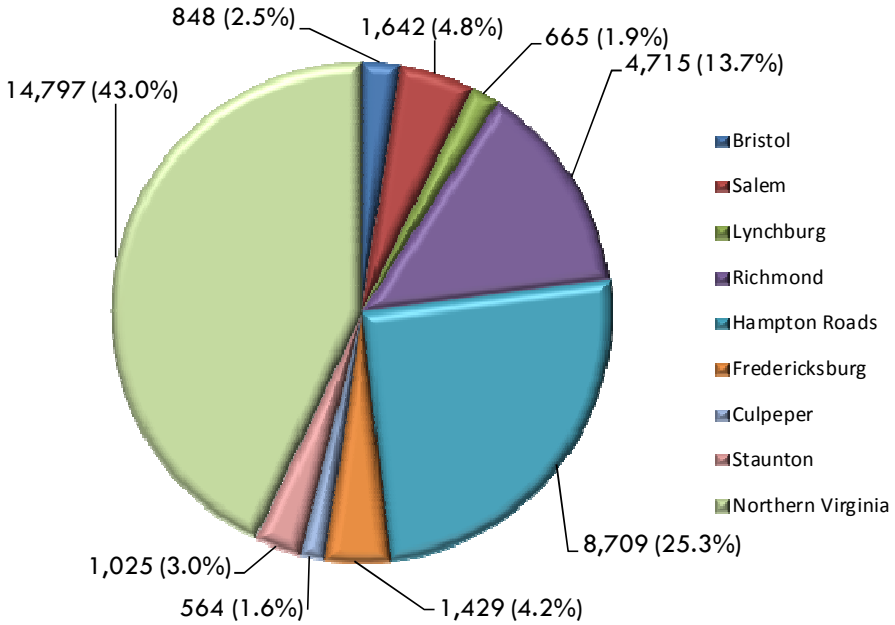
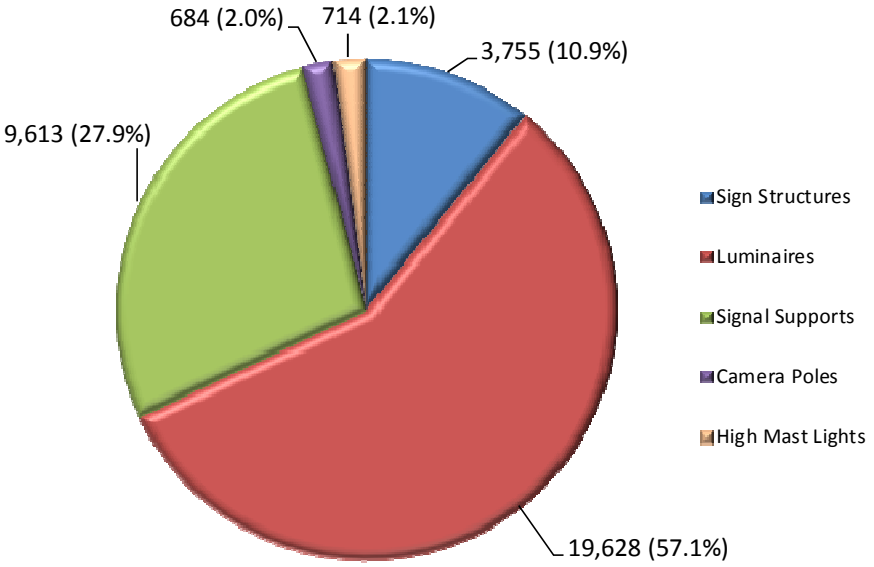


Chart 3 – Distribution of Ancillary Structures by Type



DETERMINING THE CONDITIONS OF STRUCTURES

VDOT uses its comprehensive inspection program to evaluate and monitor the condition of its structures. The data collected during inspections is used as the primary source of information for determining maintenance, repair and replacement needs. NBI structures receive detailed inspections at regular intervals not exceeding 24 months. The non-NBI bridges are inspected at intervals not exceeding 24 months, and the non-NBI large culverts are inspected at intervals not exceeding 48 months.

Inspectors use condition ratings to describe each existing structure. These condition ratings are based on the Federal Highway Administration's (FHWA) criteria. The condition assessments of the structures are performed by qualified inspectors, and all assessments are performed in accordance with the National Bridge Inspection Standards (NBIS) as well as VDOT's policies and procedures. VDOT's inspection procedures and requirements are detailed in VDOT's Current Instructional and Informational Memorandum IIM-S&B-27, and the NBIS requirements in the Code of Federal Regulations. VDOT inspects over 10,321 of bridges and large culverts annually, at an approximate cost of $34.20 million.

In addition to the specific data required by the NBIS, VDOT inspectors collect and record detailed structural element data, which is used in the operation of its Bridge Management System (BMS). The BMS information is used to determine current and future maintenance and preservation needs of the structures.

VDOT also utilizes an inspection program to evaluate and monitor the condition of its ancillary structures. The data collected during inspections is the primary source of information for determining maintenance, repair and replacement needs for structural components.

VDOT utilizes an internally-developed inventory and inspection software system to maintain data on its ancillary structures. Inspections of the ancillary structures are usually performed on a four (4) year cycle, but the required inspection interval varies depending on the purpose, condition, and type of the structure. At the time of each inspection an inspector assigns condition ratings to describe each of the major structural components of each structure. These condition ratings are based on criteria similar to the FHWA Bridge Inspection criteria. The condition assessments of the structures are performed by qualified inspectors and all assessments are performed in accordance with VDOT's policies and procedures.

VDOT's ancillary structure inspection procedures and requirements are detailed in VDOT's Current Instructional and Informational Memorandums IIM-S&B-82 and IIM-S&B-90, and VDOT's "Traffic Ancillary Structures Inventory and Inspection Manual." VDOT inspects over 5,192 of these structures annually, at an approximate cost of $6.30 million per year.

The inspection reports list repair recommendations for each structure. At the time of inspection the inspectors utilize their experience and judgment to determine the immediacy of the need for maintenance and to prioritize the recommended repairs accordingly. Many of VDOT's inspectors have completed FHWA's NHI training course "Inspection and Maintenance of Ancillary Highway Structures" and draw on this training when performing inspections.

STRUCTURE INVENTORY

VDOT uses the AASHTOWare Bridge Management software (BrM) to maintain data on all of the Commonwealth's highway structures. Tables 1 through 3 show the distribution of structures in each of the Districts by system. Unless otherwise stated, the data and charts shown in this report include both NBI and Non-NBI bridges and large culverts.

Table 1 – Total Number of Bridges and Large Culverts

DISTRICT	Number of Structures (Bridges and Large Culverts)				
	Interstate	Primary	Secondary	Urban	Total
Bristol	216	956	2,033	205	3,410
Salem	218	812	1,936	102	3,068
Lynchburg	0	657	1,371	58	2,086
Richmond	521	783	1,127	160	2,591
Hampton Roads	456	453	497	291	1,697
Fredericksburg	81	254	476	7	818
Culpeper	121	497	1,060	22	1,700
Staunton	429	827	2,131	112	3,499
NOVA	379	545	1,252	45	2,221
Grand Total	**2,421**	**5,784**	**11,883**	**1,002**	**21,090**

Table 2 – Number of NBI - Bridges and Large Culverts

DISTRICT	Number of NBI Structures (Bridges and Large Culverts)				
	Interstate	Primary	Secondary	Urban	Total
Bristol	164	520	1,116	202	2,002
Salem	140	453	1,134	95	1,822
Lynchburg	0	413	907	58	1,378
Richmond	365	580	851	158	1,954
Hampton Roads	376	369	369	286	1,400
Fredericksburg	45	177	303	7	532
Culpeper	85	241	685	17	1,028
Staunton	255	458	1,042	107	1,862
NOVA	285	396	789	44	1,514
Grand Total	**1,715**	**3,607**	**7,196**	**974**	**13,492**

Table 3 – Number of NHS (NBI) - Bridges and Large Culverts

DISTRICT	Number of NHS (NBI) Structures (Bridges and Large Culverts)				
	Interstate	Primary	Secondary	Urban	Total
Bristol	164	174	2	1	341
Salem	138	217	0	1	356
Lynchburg	0	214	1	0	215
Richmond	361	357	14	8	740
Hampton Roads	372	221	2	73	668
Fredericksburg	45	98	1	2	146
Culpeper	83	90	0	2	175
Staunton	252	139	0	2	393
NOVA	280	303	32	0	615
Grand Total	**1,695**	**1,813**	**52**	**89**	**3,649**

A large proportion (64.0%) of the Commonwealth's structure inventory is 40 years old or older. These structures have either exceeded or will soon exceed their originally anticipated design service life of 50 years. The percentage of structures equal to or greater than 40 years in age, by system, is as follows: 69.4% of the interstate, 68.0% of the primary, 62.0% of the secondary, and 51.5% of the urban system structures. The average age of all structures is 48.2 years. The age of Virginia's highway structures is depicted graphically in Charts 4 through 6.

Bridges built prior to 2007 could be expected to have a service life of 50 years, but with improvements in design guidelines and construction materials the anticipated service life of bridges constructed since 2007 is 75 years. Improvements have included the following:

- Corrosion resistant reinforcement in 2009*
- Jointless bridge technology for new bridges in 2011*
- Continuous spans for new bridges starting in the 1970's
- High Performance Concrete in all bridge elements in 2003*
- Three coat zinc-based paint in 1982 *
- Self-consolidating concrete for drilled shafts
- Latex modified concrete deck overlays (milling only) starting in the 1970s
- Epoxy deck overlays starting in the 1970s
- Low-shrinkage, low-cracking, concrete in decks in 2015
- Latex modified concrete overlays (the addition of hydrodemolition to milling) in 2015

  * Year of full implementation

In the near future, the Structure and Bridge Division will be placing greater emphasis on the following materials and actions to further improve the durability of its structures:

- Hydrodemolition for patches and refacing of substructures
- Increased use of joint elimination when repairing and rehabilitating bridges
- Use of materials for large culverts that have shown good past performance
- Carbon fiber prestressing strands in prestressed concrete piles
- Lightweight concrete
- Elastomeric Concrete Plug Joints (Implementation project currently under way)

- Self-consolidating concrete for substructure surface repairs

A large portion of the inventory was constructed using older construction technology and materials and is approaching the last quarter of useful service life. This period can be extended through planned preventative maintenance, restorative maintenance and major rehabilitation, and use of better materials, all of which include improved details as part of such activities.

Chart 4 – Cumulative Age Distribution of Bridges and Large Culverts

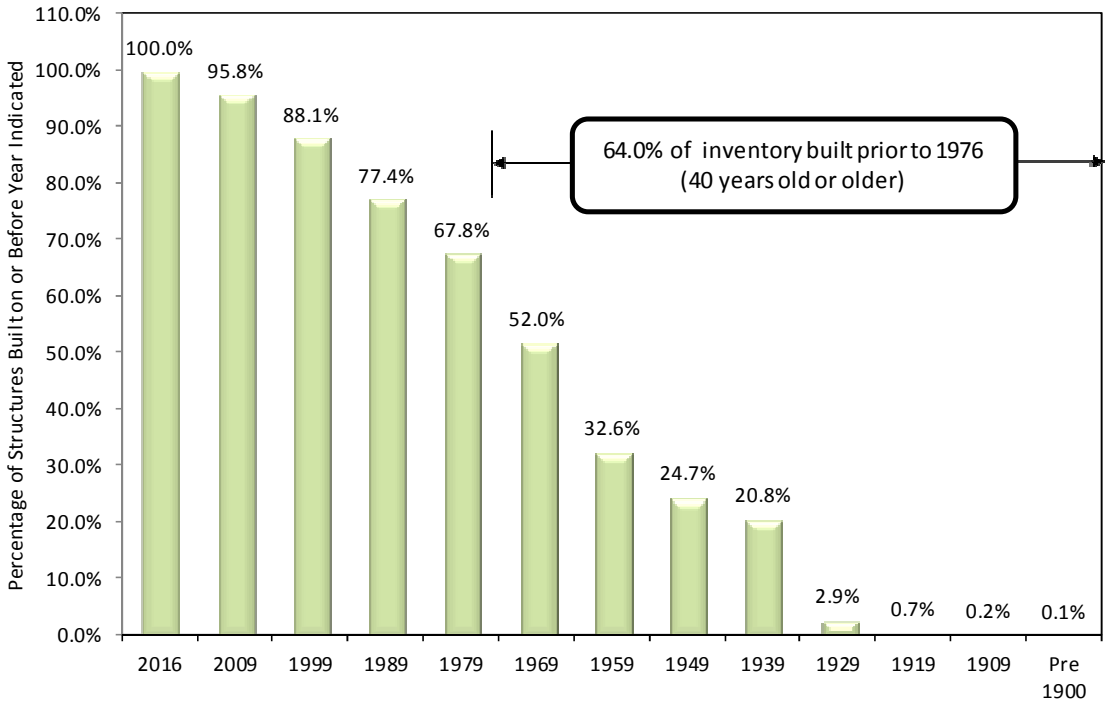


Chart 5 – Average Age of Bridges and Large Culverts by District

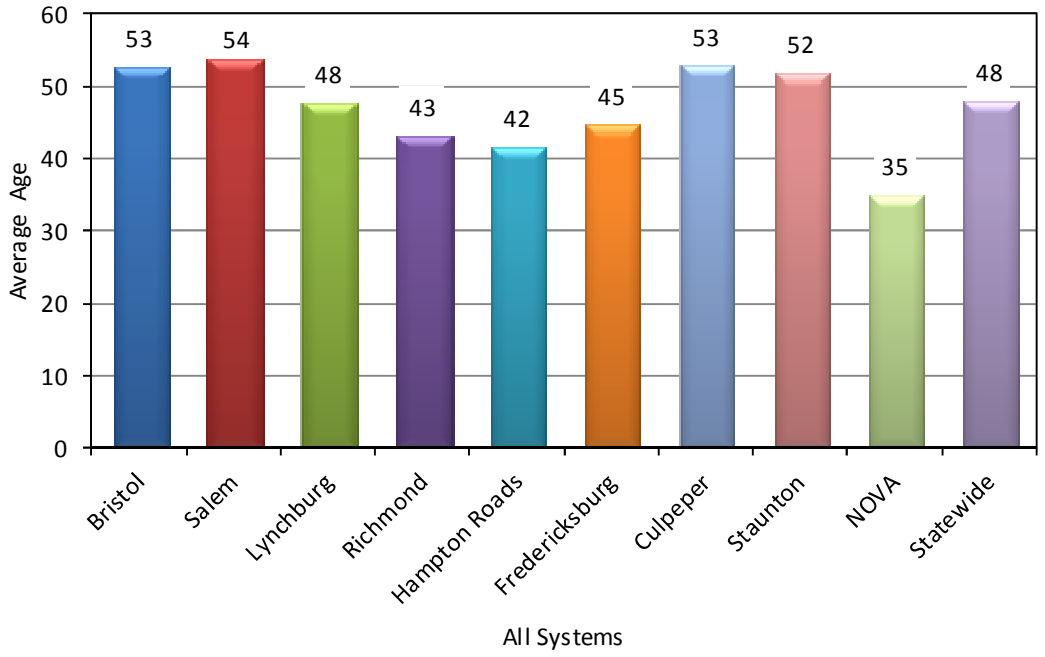
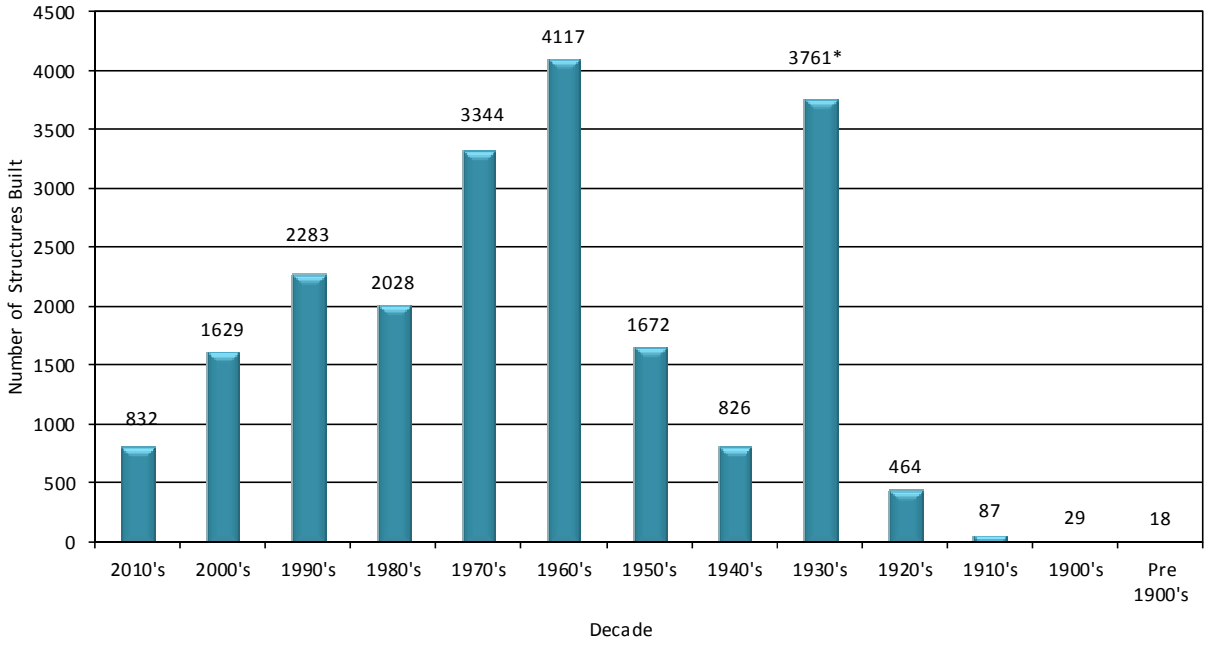


Chart 6 – Number of Bridges and Large Culverts Built per Decade



* County bridges added to the VDOT Inventory during this period with unknown construction dates. Those structures with unknown construction dates have been assumed to have been built in the 1930s.

Additional inventory information on bridges and large culverts can be found in Appendix A.

Table 4 below provides a summary of the total number and type of ancillary structures in each district. Similar information for the subcategories of each type of ancillary structure, along

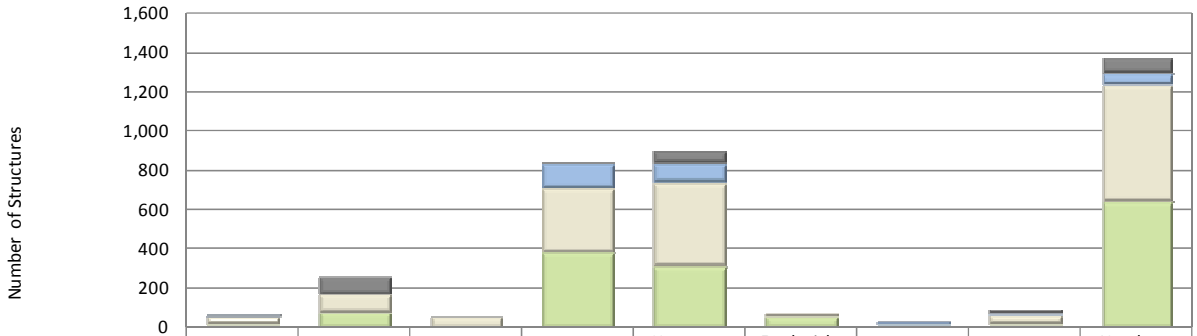
with pictures providing typical examples of each type of ancillary structure, is provided in Appendix B.

Table 4 – Total Number of Ancillary Structures

DISTRICT	Number of Ancillary Structures						Percent
	Sign Structures	Luminaires	Signal Supports	Camera Poles	High Mast Lights	Total	
Bristol	70	457	244	76	1	848	2.5%
Salem	264	821	541	13	3	1,642	4.8%
Lynchburg	65	301	299	0	0	665	1.9%
Richmond	844	2,198	1,519	105	49	4,715	13.7%
Hampton Roads	900	6,855	522	145	287	8,709	25.3%
Fredericksburg	87	580	738	1	23	1,429	4.2%
Culpeper	39	158	367	0	0	564	1.6%
Staunton	107	244	588	20	66	1,025	3.0%
Northern Virginia	1,379	8,014	4,795	324	285	14,797	43.0%
Statewide	**3,755**	**19,628**	**9,613**	**684**	**714**	**34,394**	**100.0%**

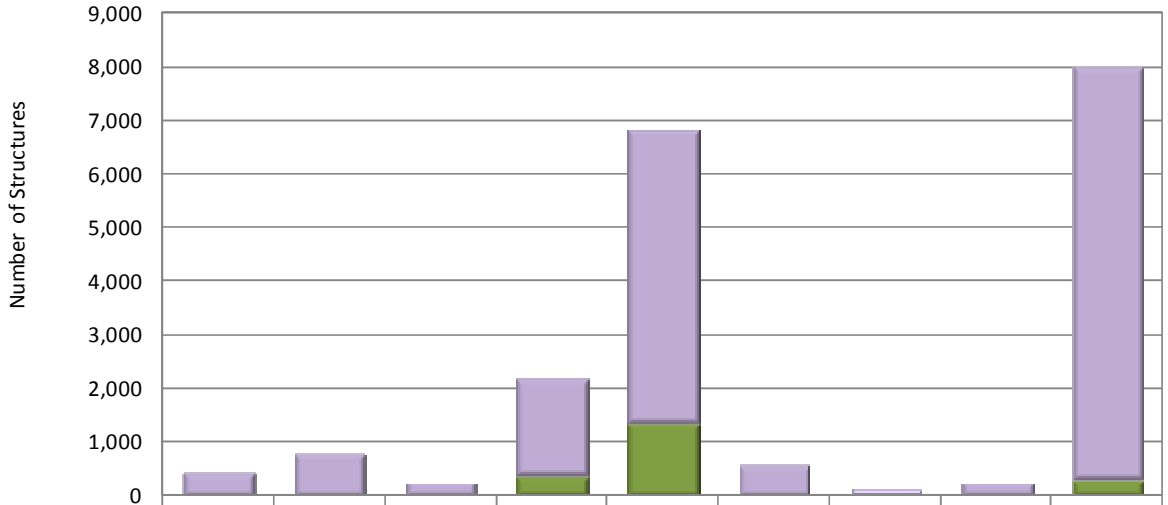
Charts 7 through 10 graphically display the total number of ancillary structures for each of the general structure types by subcategory and district.

Chart 7 – Number of Sign Structures by Subcategory and District



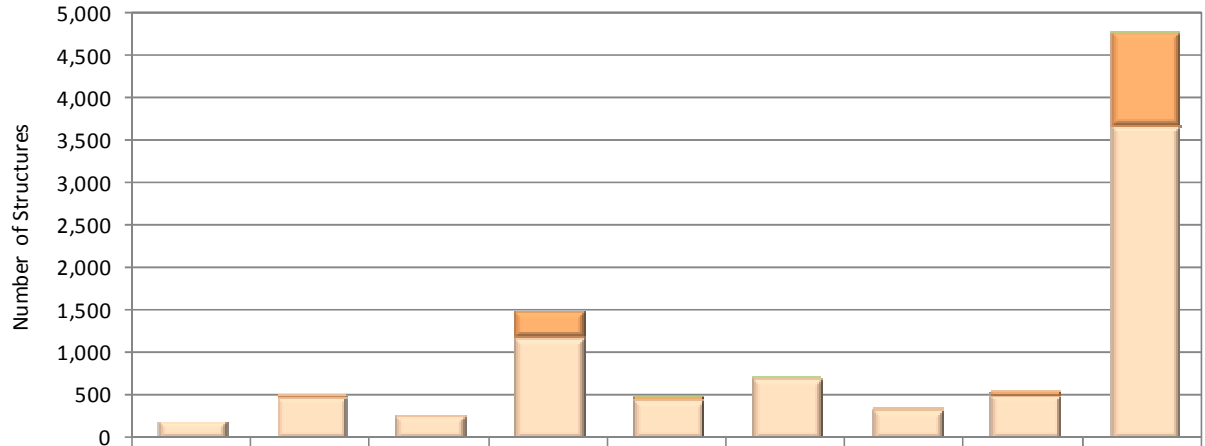
	Bristol	Salem	Lynchburg	Richmond	Hampton Roads	Fredericksburg	Culpeper	Staunton	Northern Virginia
Butterfly	10	92	5	1	57	0	3	22	82
Parapet Mount	1	0	0	130	99	0	10	15	61
Overhead	37	88	56	325	424	26	18	50	592
Cantilever	22	84	4	388	320	61	8	20	644
Total	70	264	65	844	900	87	39	107	1,379

Chart 8 – Number of Luminaire Structures by Subcategory and District



	Bristol	Salem	Lynchburg	Richmond	Hampton Roads	Fredericksburg	Culpeper	Staunton	Northern Virginia
Luminaires	455	797	301	1,793	5,494	580	158	244	7,699
Parapet Mount	2	24	0	405	1,361	0	0	0	315
Total	457	821	301	2,198	6,855	580	158	244	8,014

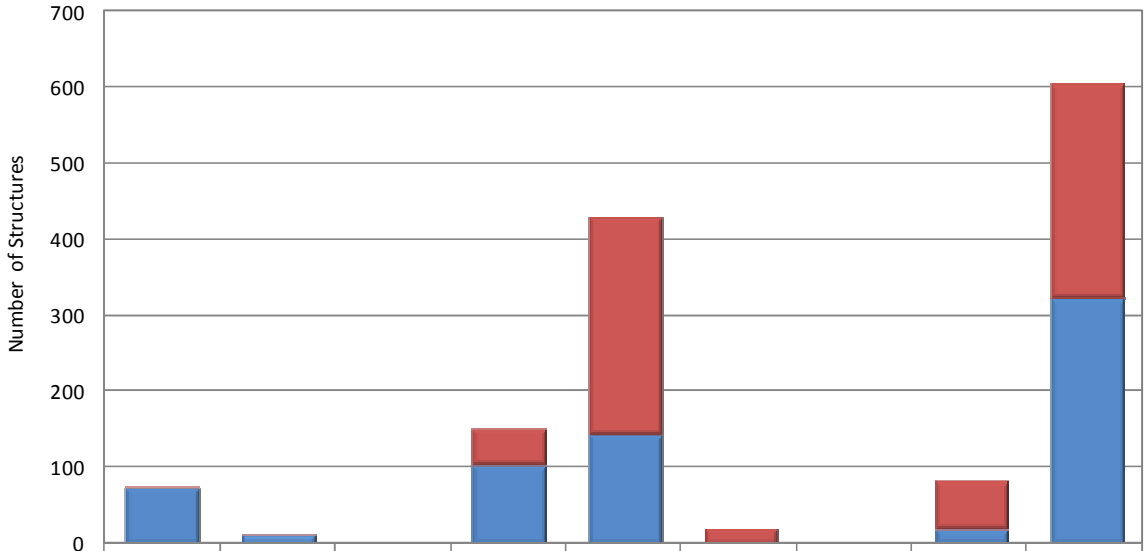
Chart 9 – Number of Signal Structures by Subcategory and District



	Bristol	Salem	Lynchburg	Richmond	Hampton Roads	Fredericksburg	Culpeper	Staunton	Northern Virginia
Other *	0	0	0	0	1	1	0	0	2
Span Wire	24	32	2	331	55	10	8	64	1,115
Cantilever	220	509	297	1,188	466	727	359	524	3,678
Total	244	541	299	1,519	522	738	367	588	4,795

*Other - Overhead and Parapet Mount Structures

Chart 10 – Number of High Mast Lights and Camera Poles by Subcategory and District



	Bristol	Salem	Lynchburg	Richmond	Hampton Roads	Fredericksburg	Culpeper	Staunton	Northern Virginia
High Mast Lighting	1	3	0	49	287	23	0	66	285
Camera Poles	76	13	0	105	145	1	0	20	324
Total	77	16	0	154	432	24	0	86	609

MEASURING PERFORMANCE

VDOT's global performance measure for structures is based on the percentage of SD structures in the Department's inventory. A Structurally Deficient (SD) structure has either of the following:

- a general condition rating (GCR) of poor (GCR of 4) or less for one or more of the following structural components: deck, superstructure, substructure or large culvert
- an appraisal rating of two (2) or less for the Structural Evaluation or Waterway Adequacy

These deficient structural components require the structure to be monitored and/or repaired. In some instances these structures have been posted to restrict the weight of vehicles driving on the structure. Appendix C provides definitions of the general condition ratings and provides comparative data on the average condition ratings by District.

VDOT's current goal is to have no more than eight (8%) percent SD structures for the entire state. Goals have also been established to limit the percentage of SD structures on each of the three highway systems. These goals apply statewide and to the Districts individually: three (3%) percent of Interstate system structures, six (6%) percent of Primary system structures and eleven (11%) percent of Secondary system structures.

At the end of the FY2016, 5.29% percent (1,116 structures) of the structures in the inventory were rated as SD by number of structures. The percent that are SD by structure area is 4.0%. Tables 5a and 5b show the number of SD structures that were restored and those that fell into SD status during the fiscal year. Chart 11A graphically displays the current number and percentage of SD structures by District (District percentages are based on the number of structures in that particular District). Chart 11B provides the same information except only NHS (NBI) structures are shown. Chart 12 shows the current percentage of SD structures by Custodian. Chart 13A shows the nine year statewide trend for the percentage of SD structures. Chart 13B shows the nine year statewide trend for the percentage of structures in Good or Fair condition. These charts address all of the Commonwealth's structures, including those that are not part of the NBI. Appendix D provides more detailed data by highway system.

Appendix L shows the national trend of deficient structures from 2000 to 2015. National data is reported by the states at the end of March for the previous year and is not available until May or June of the following year. The data for Virginia shown in Appendix L only addresses the NBI bridges and large culverts, which does not include structures with a length of 20 feet or less.

Table 5a – Change in Number of Structurally Deficient Structures Between FY2015 and FY2016

DISTRICT	Structurally Deficient		
	End of FY2015	End of FY2016	Change
Bristol	268	236	-11.9%
Salem	206	150	-27.2%
Lynchburg	121	110	-9.1%
Richmond	211	172	-18.5%
Hampton Roads	85	74	-12.9%
Fredericksburg	74	69	-6.8%
Culpeper	108	80	-25.9%
Staunton	193	185	-4.1%
NOVA	44	40	-9.1%
Statewide	**1,310**	**1,116**	**-14.8%**

Note: Percentages are based on count of FY2016 inventory

Table 5b – Change in Number of Structurally Deficient Structures During FY2016

DISTRICT	During FY2016				
	Reduced No. of SD Structures			New SD Structures	Net Change
	Restored	Closed	Removed		
Bristol	-45	-1	-1	+15	-32
Salem	-54	-9	-3	+10	-56
Lynchburg	-29	-1	-6	+25	-11
Richmond	-49	-2	0	+12	-39
Hampton Roads	-14	-4	0	+7	-11
Fredericksburg	-11	-1	0	+7	-5
Culpeper	-22	-10	0	+4	-28
Staunton	-22	-3	-5	+22	-8
NOVA	-8	0	0	+4	-4
Statewide	**-254**	**-31**	**-15**	**+106**	**-194**

Chart 11A – FY2016 Percentage of No. of Structurally Deficient Structures by District

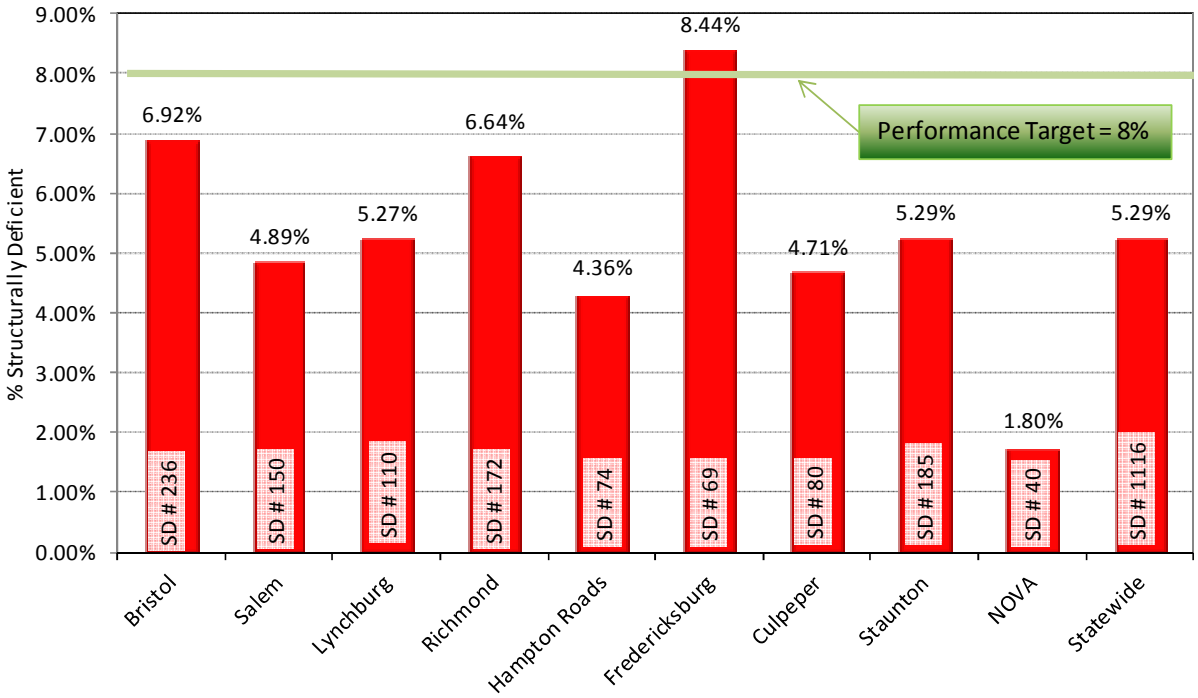


Chart 11B – FY2016 Percentage of No. of NHS (NBI) Structurally Deficient Structures by District

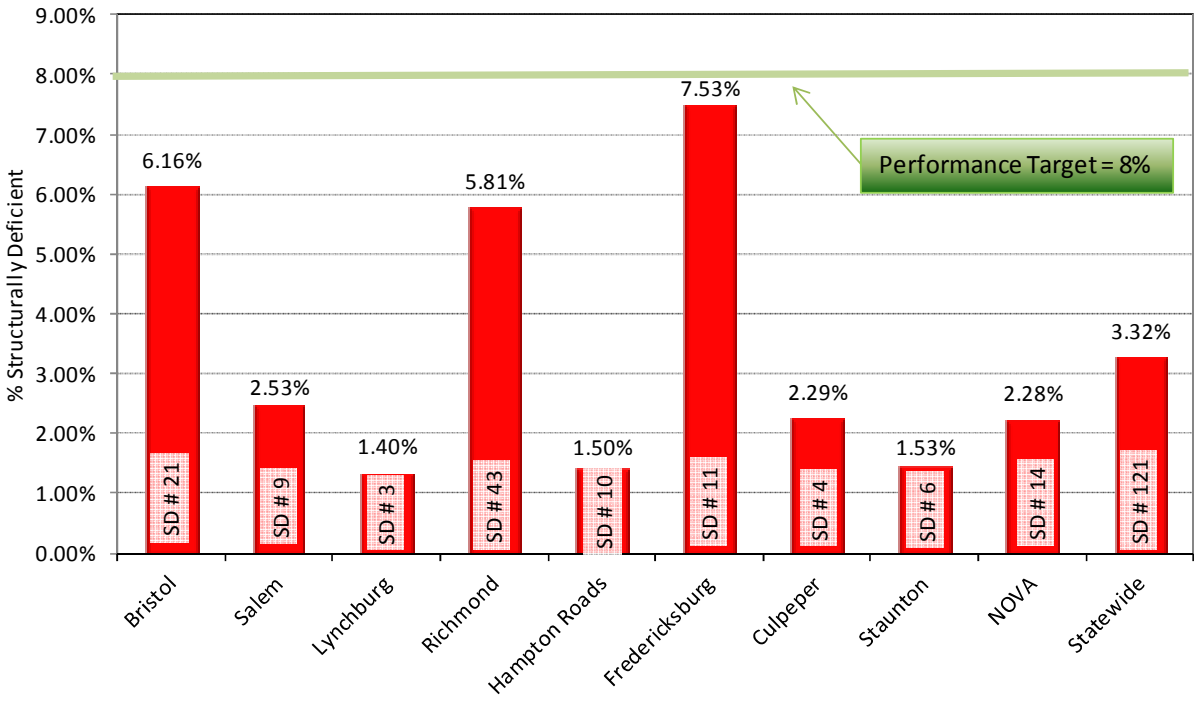
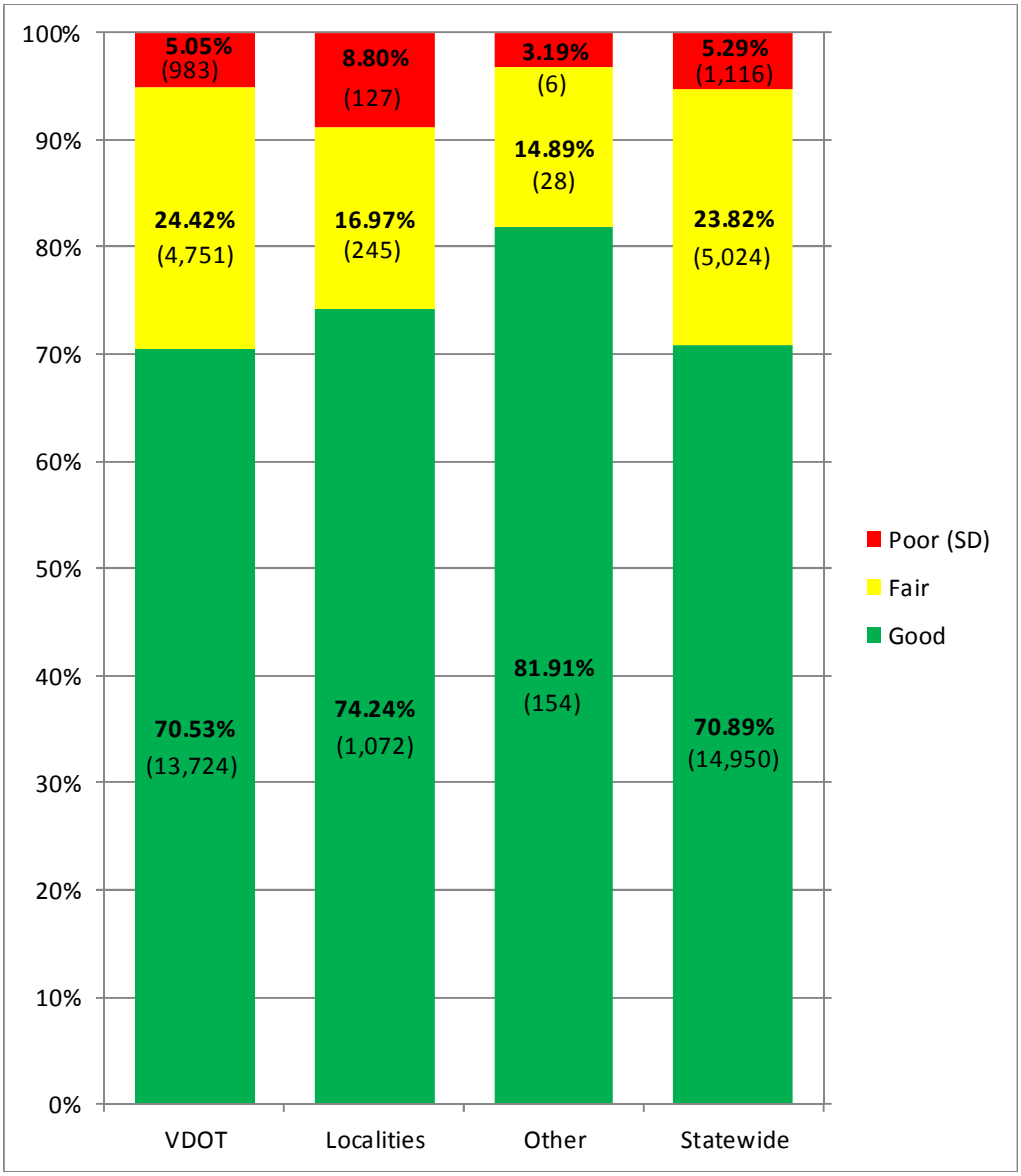


Chart 12 – FY2016 Percentage of No. of Structurally Deficient Structures by Custodian



Other Custodians include State Toll Authorities (CBBT), Other State Agencies (Game and Inland Fisheries, State Parks), Local Toll Authorities (RMA, DGT), Railroads, Private (Other than Railroads), and National Park Service

Chart 13A – Percentage of Structurally Deficient Structures Statewide (Ten Year Trend)

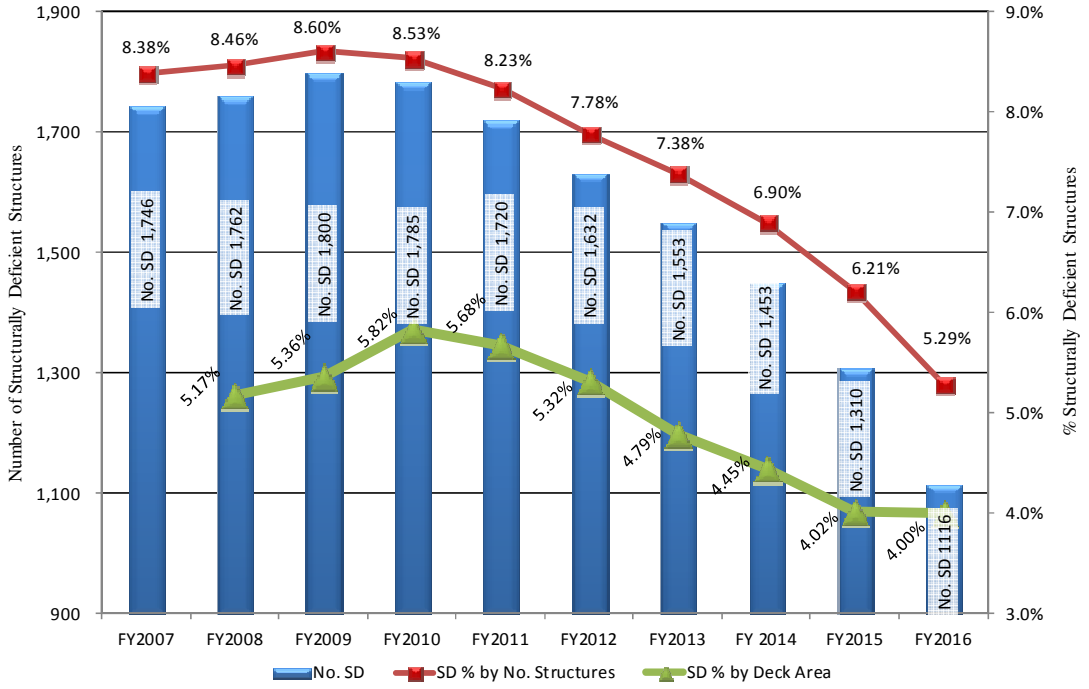
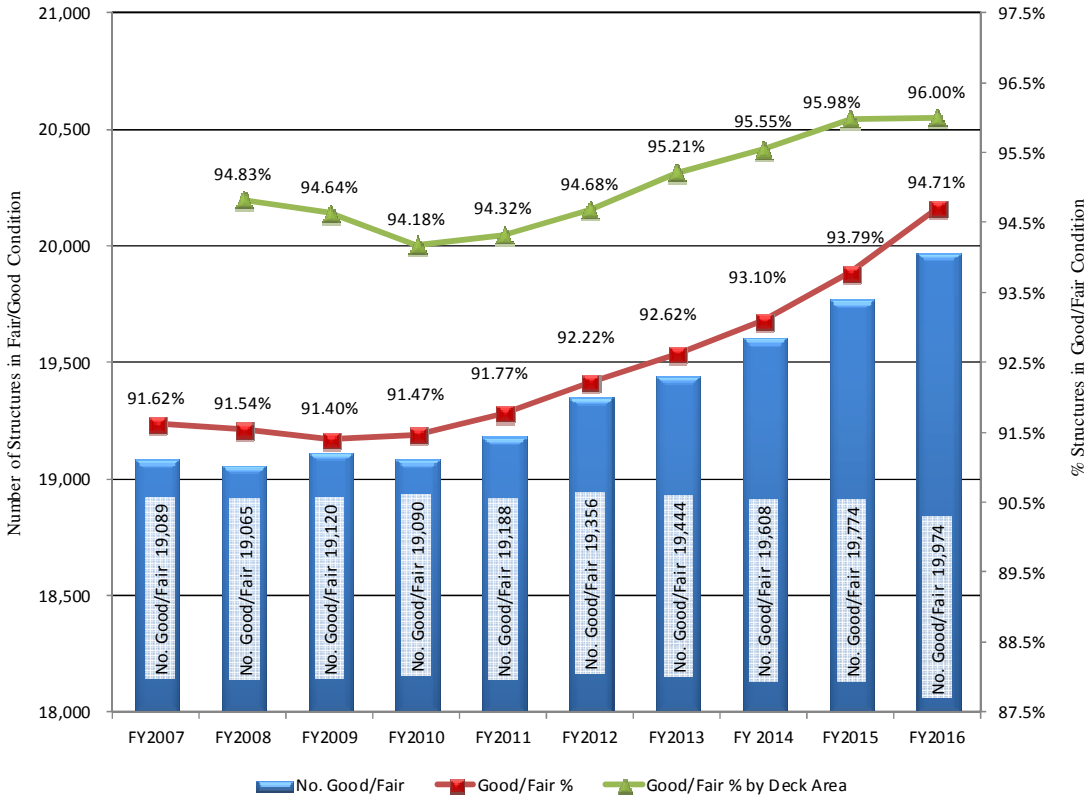


Chart 13B – Percentage of Structures in Good or Fair Condition (Ten Year Trend)



In addition to the percentage of SD structures, VDOT also tracks other indicators to assist in the overall management of the structural inventory. These include: functional obsolescence (FO), the number of posted structures, deficient deck area and the Health Index.

- Appendix C compares general condition ratings by structure component and District.
- Appendix E provides charts showing multi-year trends for these indicators statewide and for each highway system.
- Appendix F shows the fiscal year performance measures based on the square footage area of the structures
- Appendix G provides charts that address all of the bridges and large culverts that comprise the Commonwealth's inventory, including those that are not part of the NBI. The method of accounting for the number of structures by system has changed from previous years. Accordingly, graphs depicting data for specific highway systems show trend lines beginning in FY2009.
- Appendix H have Statewide and District maps showing the location of each SD structure.
- Appendix I show examples of items that can cause a structure to be functionally obsolete.
- Appendix J gives an overview of the Quality Assurance Program followed in the Commonwealth. VDOT operates a Quality Assurance Program to check that all of the inspections performed follow the national and VDOT requirements for the inspection of structures in the Commonwealth.

VDOT'S PERFORMANCE GOALS AND WORK NEEDS

Performance measurement has become an essential tool for making the best use of limited funds in a highly transparent and accountable manner. A sound performance measurement program requires years of work to identify and adopt a set of metrics that are meaningful, actionable and practical to measure.

VDOT performs an annual analysis in order to determine and report on the monetary needs for each of its assets. The monetary needs for any particular asset are defined as the amount of funding required to reach stated performance goals, which have been established to maintain and improve the condition of Virginia's bridges.

The Structure and Bridge Division uses three sets of performance goals in determining its program's monetary needs. These performance goals address structures in various condition categories. A true system preservation extends the service life of structures, which requires a balanced approach of completing work on structures in all conditions (good, fair and poor condition). For consistency and ease of measurement, structures are placed in one of the three condition categories based on the minimum General Condition Rating (GCR) of each structure, as assigned during the structure's most recent safety inspection. As explained elsewhere in this report, the General Condition Rating is a numerical measurement of the primary components of each structure. Measured on a 0-9 scale, with 0 representing a failed structure, a General Condition Rating is assigned to each bridge's deck, superstructure and substructure at each inspection. Large culverts receive a single GCR. The minimum GCR for each bridge or Large culvert is used to define its condition category (good, fair or poor) as follows:

Good Structures:	Minimum GCR ≥ 6
Fair Structures:	Minimum GCR = 5
Poor Structures:	Minimum GCR ≤ 4*

*Also includes structures that have a minimum GCR greater than 4 but has an Appraisal rating of 2 or less for Structural Evaluation or Waterway Adquacy

The general work needs for a balanced approach to bridges in good, fair or poor condition are shown below and are noted in Chapter 32, Part 2, of the VDOT Manual of the Structure and Bridge Division re-iterated as follows:

- Maintain 90% of expansion joints in a Condition State of 1[1]
- Eliminate 2% of the expansion joints in each District in each fiscal year
- Perform maintenance activities on at least 6% of structures with a minimum GCR of 5 in each District in each fiscal year
- Perform maintenance activities on at least 2% of structures with a minimum GCR of 6 in each District in each fiscal year
- For each highway system no more than the following percentage of structures can be structurally deficient[2]

Interstates	3%
Primaries	6%
Secondaries	11%
All	8%

[1] *In addition to GCR, Condition States are assigned to various critical bridge elements during bridge inspections. Elements in good condition are assigned a condition state of "1", and higher numbers are assigned to elements in worse condition*

[2] *There is a very close, but not exact, correlation between "Poor" structures and "Structurally Deficient" (SD) structures. All poor structures (min GCR≤4) are SD, but about 5% of VDOT's SD structures are in fair or good condition but have received the SD designation due to an Appraisal rating of 2 or less for Waterway Clearance or Structural Evaluation.*

The performance goals above were determined using an analysis of the annual transition of VDOT's structures from one condition classification to another. Recognizing that the bridge maintenance program requires a balanced approach, where the maintenance needs of structures in each of the three condition classifications are regularly addressed, the analysis sought to establish thresholds that would achieve the goal of maintaining the average GCR of the existing inventory over time. There is no unique solution for these goals (various combinations of thresholds for good, fair and poor could achieve the desired result of maintaining the average GCR). Prior to establishing the actual thresholds a transition study was performed to determine the number of structures whose minimum GCR either improves or deteriorates in any particular year. Since the goal of the study was to determine how structures deteriorate from the beginning to the end of a fiscal year (year-to-year). The numbers of actual year-to-year transitioned for the Fiscal Year is displayed in Chart 14, which depicts the number of structures that transitioned from one condition classification to another or moved up or down within a condition classification. The initial study focused on the transition between 2009 and 2010, and the numbers were used to establish a baseline and develop achievable goals for each condition classification.

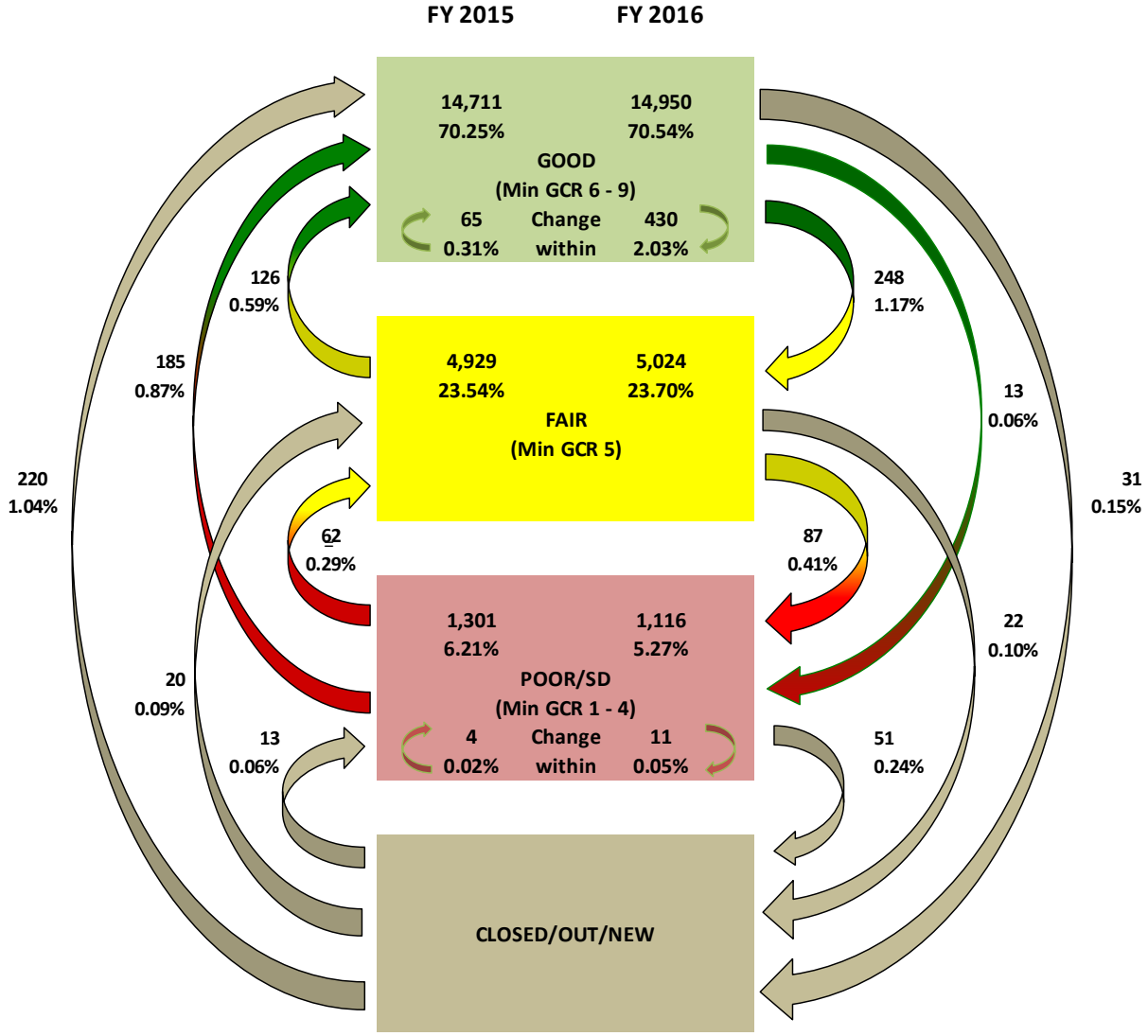
Based on the study, it was determined that system sustainability could be achieved with the goals shown above. Furthermore, these goals were deemed to be reasonably attainable with existing staff. However, the funding required to meet these goals remains significantly higher than that provided.

As shown in Chart 14, during FY 2016, 248 structures fell from "Good" to "Fair" condition and 126 structures were improved from "Fair" to "Good" condition. This analysis utilized only structures that were present in the inventory at both the beginning and end of the Fiscal Year, thus eliminating any influence of new, replaced and closed bridges.

While early preservation actions are significantly more cost-effective, the maintenance program cannot focus exclusively on the better structures. The age and condition of the inventory, along with the needs of the traveling public, require that poor structures be repaired, rehabilitated or replaced. These very real constraints have led VDOT to adopt a balanced approach to bridge maintenance, which is reflected in the three sets of performance goals.

The establishment of performance goals for bridges has received a great deal of attention nationally, and the Federal Highway Administration and AASHTO have been working to establish consensus on the best guidelines and methodologies.

Chart 14 – Annual Transitions of Good/Fair/Poor (SD) from FY2015 to FY2016



The most recent federal highway legislation, FAST-ACT establishes a minimum standard for NHS bridge conditions. If more than 10% of the total deck area of NHS bridges in a State is on structurally deficient bridges for three consecutive years, the State must devote National Highway Performance Program (NHPP) funds in an amount equal to 50% of the State's FY 2009 Highway Bridge Program apportionment to improve bridge conditions during the following fiscal year (and each year thereafter if the condition remains below the minimum). FAST-ACT also requires each state to establish and meet performance goals for its inventory. Nearly all of the AASHTO reports published to date have aligned closely with VDOT's methodology, recommending a balanced approach to both maintenance and measurement of performance. More information about the national effort to understand performance measurement and goals may be found in the following links and documents:

DRAFT Report to the AASHTO Subcommittee on Bridges and Structures (SCOBS)
Topic: Development of National Performance Measures for Highway Bridges
Presentations concerning performance measures for bridges:
http://bridges.transportation.org/Documents/2014%20SCOBS%20presentations/Technical%20Committee%20Presentations/T-9_9_Bruce%20Johnson_National%20Bridge%20Performance%20Measures.pdf

ANCILLARY STRUCTURES

Ancillary structures are rated using general condition rating definitions that are similar to those used in the FHWA's National Bridge Inventory System. General Condition Ratings (GCRs) are assigned based on a numerical grading system that ranges from 0 (failed condition) to 9 (excellent condition). Appendix K gives a brief description for each of the ratings and also provides illustrative examples.

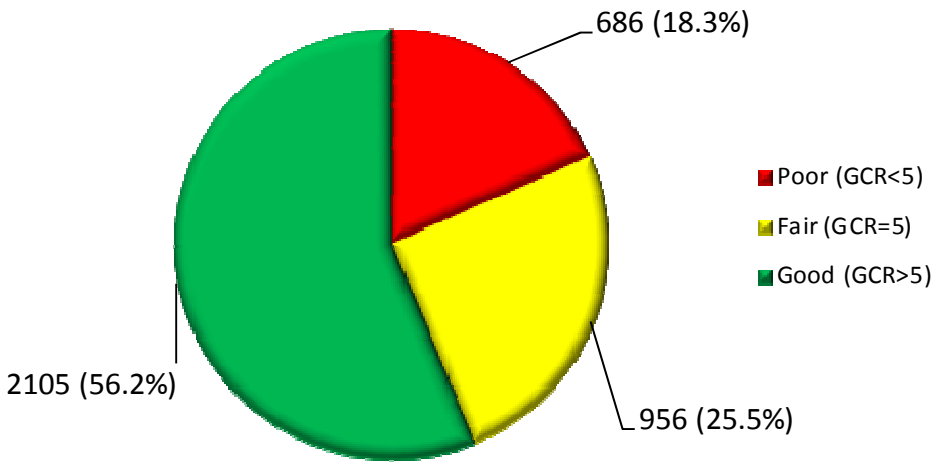
At the time of each inspection, inspectors assign a GCR for each of the major structural components: foundation; parapet mounting; and superstructure. They do not rate the appurtenances supported by the ancillary structure such as sign panels, light fixtures and traffic signals.

In order to develop a general understanding of the condition of the ancillary structure inventory, the nine condition ratings have been combined into three categories: Good (min. GCR > 5), Fair (min. GCR = 5) and Poor (min. GCR < 5). Summaries of the current conditions of the four general type structures are provided in Table 6 and Charts 15a through 15e.

Table 6 – Minimum General Condition by Structure Type

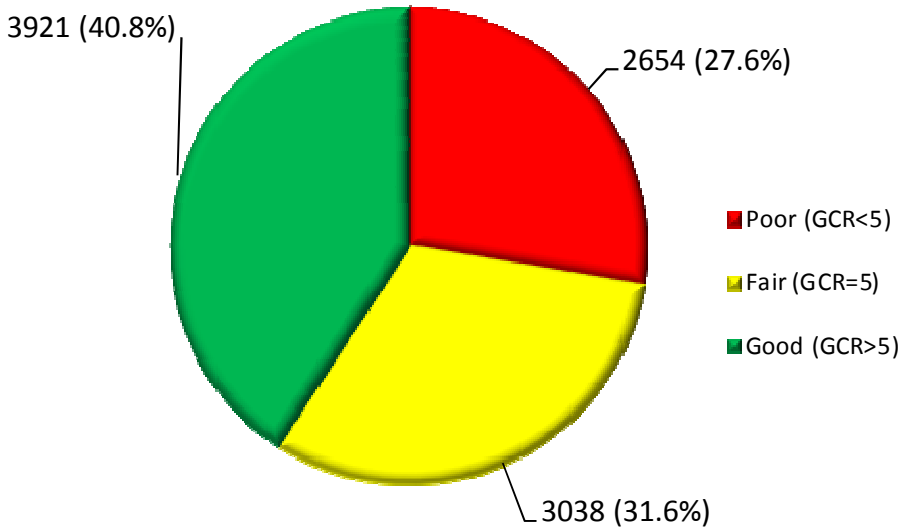
Structure Type	Condition Categories (No. of Structures)			Minimum General Condition Rating (Percentage)		
	Good	Fair	Poor	Good	Fair	Poor
Signs	2,105	956	686	56.2%	25.5%	18.3%
Signals	3,921	3,038	2,654	40.8%	31.6%	27.6%
High Mast Lights and Camera Poles	1,072	200	105	77.9%	14.5%	7.6%
Luminaires	7,541	6,101	5,986	38.4%	31.1%	30.5%
Total	**14,639**	**10,295**	**9,431**	**42.6%**	**30.0%**	**27.4%**

Chart 15a – Sign Structures by Minimum General Condition Rating



Note: Chart excludes ancillary structures with a GCR = 0 (out of service)

Chart 15b – Signal Structures by Minimum General Condition Rating



Note: Chart excludes ancillary structures with a GCR = 0 (out of service)

Chart 15c – High Mast Lights and Camera Poles by Minimum General Condition Rating

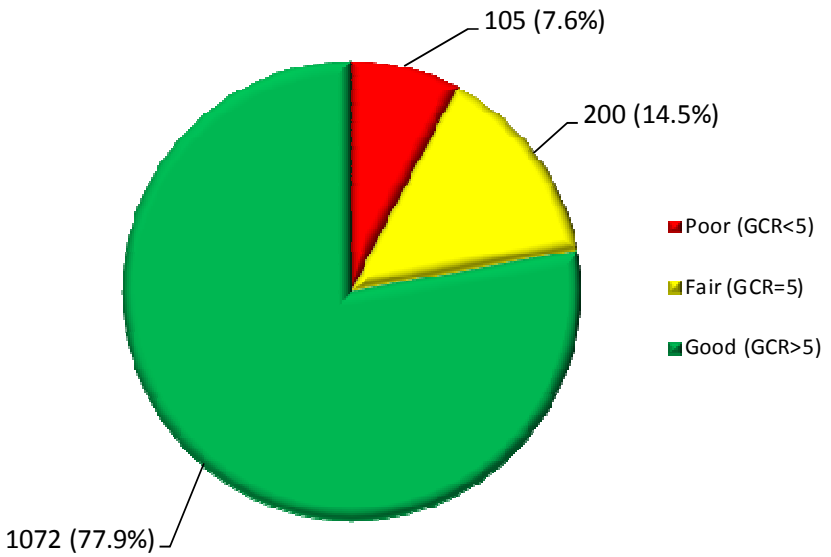
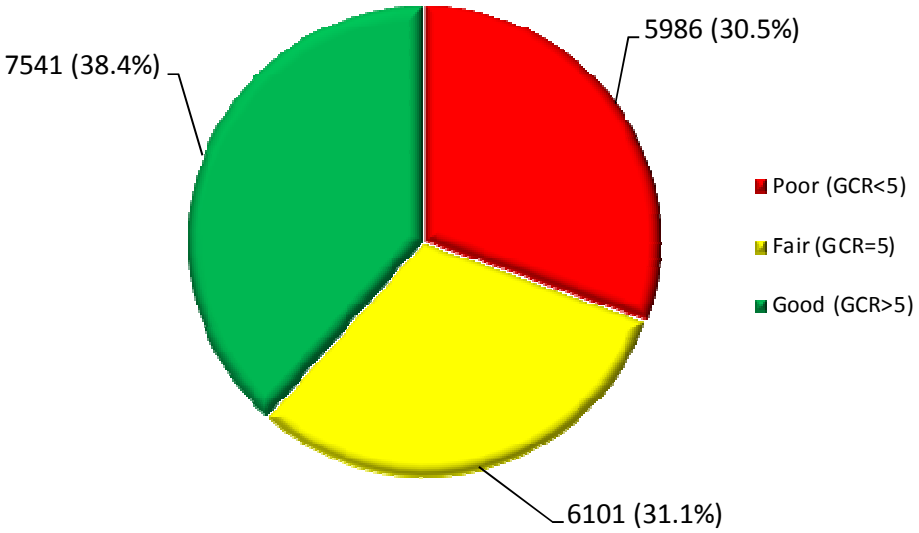


Chart 15d – Luminaires by Minimum General Condition Rating

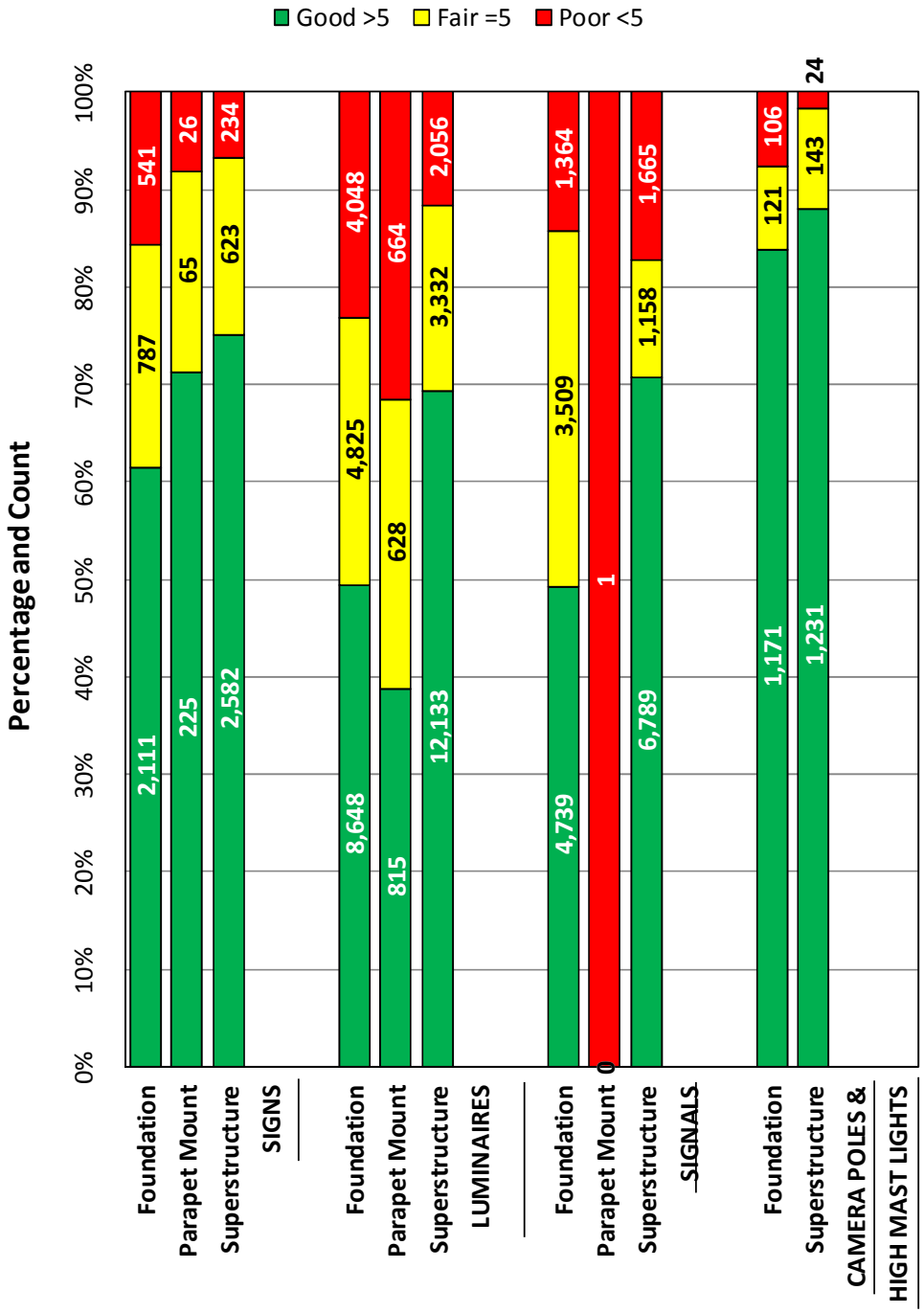
Note: Chart excludes ancillary structures with a GCR = 0 (out of service)



Note: Chart excludes ancillary structures with a GCR = 0 (out of service)

Chart 15e provides the condition of the ancillary structures by structural component by asset statewide. In Appendix K, other charts are presented to gain a more specific understanding of the conditions that cause structures to receive reduced GCRs.

Chart 15e – Statewide Ancillary Structure Condition by Asset Type



VDOT'S SPECIAL STRUCTURES

VDOT has identified a group of structures with characteristics that warrant special consideration for maintenance, repair and funding. These structures are large and/or complex and play a critical role in the function of the transportation network. They include large fixed-span bridges, movable bridges and tunnels. A list of the structures is provided below:

	STRUCTURE NAME	ROUTE CARRIED	DISTRICT
TUNNELS	Big Walker Mountain	I-77	Bristol
	East River Mountain	I-77	Bristol
	Hampton Roads Bridge Tunnel (HRBT)	I-64	Hampton Roads
	Monitor Merrimac Memorial Bridge Tunnel (MMBT)	I-664	Hampton Roads
	Elizabeth River Downtown Tunnel	I-264	Hampton Roads
	Elizabeth River Midtown Tunnels	Rt. 58	Hampton Roads
	Rosslyn Tunnel	I-66	Northern Virginia
MOVABLE BRIDGES	Chincoteague Bridge	Rt. 175	Hampton Roads
	High Rise Bridge	I-64	Hampton Roads
	Berkley Bridge	I-264	Hampton Roads
	Coleman Bridge	Rt. 17	Hampton Roads
	James River	Rt. 17	Hampton Roads
	Benjamin Harrison	Rt. 156	Richmond
	Eltham Bridge	Rt. 30/33	Fredericksburg
	Gwynn's Island Bridge	Rt. 223	Fredericksburg
COMPLEX STRUCTURES	Varina-Enon Bridge	I-295	Richmond
	Norris Bridge	Rt. 3	Fredericksburg
	HRBT Approach Bridges	I-64	Hampton Roads
	I-64 over Willoughby Bay	I-64	Hampton Roads
	MMMBT Approach Bridges	I-64	Hampton Roads
	James River Bridge Approach Spans	Rt. 17	Hampton Roads
	High Rise Bridge Approach Spans	I-64	Hampton Roads
	Pocahontas Parkway over James River	I-895	Richmond
	Smart Road Bridges	Smart Rd.	Salem
	460 Connector Bridges	Rt. 460	Bristol

These structures have one or more of the following traits that constitute critical features:

- High traffic in conjunction with a long detour
- Critical and non-redundant link for communities with significant population
- Structural complexity
- High maintenance and/or operational demands

Operational and maintenance responsibility for the tunnels resides with VDOT's Operations Division, while responsibility for the movable bridges is shared between the Operations and Structure and Bridge Divisions. Fixed span structures are inventoried and maintained by the Structure and Bridge Division.

Bridge Maintenance Crews

Each of the districts has two or more maintenance crews whose primary function is to maintain state-owned bridges and large culverts. They are supplemented by hired equipment operators to assist in their work. The type of work varies from preventive maintenance to complete replacement of smaller structures. The types of activities performed include the following:

Type of Work	Typical Activities performed
Preventive Maintenance	Deck sweeping, deck washing, beam end washing, deck patching, sealing cracks, thin overlays, joint rehabilitation, culvert cleaning, vegetation removal, etc…
Restorative Maintenance	Overlays, rail repair, superstructure repairs, substructure repairs, bearing repairs, painting, culvert repairs
Rehabilitation	Deck and superstructure replacement, major repairs to substructures and culverts
Replacement	Complete bridge and culvert replacement
Other	Special purchases of equipment or materials

DISTRICT	VDOT State Force Bridge Crews	
	No. Crews	Total Members
Bristol	6	36
Salem	5	35
Lynchburg	4	30
Richmond	4	27
Hampton Roads	5	36
Fredericksburg	2	16
Culpeper	3	33
Staunton	5	37
NOVA	3	21
Statewide	**37**	**271**

Table 7 gives a breakdown of the number of structures where work was performed and the associated costs for each of the 4 types of work.

Table 7 – Maintenance Work Performed By State Forces*

DISTRICT	Preventive		Restorative		Rehabilitation			Replacement			Other	State Force Expenses			Funds Allocated
	No.	Amount	No.	Amount	No.	No. SD	Amount	No.	No. SD	Amount	Amount	No.	No. SD	Amount	
Bristol	748	$1,193,895	179	$633,280	26	25	$1,871,925	4	4	$351,035	N/A	957	29	$4,050,135	$4,300,000
Salem	1,050	$1,141,337	122	$756,542	18	11	$573,781	6	6	$1,231,820	N/A	1,196	17	$3,703,480	$6,025,000
Lynchburg	74	$292,023	26	$97,339	6	3	$313,140	25	25	$3,862,682	$2,689,144***	131	28	$7,254,328	$7,254,328
Richmond	333	**	90	**	9	9	**	1	1	**	N/A	433	10	$4,053,000	$4,053,000
Hampton Roads	**	$682,000	**	$715,000	8	6	$428,000	2	2	$201,500	N/A	10	8	$2,026,500	$2,027,000
Fredericksburg	73	$476,000	17	$222,000	4	3	$169,000	3	3	$1,402,000	N/A	97	6	$2,269,000	$2,769,502
Culpeper	360	$1,000,000	**	$250,000	8	8	$1,750,000	12	12	$1,200,000	N/A	380	20	$4,200,000	$4,253,375
Staunton	844	$1,200,000	30	$2,310,000	13	10	$1,275,000	14	8	$1,288,000	N/A	901	18	$6,073,000	$5,900,000
NOVA	189	$1,453,634	98	$1,227,090	4	4	$167,307	1	1	$126,425	N/A	292	5	$2,974,456	$3,120,826
Statewide	**3,671**	**$7,438,889**	**562**	**$6,211,251**	**96**	**79**	**$6,548,153**	**68**	**62**	**$9,663,462**	**$2,689,144**	**4,397**	**141**	**$36,603,899**	**$39,703,031**

*Includes costs incurred by hired equipment operators in support of bridge crews

** Information not available

*** Equipment and bridge components to be installed FY17 by hired equipment

VDOT'S STRUCTURE & BRIDGE PROGRAM FUNDING

The S&B Division receives funding for bridge projects through two programs within VDOT: Highway System Acquisition and Construction Program, denoted hereafter as the Construction (603) Program, and Highway System Maintenance Program, denoted hereafter as the Maintenance (604) Program.

For the S&B Construction (603) Program for Fiscal Year 2016, the S&B Division reports on projects that are funded by MAP-21/FAST ACT Federal bridge funds as well as bridge specific allocation of CTB Formula state funds, together hereafter referred to as Bridge Funding. The Construction (603) Program also has projects that contain structures that are funded by other Federal and State revenue sources, which includes Design-Build Program projects that contain structures.

The S&B Division apportionment of the Construction (603) Program is primarily supported by a federal fund formerly known as the Highway Bridge Replacement Program (HBRRP), created in 1978 by the Surface Transportation Assistance Act. The HBRRP was established by the United States Congress to provide a funding source for the nation's in-service bridges. The original intent of the program was to fund bridge rehabilitation and replacement needs. The 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFETEA-LU) established extensive new resources and opportunities to fund bridge construction. Federal Funds apportioned as HBRRP must be allocated and obligated as required by federal law to eligible projects. VDOT used the anticipated federal bridge allocations to create what is known as the Dedicated Bridge Fund (DBF). Funding eligibility for bridge projects then extended beyond replacement and rehabilitation to include preservation activities.

On October 1, 2012, the federal government implemented a new funding program to replace SAFETEA-LU called MAP-21. The federal programs for these revenues are the National Highway Participation Program (NHPP) and the Surface Transportation Program (STP). MAP-21 created three funding sources for the S&B Construction (603) Program, denoted as NHPP-BR, STP-BR and STP-BROS (labelled as off system).

- NHPP-BR funds are designated for structures on the National Highway System (NHS).
- STP-BR funds are the most flexible type funds. They can be used on any bridge project regardless of roadway classification or NBI status.
- STP-BROS funds can only be used for bridges that are not on the NHS. The STP program maintains a requirement that no less than 15% and no greater than 35% of apportioned funds be placed on projects that are not on the NHS.

On December 4, 2015, the federal government signed into law a new program to replace MAP-21, called FAST ACT, which generally continues the same bridge funding requirements that were placed into effect with MAP-21. The only change related to bridges is the removal of the National Highway System requirement under the NHPP program. NHPP funds obligated on projects after December 4, 2015 can be used on any Federal Aid Highway bridge project.

In order to supplement the Federal fund apportionments from FAST ACT and MAP-21, the Governor's Transportation Package of 2012 introduced a new state-based funding source, known as the Commonwealth Transportation Board (CTB) Fund, which started in FY2014. This package, adopted by Virginia General Assembly, required that 25% of the CTB Fund be directed toward the S&B Construction (603) Program for the period of FY2014 through FY2020. In FY2016, S&B Division had distribution responsibility for both MAP-21 and CTB Bridge funds. The CTB Bridge funds are being utilized to supplement program priorities. After passage of the Governor's Transportation package, the S&B Construction (603) Program was comprised of two areas: DBF, which included all Federal Funding Sources, and the CTB Funds, which were generally based on state revenues.

Projects initiated through the DBF and CTB were required to meet the following eligibility criteria:

1. The bridge is deficient (structurally deficient)
2. No major rehab or reconstruction has been done to the bridge in the last 10 years regardless of the funding source or type that was used
3. Estimated project cost is less than $20 million
4. Only VDOT owned bridges through FY2020

Federal funds associated with DBF and CTB Fund projects are apportioned to the S&B Division by the VDOT Infrastructure Investment Division (IID). NHPP-BR and STP-BR funding levels are apportioned at the discretion of the VDOT IID. The STP-BROS funding levels are set aside at no less than 15% and no more than 35% of the State's Highway Bridge Program apportionment.

The S&B Division then distributed the bridge program funds among the nine (9) VDOT District Bridge offices based on a distribution formula developed by Central Office S&B Division. This formula allocated funds for each district based on the square footage area of deficient bridges and the number of structurally deficient structures that are not currently funded in each district. The Districts distributed their allocated funds based on structural priorities. A ranking formula was developed to aid in prioritizing the funding and programming of eligible projects. The formula considers the following equally weighted factors: Average Daily Traffic (ADT), Truck ADT, Weight Restrictions, Detour Length, Fracture Critical, Scour Critical, Structural Deficiency, General Condition Rating, Substandard Roadway Width; and Age. This methodology is monitored yearly for continuous improvement.

Two recent acts of the Virginia General Assembly, HB 2 and HB 1887, significantly re-ordered the Commonwealth's transportation construction funding and project selection process. HB 2, now known as "SMART SCALE", was developed to provide dedicated funding to improve safety and relieve congestion in Virginia's transportation network. All SMART SCALE candidate projects must be submitted by regional entities including Metropolitan Planning Organizations (MPOs) and Planning District Commissions (PDCs), along with public transit agencies and cities and towns that maintain their own infrastructure. Projects are selected through an objective scoring formula that favors projects that improve safety or throughput capacity at low cost. In general, projects that improve conditions of existing assets without adding capacity or improving safety do not score well with the SMART SCALE formula. While some SMART SCALE projects

will include replacement or rehabilitation of existing bridges, improvement of existing asset condition is not the intended emphasis of the program.

HB 1887, now known as the State of Good Repair (SGR), was instituted to supplement the SMART SCALE program and provide a dedicated funding source for the improvement of the condition of Virginia's bridges and pavements. HB 1887 mandated that 45% of the Virginia's Construction (603) program be used for the exclusive purpose of improving Virginia's deficient bridges and pavements. The SGR program will replace and consolidate the previous sources of funding for Virginia's bridge construction and will include both VDOT and locality-owned bridges. Projects funded through the CTB Fund or DBF will continue through 2020, but starting in FY2021 all Construction (603) program funds for bridges will be allocated through either the SGR or SMART SCALE programs.

While the SGR program was intended to begin in FY2021, an unanticipated influx of funding became available in FY 2016 and was used to begin the SGR program immediately. Accordingly, for Fiscal Years 2017 through 2020, Virginia's Bridge Construction (603) program will be funded from previous sources (DBF, CTB) and current/future sources (SGR). The table below shows how the funding stream is transitioning over the next several years.

Table F-001. – Breakdown of Bridge Funding Fiscal Years 2016-2022

Bridge Funding Breakdown by Fiscal Year FY16 Forward				
Fiscal Year	**CTB Funds and DBF - All Sources**	**SGR - VDOT**	**SGR - LOCAL**	**Bridge Funds - All Sources**
FY 2016	$123,658,554	N/A	N/A	**$123,658,554**
FY 2017	$118,943,248	$99,384,417	$17,634,814	**$235,962,479**
FY 2018	$158,500,763	$47,633,571	$8,452,121	**$214,586,455**
FY 2019	$204,374,544	$40,671,454	$8,387,756	**$253,433,754**
FY 2020	$203,338,182	$23,988,473	$5,463,088	**$232,789,743**
FY 2021	N/A	$206,734,414	$37,930,646	**$244,665,060**
FY 2022	N/A	$203,188,815	$37,342,553	**$240,531,368**

Future Construction (603) Program funds will be distributed through VDOT's Asset Management Division (AMD) using a needs-based distribution formula that allocates funding to 36 district groups. The funding groups are comprised of two VDOT funds per district (one for pavements, another for bridges) and two locality funds per district (one for pavements, another for bridges).

In accordance with the June 14, 2016 Resolution of the Commonwealth Transportation Board, structures will be selected for SGR funds based on a prioritization formula as outlined below.

Priority = a (IF) + b (CF) + c (DRF) + d (SCF) + e (CEF)

- Maximum = 1.00 (highest priority); Minimum = 0.00 (lowest priority)
- Where a, b, c, d, e are weighting coefficients and ∑ (a, b, c, d, e) = 1.0

The formulas below describe the methodology for computing the raw scores for each of the variables. The formula is based on the five (5) variables below, each of which varies from 0.00 to 1.00

IF = Importance Factor - measures the relative importance of each bridge to the overall highway network

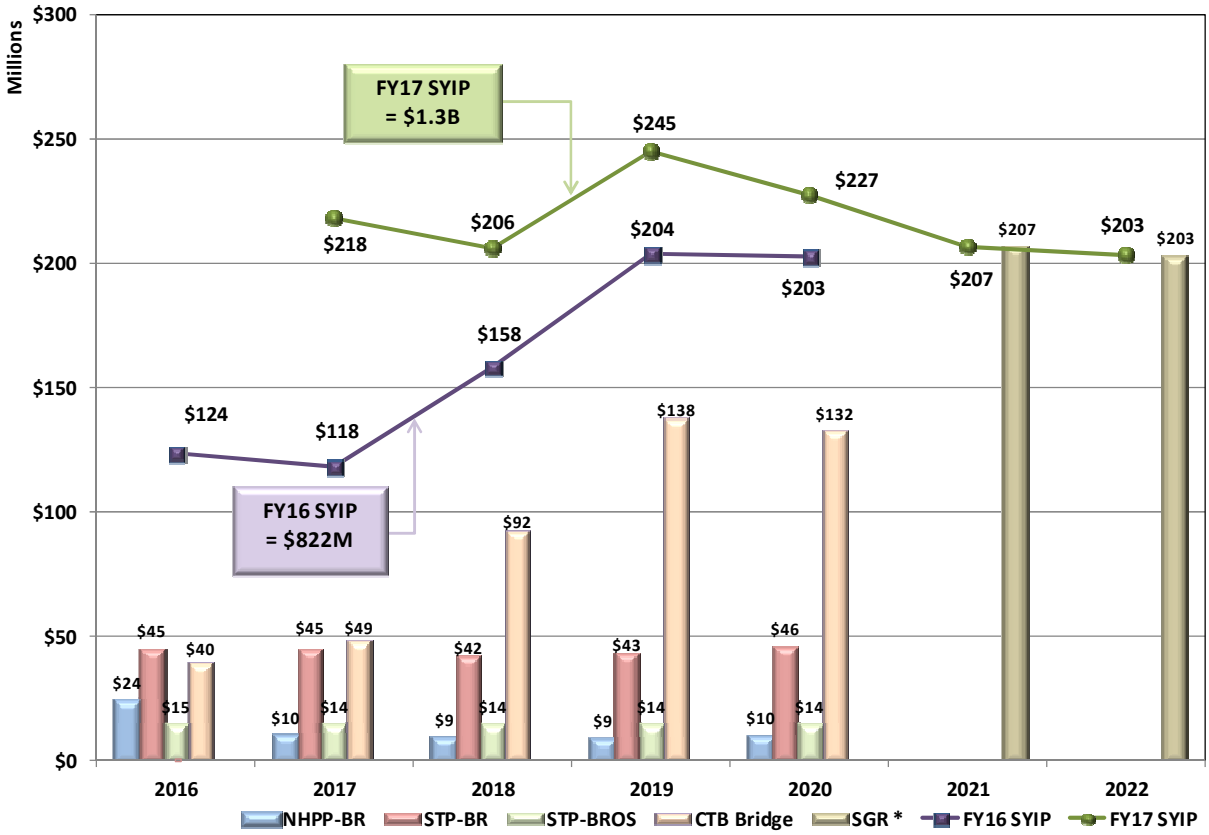
CF = Condition Factor – measures the overall physical condition of each bridge based on the condition of each individual element

DRF = Design Redundancy Factor - measures four important risk factors: Fracture Critical, Scour Susceptibility, Presence of fatigue prone details, and Earthquake vulnerability

SCF = Structure Capacity Factor- measures the capacity of the structure to convey traffic, including the effects of weight restrictions, waterway adequacy, vertical clearance and deck width

CEF = Cost-Effectiveness Factor - measures the cost-effectiveness of the required work

Chart 16 – S&B Construction (603) Program Funding FY2016 SYIP vs. FY2017 SYIP (VDOT & Localities)

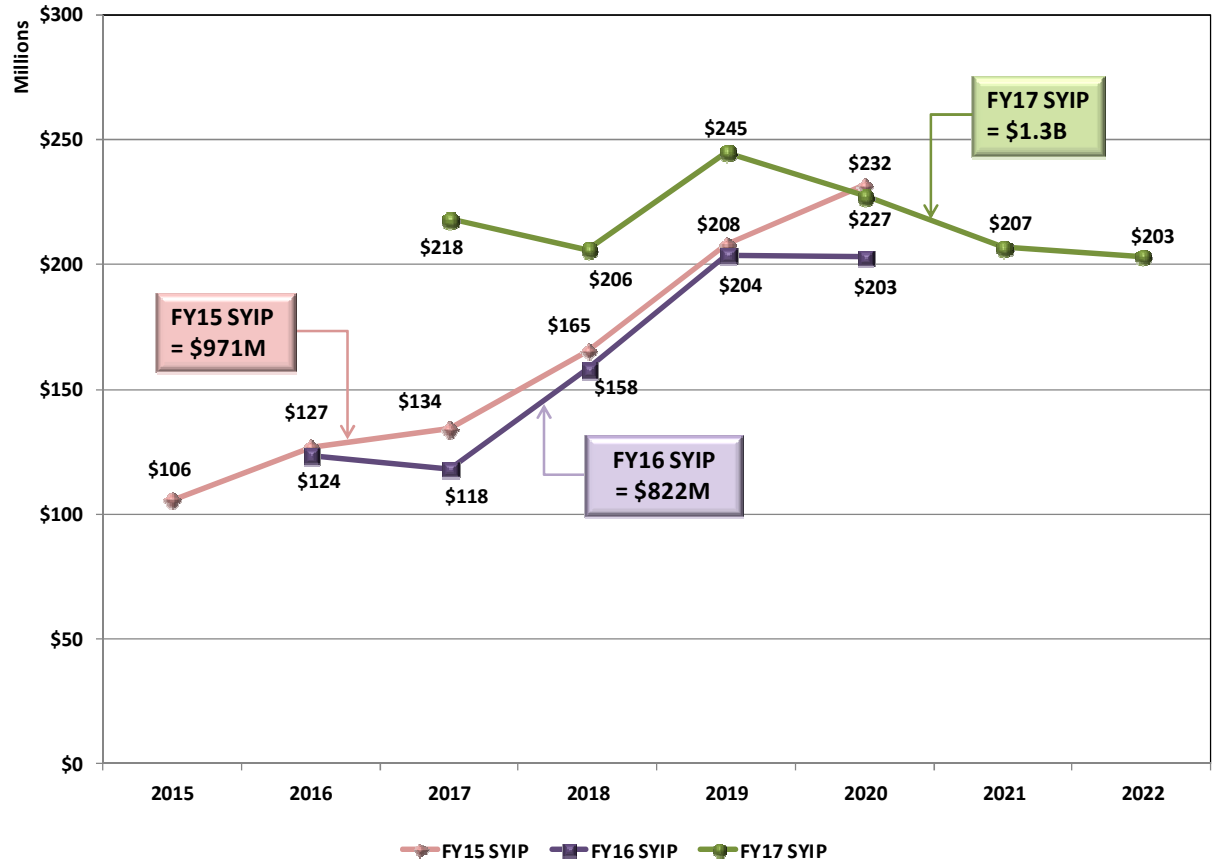


* SGR funds shown for FY21 & FY22 were not adotped until FY17 SYIP. Illustrated here to complete comparison between FY16 & FY17 SYIPs.

The CTB Bridge funds made up approximately 32% of the FY2016 Six Year S&B Construction (603) Program. The majority of the CTB Bridge funds are expected in FY2018 through FY2020.

The three curves shown in Chart 17 compare the funding plans for fiscal years 2015, 2016 and 2017. Each curve displays the six-year improvement plan as it was established at the beginning of the fiscal year. FY2016 only depicts five years of funding, through FY2020, due to the ongoing process to finalize distribution of FY2021 State of Good Repair funding. FY2017 includes the newly added SGR Program revenues.

Chart 17 – S&B Construction (603) Program Comparison from FY2014, FY2015 and FY2016 (VDOT & Localities)



Construction (603) Program Expenditures

Structure project expenditures are derived from the VDOT Cardinal Accounting System. These expenditures are grouped into three separate categories for the S&B Construction (603) Program reporting purposes (Bridge Funding Projects, Design Build Bridge Projects, Construction (603) Program Bridge Projects containing no Bridge Funding). The following categories were used in determining bridge-related expenditures:

1. S&B Construction (603) Program Projects (Bridge Funding Projects)
2. Design Build program projects containing structures
3. All projects containing structures funded by means other than Bridge Funding (examples include CPR and GARVEE Bonds, CTB Formula Statewide funds, etc.)

Category 3 was determined by using the Project Pool VDOT system to determine projects that contain structure work. As the Cardinal Accounting System used to capture expenditures is limited in its capacity to separate expenditures related to bridge work versus other work on projects, this report adopts the convention of including all expenditures related to projects containing bridge work.

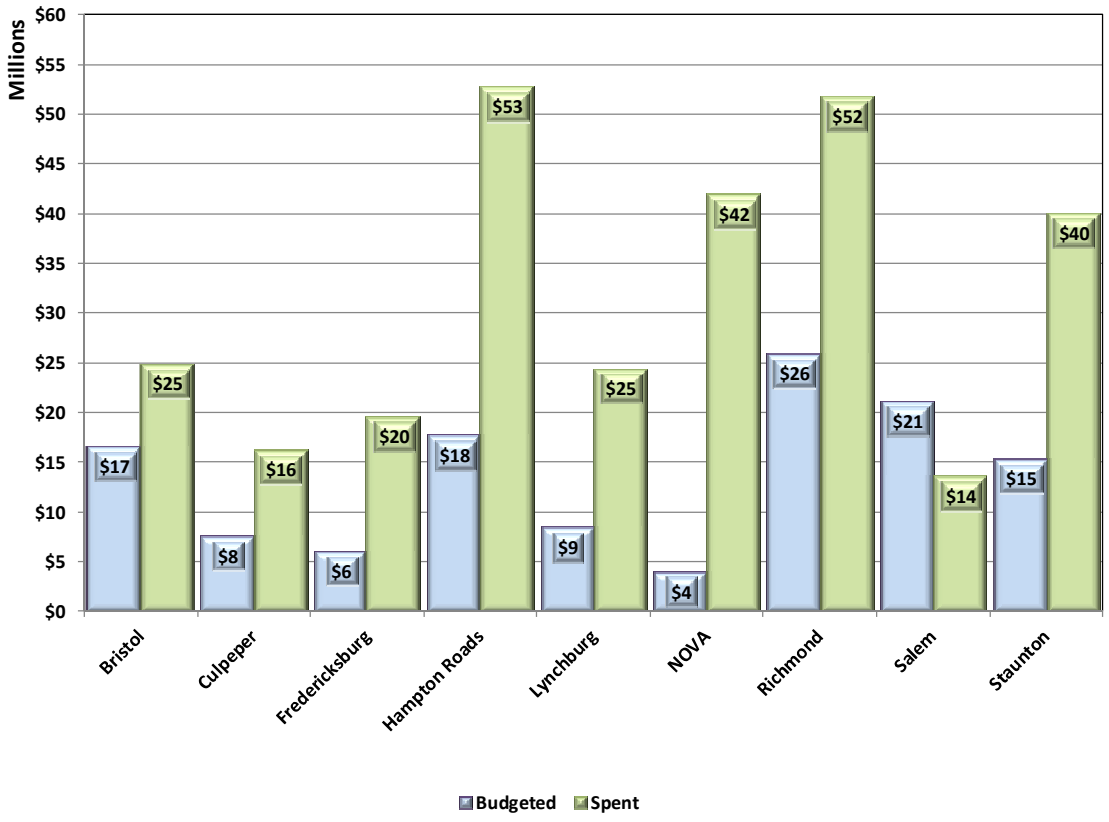
Approximate structure project expenditures based on data derived from the VDOT Cardinal Accounting System for FY16 were as follows:

1. $286M for Bridge Funding Projects
2. $6M for Design Build Projects containing bridges
3. $20.5M for Bridge Projects funded by other means

Chart 18 below shows the District distribution of the $124M allocated to the bridge program in FY2016 and actual expenditures for bridge projects in the S&B Construction (603) Program in FY2016. The program was budgeted for $124M and had $286M in total expenditures. Unspent funds are not lost but rather carry over with the project into the subsequent fiscal year. Differences between the anticipated pace of funding and the spent amounts are often the result of a difference between the anticipated pace of construction and the actual pace. For the same reason, all districts with the exception of Salem actually spent more than allocated, as funds from previous year(s) carried over on certain projects.

Chart 18 – S&B Construction (603) Program FY2016 Budget vs. Expenditures by District

The difference between budgeted and actual expenditures can be primarily attributed to the multi-year nature of the SYIP projects and should not imply that project budgets are being exceeded. Districts can transfer funds with other districts throughout the year to ensure statewide program funding effectiveness and efficiency.



S&B Maintenance (604) Program Overview

The S&B Maintenance (604) Program is developed and managed by the District Bridge Offices. VDOT's Asset Management Division (AMD) allocates these funds to each district maintenance office and the Central Office S&B Division every fiscal year in accordance with the direction of VDOT's Executive Management.

Allocations represent a suggested funding level for each of the activities that require Maintenance (604) Program funds. The allocations are based on a proportional formula that determines the suggested funding level based on the program needs as submitted in the Annual Needs Report by AMD. AMD generates the Annual Needs Report using estimates determined by the various responsible divisions. The term "allocation", as used in the process, does not represent an actual funding amount; it is a recommended funding level for particular activities and Cost Centers (CSCs). District Maintenance Managers (DMM) use the allocations as a guide to build budgets, which establishes the actual funding amount for each of the program areas for which the manager has funding responsibility.

The needs for the S&B Maintenance (604) Program are developed by the S&B Central Office staff. The reported needs do not represent the total funding required to improve all of the structures. S&B Division reports needs for the amount of money required to meet its performance goals. The S&B Division 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.

The S&B Maintenance (604) Program budget in FY2016 was $199.8M. In recent years the calculated monetary need for bridge maintenance and construction has significantly exceeded available funding. The availability of funding is the most significant factor in the performance of the bridge inventory. The S&B Division's single performance measure limits the percentage of structurally deficient structures to 8%. In recent years, the percentage of structurally deficient (poor) structures has steadily decreased, reflecting an apparent improvement in bridge conditions. However, while the number of poor structures has indeed decreased, the overall condition of the inventory has not improved. This slow decrease in overall condition can primarily be attributed to the gap between required and available funding. Allocated funds are often used to address structures in immediate need of repair or replacement, leaving less money than required for preventive maintenance.

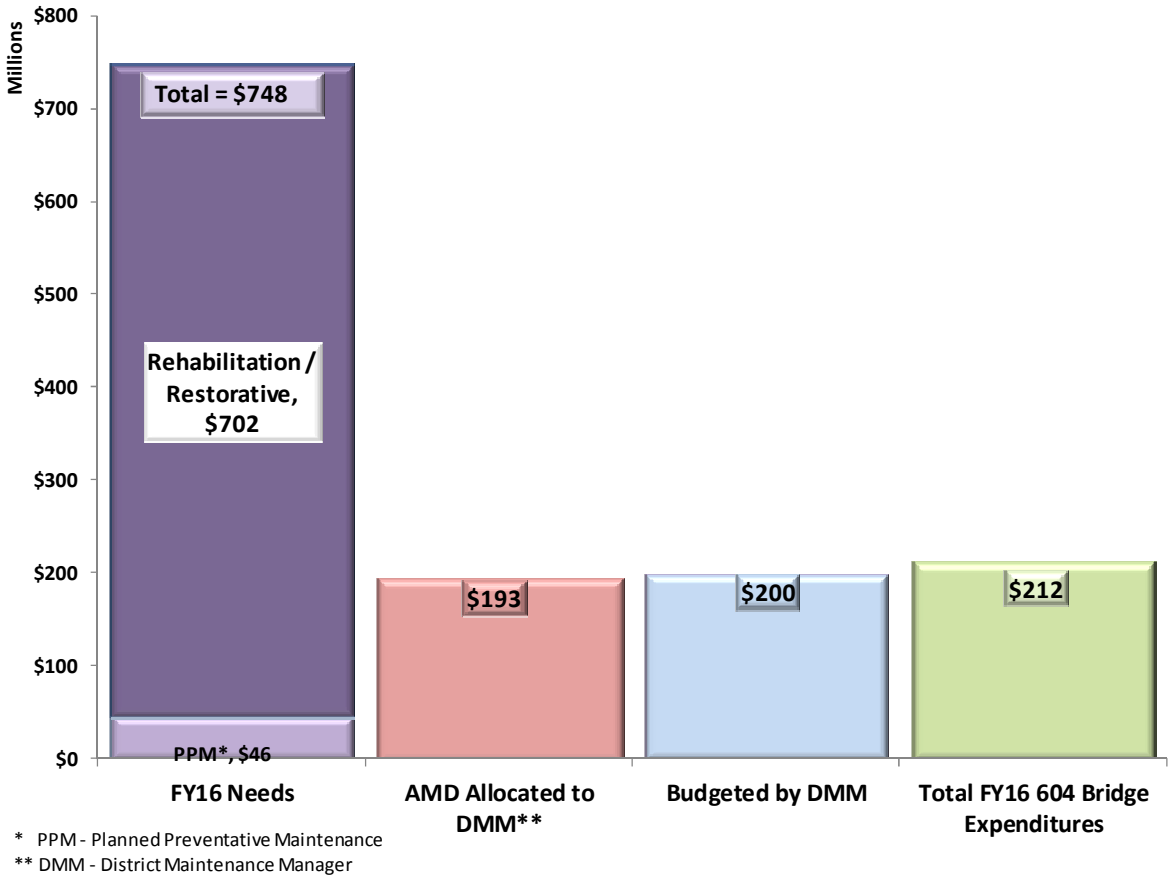
Another significant factor affecting long-term performance relates to the selection of structures scheduled for replacement or major rehabilitation. In recent years, available funding in the construction program has often led to smaller structures being selected for this work. This has resulted in a notable reduction in the number of poor structures. However, by selecting smaller, less expensive structures for replacement and rehabilitation, we are also developing a backlog of larger, more expensive structures that will soon require significant work.

Bridge deterioration occurs over a period of decades rather than months or years, so the results of short-term funding deficiencies will not necessarily be readily evident in near-term trends of conditions. However, over time, if the funding for bridge maintenance and replacement

is not increased, we should expect to see significant degradation of the average bridge conditions.

Chart 19 below compares the total amounts of the S&B Maintenance (604) Program needs, allocations provided to the DMM by the OPO, the actual S&B Division budget built by the DMM and the expenditures for FY2016.

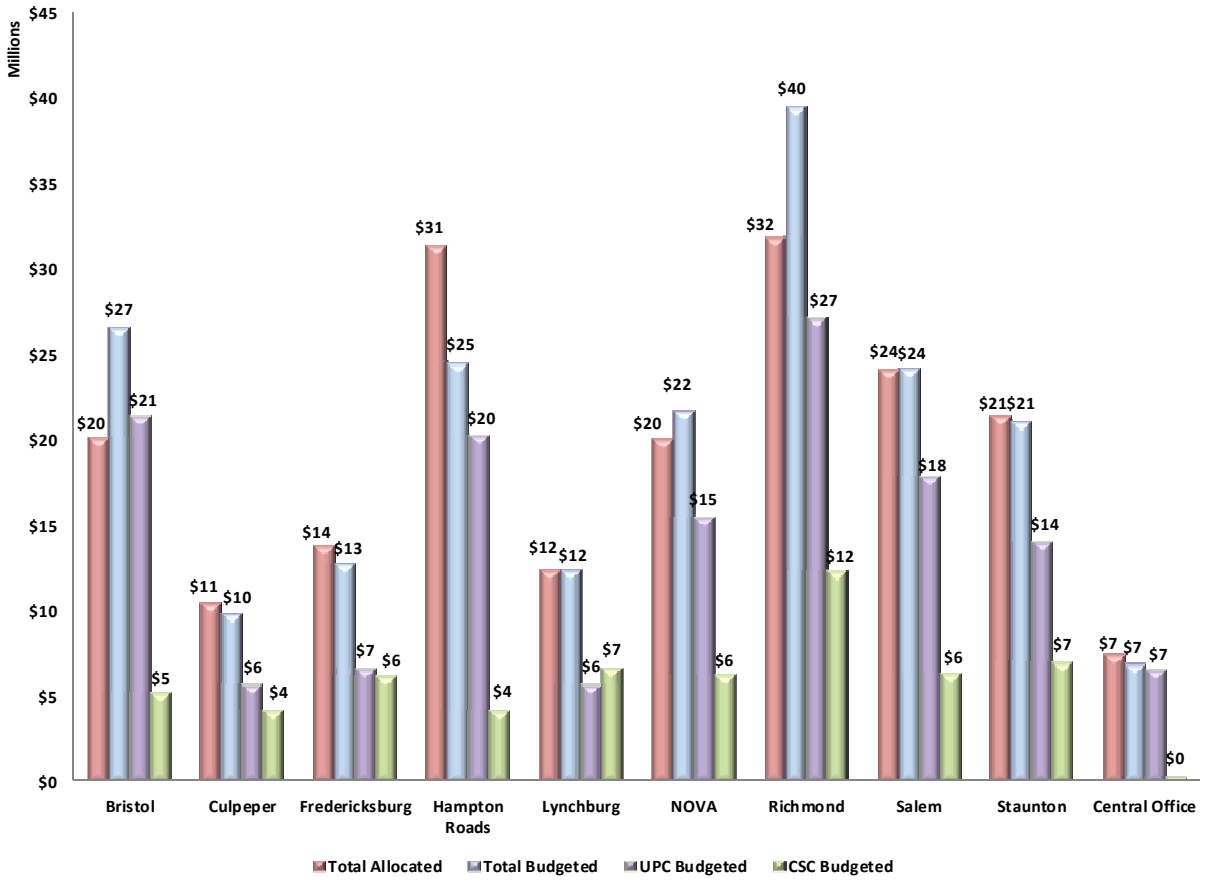
Chart 19 – FY2016 S&B Maintenance (604) Program Overview



* PPM - Planned Preventative Maintenance
** DMM - District Maintenance Manager

Chart 20 below provides a breakdown, by District, of the total S&B Maintenance (604) Program. This is typically around $150M per year. Inspection comprised $36.5M of the $199.8M budgeted by the DMM in FY 2016, and $34.2M of the $212M expended.

Chart 20 – FY2016 S&B Maintenance (604) Program Distribution by District



The S&B Maintenance (604) Program budget is built utilizing both CSCs and UPCs. The nature of CSC and UPC are such that it is possible for expenditures to exceed amounts budgeted. CSCs can pull funds from other CSCs within the district to accommodate expenditures in excess of budgeted figures. Excess UPC expenditures can be primarily attributed to the multi-year nature of the SYIP projects and should not imply that project budgets are being exceeded. Another factor that can attribute to the excess expenditures in the Maintenance (604) Program is the awarding of Bonus Obligation Authority (Bonus OA) funds that may be allocated mid-year. If VDOT is awarded Bonus OA funds from FHWA, a portion of those funds may be given to the S&B Division under the Maintenance (604) Program. In recent years, VDOT has been awarded Bonus OA funds and a partition provided to the S&B Division for tasks such as joint elimination and repairs and deck overlays. These funds are not included in the VDOT overall budget as they are not guaranteed to be available, however, they are included in the totals for end-of-year expenditures.

Chart 21 below shows the bridge maintenance funds budgeted and spent per district for FY2016. In FY2016, the S&B Maintenance (604) Program was originally budgeted $199.8M and expended $212M.

Chart 21 – FY2016 S&B 604 Maintenance Program Total Budgeted and Spent

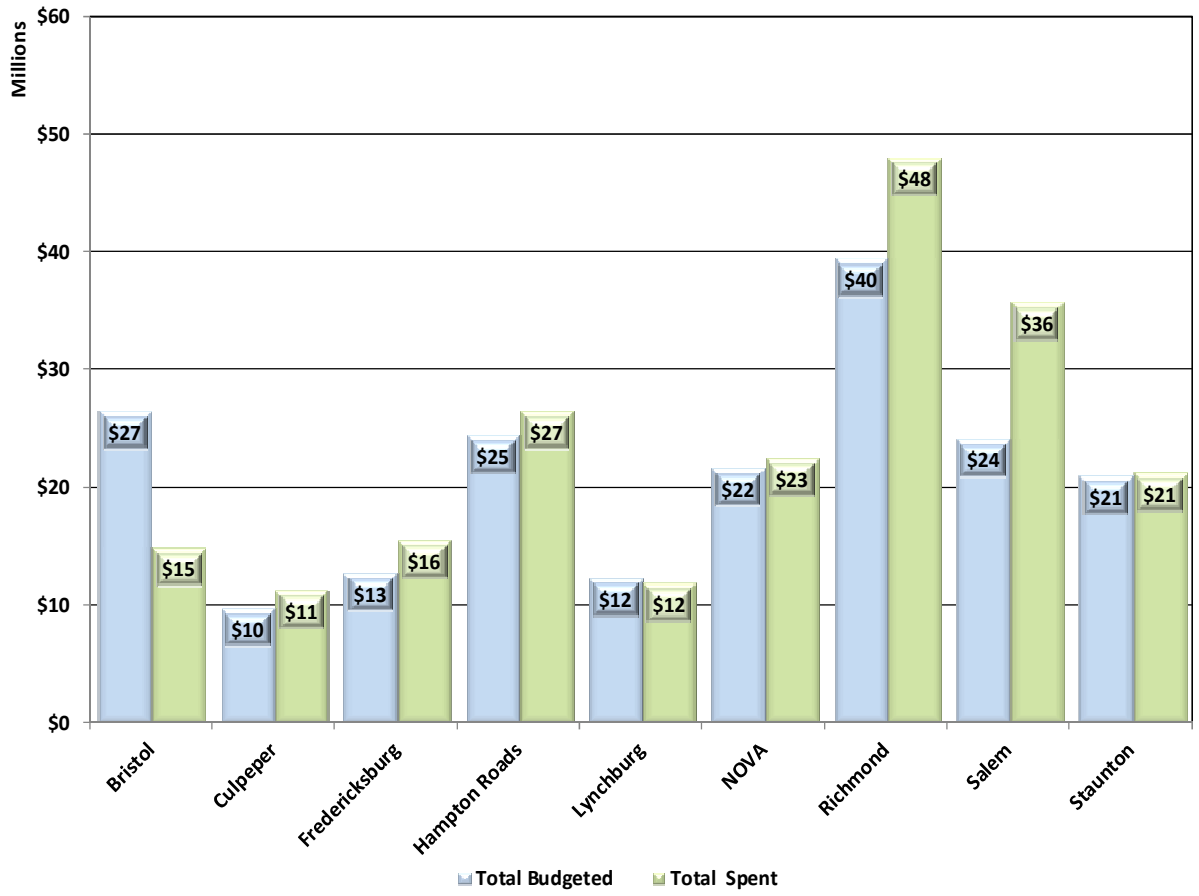


Chart 22 compares original budget and expenditures for district CSCs. Most of the budgeted funds not spent in the CSCs can be attributed to accommodating the high cost of snow removal for the districts during FY2016.

Chart 22 – FY2016 S&B Maintenance (604) Program CSC Budgeted and Spent

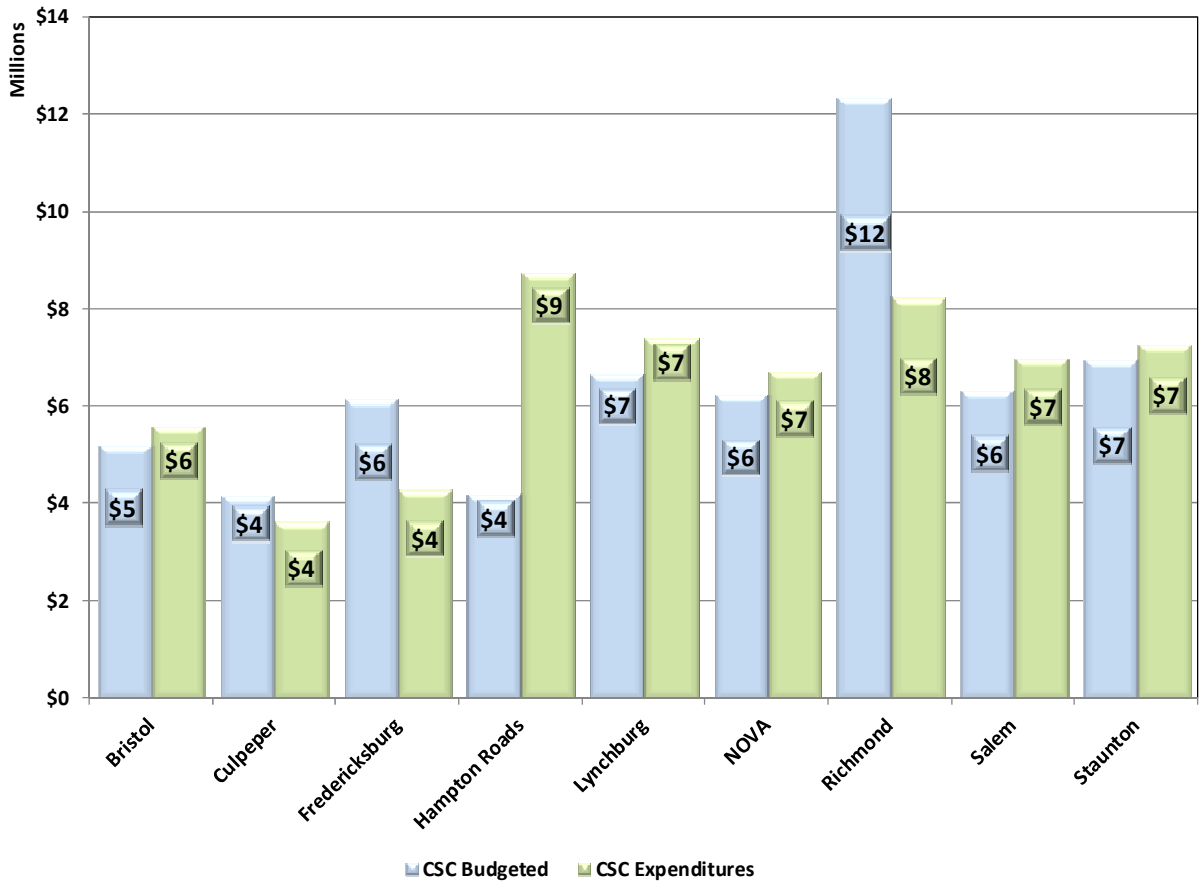


Chart 23 below illustrates the bridge maintenance UPC funds budgeted and spent per district for FY2016. The differences between amounts budgeted and spent can be attributed to the nature of UPCs. Maintenance (604) Program UPC project funding does not necessarily align with UPC project spending in the Construction (603) Program due to the classification of projects in each program. The funding is established by the project, which may take place over multiple fiscal years, and spending is tracked on an annual basis by fiscal year. One such example is Salem District's multiple superstructure replacement contracts that are funded with S&B Maintenance (604) Program funds and have not yet been awarded for construction. Therefore, these projects are not yet incurring charges. The Fredericksburg District provides another example of overspending, as they are spending funds on contracts that are under construction but mostly funded in previous fiscal years. These funds may be carried forward to the current fiscal year to be spent but not reported under the beginning of the year budget, thus the perception of overspending. Another example of overspending would be emergency operations that may require maintenance reserve funds to be utilized.

Chart 23 – S&B Maintenance (604) Program FY2016 UPC Budgeted and Spent

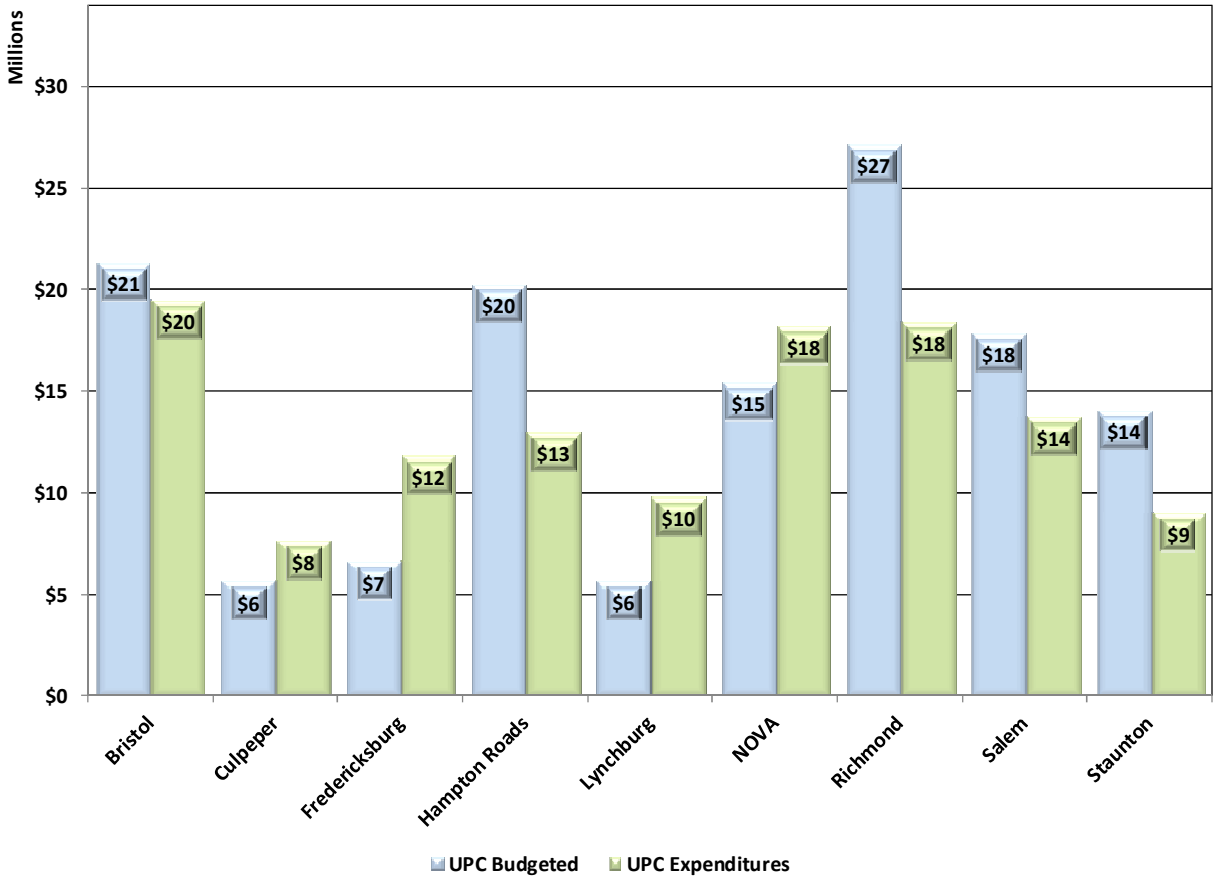
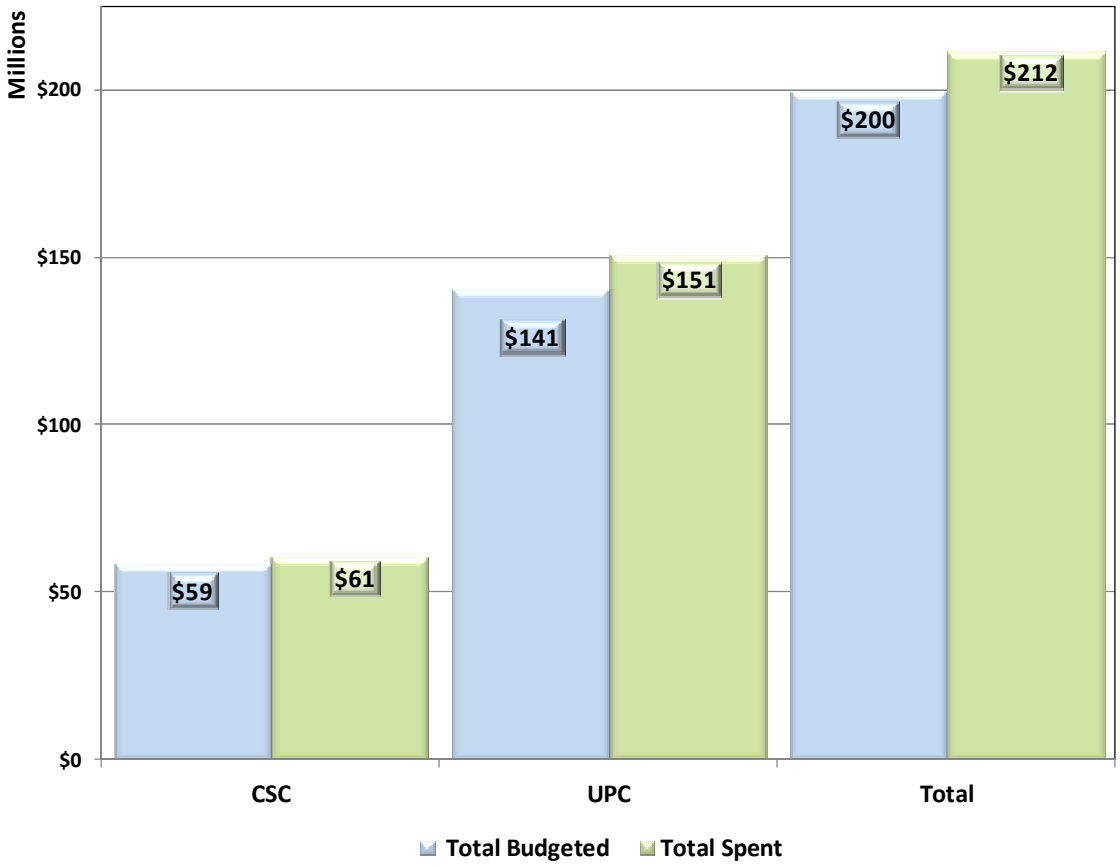


Chart 24 below displays the total S&B Maintenance (604) Program funds budgeted and spent for FY2016 by CSC and UPC.

Chart 24 – FY2016 S&B 604 Maintenance Program UPC Budgeted and Spent



APPENDIX A – ADDITIONAL INVENTORY INFORMATION ON BRIDGES AND LARGE CULVERTS

Tables A.1 through A.6 provide counts of the number of bridges and large culverts in Virginia. Tables A.1 and A.2 address the total statewide; Tables A.3 and A.4 address NBI structures; Tables A.5 and A.6 address Non-NBI structures. Charts A.1 through A.4 show the average age of structures by system and district.

Table A.1 – Total Number of Bridges by District

DISTRICT	Number of Bridges				
	Interstate	Primary	Secondary	Urban	Total
Bristol	136	548	1,559	188	2,431
Salem	117	482	1,348	73	2,020
Lynchburg	0	364	798	40	1,202
Richmond	281	492	669	100	1,542
Hampton Roads	335	337	300	221	1,193
Fredericksburg	23	143	214	6	386
Culpeper	71	256	677	11	1,015
Staunton	205	507	1,378	66	2,156
NOVA	257	334	548	17	1,156
Statewide	**1,425**	**3,463**	**7,491**	**722**	**13,101**

Table A.2 – Total Number of Large Culverts by District

DISTRICT	Number of Culverts				
	Interstate	Primary	Secondary	Urban	Total
Bristol	80	408	474	17	979
Salem	101	330	588	29	1,048
Lynchburg	0	293	573	18	884
Richmond	240	291	458	60	1,049
Hampton Roads	121	116	197	70	504
Fredericksburg	58	111	262	1	432
Culpeper	50	241	383	11	685
Staunton	224	320	753	46	1,343
NOVA	122	211	704	28	1,065
Statewide	**996**	**2,321**	**4,392**	**280**	**7,989**

Table A.3 – Total Number of NBI Bridges by District

DISTRICT	Number of Bridges				
	Interstate	Primary	Secondary	Urban	Total
Bristol	136	419	987	185	1,727
Salem	113	369	899	72	1,453
Lynchburg	0	330	676	40	1,046
Richmond	278	461	610	98	1,447
Hampton Roads	335	329	275	220	1,159
Fredericksburg	23	135	191	6	355
Culpeper	71	169	515	10	765
Staunton	205	375	804	65	1,449
NOVA	257	299	447	17	1,020
Statewide	**1,418**	**2,886**	**5,404**	**713**	**10,421**

Table A.4 – Total Number of NBI Large Culverts by District

DISTRICT	Number of Culverts				
	Interstate	Primary	Secondary	Urban	Total
Bristol	28	101	129	17	275
Salem	27	84	235	23	369
Lynchburg	0	83	231	18	332
Richmond	87	119	241	60	507
Hampton Roads	41	40	94	66	241
Fredericksburg	22	42	112	1	177
Culpeper	14	72	170	7	263
Staunton	50	83	238	42	413
NOVA	28	97	342	27	494
Statewide	**297**	**721**	**1,792**	**261**	**3,071**

Table A.5 – Total Number of Non-NBI Bridges by District

DISTRICT	Number of Bridges				
	Interstate	Primary	Secondary	Urban	Total
Bristol	0	129	572	3	704
Salem	4	113	449	1	567
Lynchburg	0	34	122	0	156
Richmond	3	31	59	2	95
Hampton Roads	0	8	25	1	34
Fredericksburg	0	8	23	0	31
Culpeper	0	87	162	1	250
Staunton	0	132	574	1	707
NOVA	0	35	101	0	136
Statewide	**7**	**577**	**2,087**	**9**	**2,680**

Table A.6 – Total Number of Non-NBI Large Culverts by District

DISTRICT	Number of Culverts				
	Interstate	Primary	Secondary	Urban	Total
Bristol	52	307	345	0	704
Salem	74	246	353	6	679
Lynchburg	0	210	342	0	552
Richmond	153	172	217	0	542
Hampton Roads	80	76	103	4	263
Fredericksburg	36	69	150	0	255
Culpeper	36	169	213	4	422
Staunton	174	237	515	4	930
NOVA	94	114	362	1	571
Statewide	**699**	**1,600**	**2,600**	**19**	**4,918**

Table A.7 – Total Number of NBI Bridges on NHS by District

DISTRICT	Number of Bridges				
	Interstate	Primary	Secondary	Urban	Total
Bristol	136	135	2	1	274
Salem	112	183	0	1	296
Lynchburg	0	168	1	0	169
Richmond	274	277	12	6	569
Hampton Roads	334	194	2	66	596
Fredericksburg	23	72	1	2	98
Culpeper	70	53	0	2	125
Staunton	203	118	0	1	322
NOVA	252	235	29	0	516
Statewide	**1,404**	**1,435**	**47**	**79**	**2,965**

Table A.8 – Total Number of NBI Large Culverts on NHS by District

DISTRICT	Number of Culverts				
	Interstate	Primary	Secondary	Urban	Total
Bristol	28	39	0	0	67
Salem	26	34	0	0	60
Lynchburg	0	46	0	0	46
Richmond	87	80	2	2	171
Hampton Roads	38	27	0	7	72
Fredericksburg	22	26	0	0	48
Culpeper	13	37	0	0	50
Staunton	49	21	0	1	71
NOVA	28	68	3	0	99
Statewide	**291**	**378**	**5**	**10**	**684**

Chart A.1 – Average Age of Interstate Structures by District

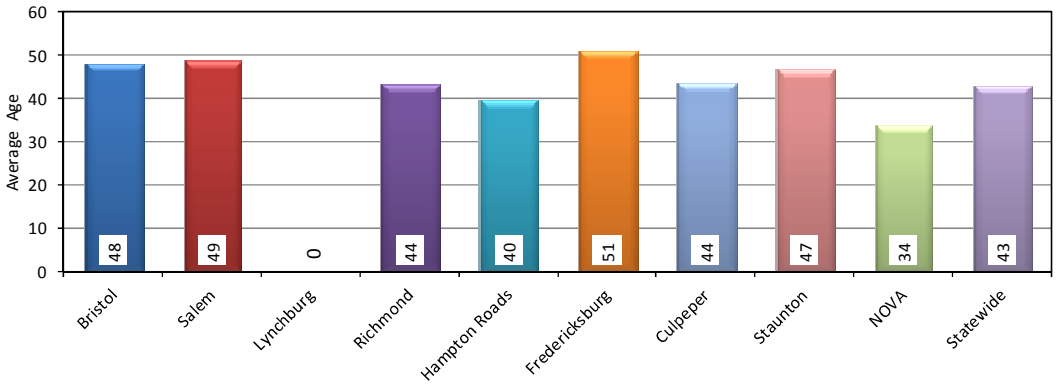


Chart A.2 – Average Age of Primary Structures by District

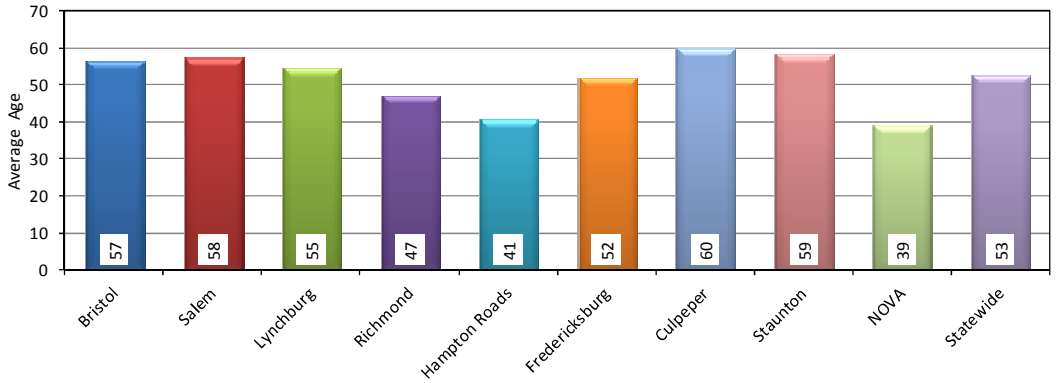


Chart A.3 – Average Age of Secondary Structures by District

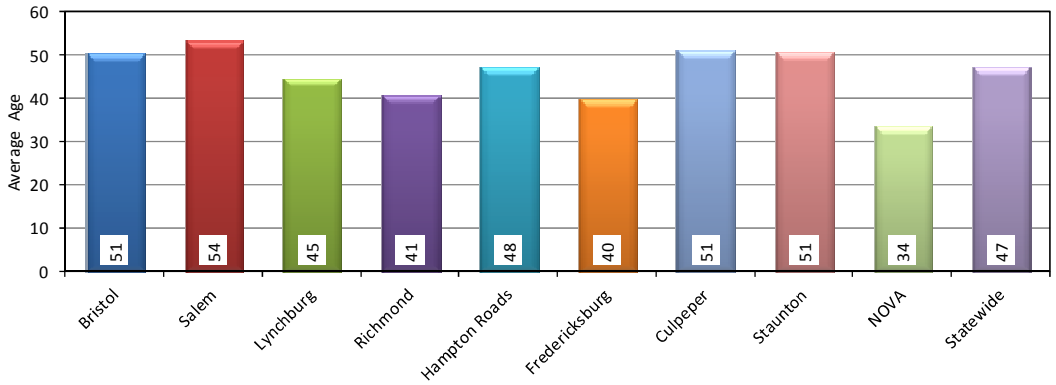
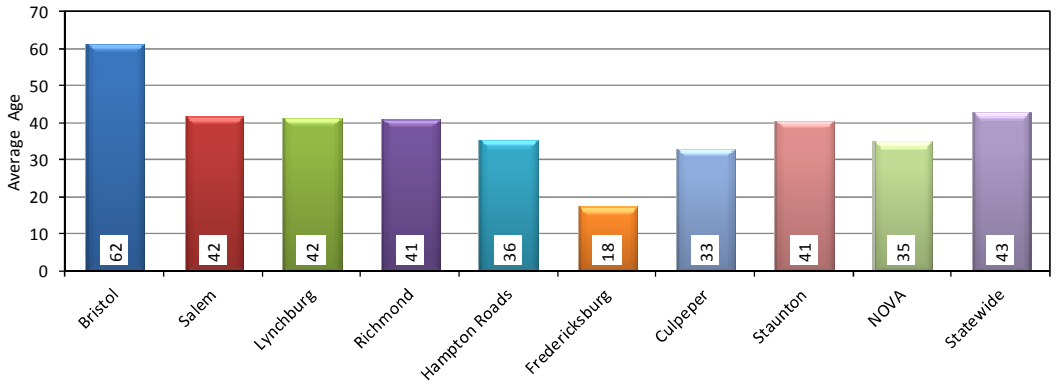


Chart A.4 – Average Age of Urban Structures by District



APPENDIX B – ADDITIONAL INVENTORY INFORMATION ON ANCILLARY STRUCTURES

Tables B.1 through B.4 provide information for the subcategories of each type of ancillary structure. Figures 1 through 13 are pictures providing typical examples of each type of ancillary structure.

Table B.1 – Total Number of Sign Structures by District

DISTRICT	Structure Type					Percent
	Cantilever	Overhead	Parapet Mount	Butterfly	Total	
Bristol	22	37	1	10	70	1.9%
Salem	84	88	0	92	264	7.0%
Lynchburg	4	56	0	5	65	1.7%
Richmond	388	325	130	1	844	22.5%
Hampton Roads	320	424	99	57	900	24.0%
Fredericksburg	61	26	0	0	87	2.3%
Culpeper	8	18	10	3	39	1.0%
Staunton	20	50	15	22	107	2.8%
Northern Virginia	644	592	61	82	1,379	36.7%
Statewide	**1,551**	**1,616**	**316**	**272**	**3,755**	**100.0%**

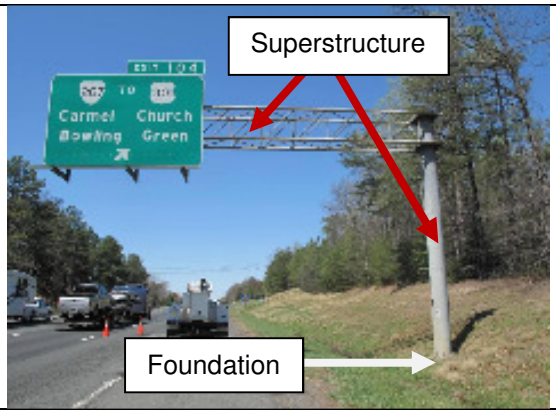


Figure 1 – Cantilever Sign Structure

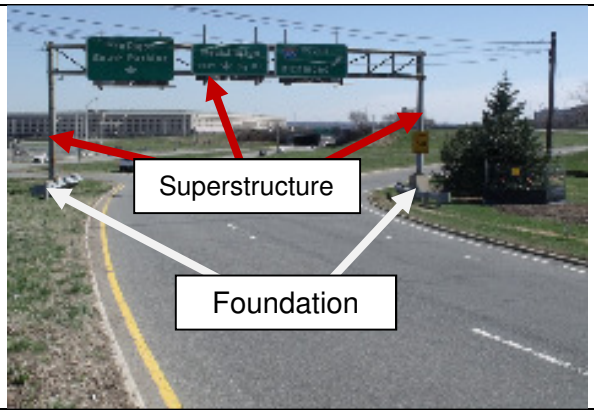


Figure 2 – Overhead Sign Structure

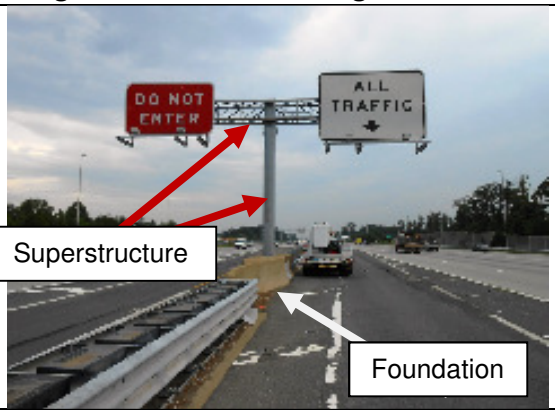


Figure 3 – Butterfly Sign Structure

Figure 4 – Parapet Mount Sign Structure
(Note that "Parapet-Mount' sign structures may also be attached to bridge girders in addition to bridge parapets)

Table B.2 – Total Number of Luminaire Structures by District

DISTRICT	Structure Type			Percent
	Parapet Mount Luminaire	Luminaires	Total	
Bristol	2	455	457	2.3%
Salem	24	797	821	4.2%
Lynchburg	0	301	301	1.5%
Richmond	405	1,793	2,198	11.2%
Hampton Roads	1,361	5,494	6,855	34.9%
Fredericksburg	0	580	580	3.0%
Culpeper	0	158	158	0.8%
Staunton	0	244	244	1.2%
Northern Virginia	315	7,699	8,014	40.8%
Statewide	**2,107**	**17,521**	**19,628**	**100.0%**

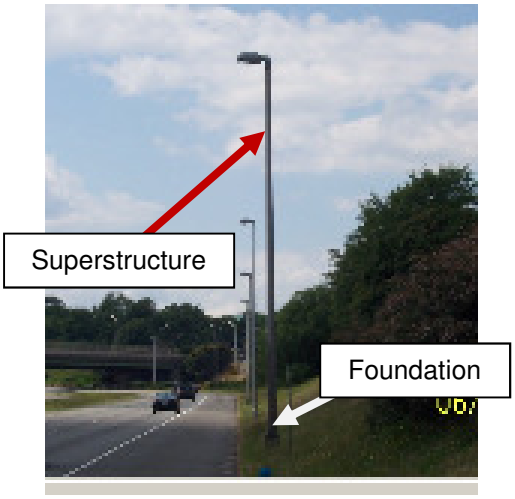


Figure 5 – Luminaire Structure

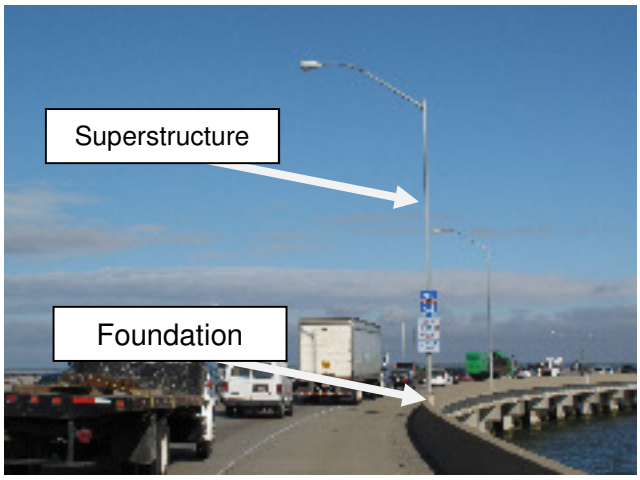


Figure 6 – Parapet Mounted Luminaire Structure

Note: Prior to September 2014 a single label "Parapet Mount" was used for the entire structure.

Table B.3 – Total Number of Traffic Signal Structures by District

DISTRICT	Structure Type					Percent
	Cantilever	Overhead	Parapet Mount	Span Wire	Total	
Bristol	220	0	0	24	244	2.5%
Salem	509	0	0	32	541	5.6%
Lynchburg	297	0	0	2	299	3.1%
Richmond	1,188	0	0	331	1,519	15.8%
Hampton Roads	466	0	1	55	522	5.4%
Fredericksburg	727	1	0	10	738	7.7%
Culpeper	359	0	0	8	367	3.8%
Staunton	524	0	0	64	588	6.1%
Northern Virginia	3,678	2	0	1,115	4,795	49.9%
Statewide	**7,968**	**3**	**1**	**1,641**	**9,613**	**100.0%**

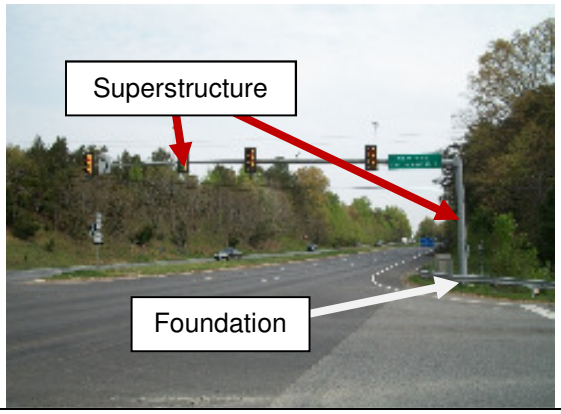


Figure 7 – Cantilevered Arm Traffic Signal Structure

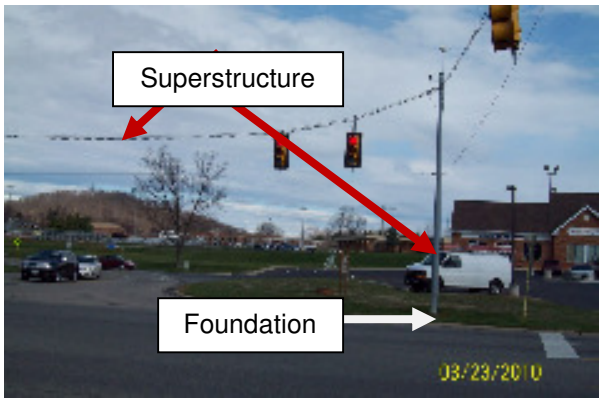


Figure 8– Span Wire Traffic Signal Structure

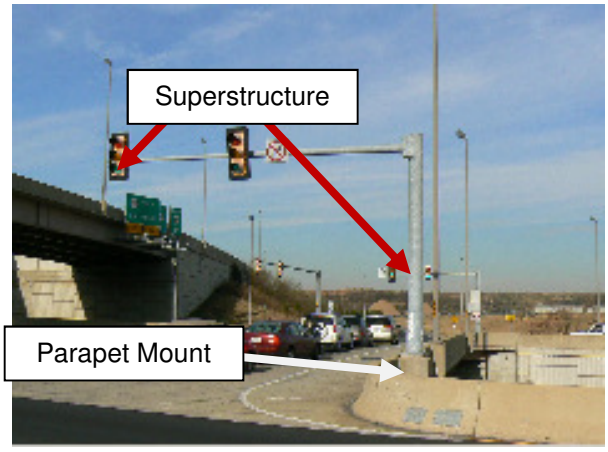


Figure 9 – Parapet Mount - Traffic Signal Structure

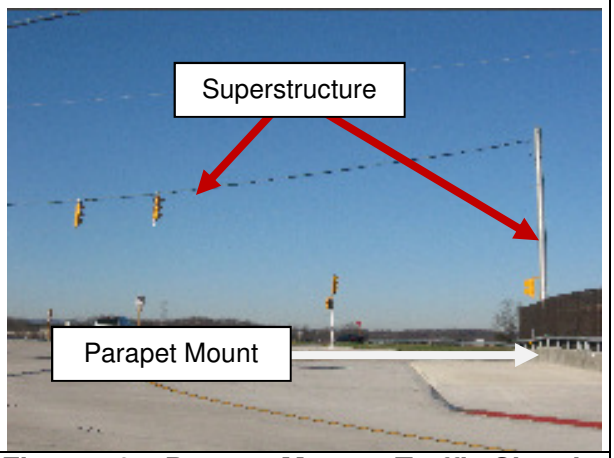


Figure 10 – Parapet Mount - Traffic Signal Structure

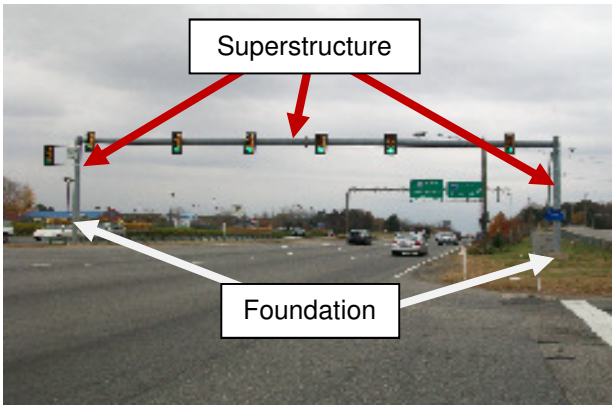


Figure 11 – Overhead Traffic Signal Structure

Table B.4 – Total Number of High Mast Light and Camera Pole Structures by District

DISTRICT	Structure Type			Percent
	Camera Poles	High Mast Light	Total	
Bristol	76	1	77	5.5%
Salem	13	3	16	1.1%
Lynchburg	0	0	0	0.0%
Richmond	105	49	154	11.0%
Hampton Roads	145	287	432	30.9%
Fredericksburg	1	23	24	1.7%
Culpeper	0	0	0	0.0%
Staunton	20	66	86	6.2%
Northern Virginia	324	285	609	43.6%
Statewide	**684**	**714**	**1,398**	**100.0%**

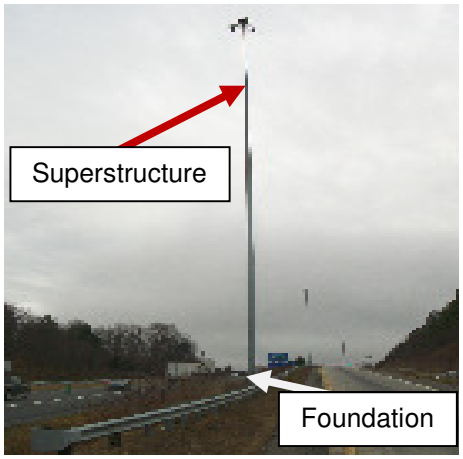


Figure 12 – High Mast Light Structure

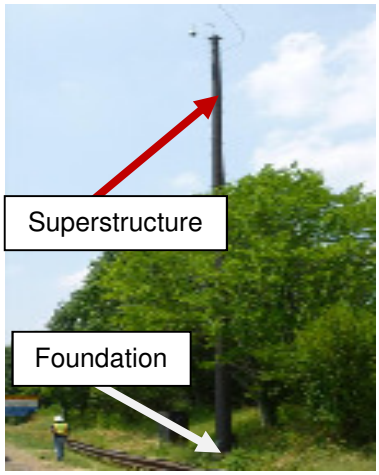


Figure 13 – Camera Pole Structure

APPENDIX C– GENERAL CONDITION RATINGS (BRIDGES AND LARGE CULVERTS)

General Condition Ratings (GCRs): According to the National Bridge Inventory (NBI), General Condition Ratings are assigned by the structure inspection team after each bridge inspection. These ratings are included in each inspection report to describe the current physical state of the bridge or large culvert. Evaluation is based on the physical condition of the structure at the time of inspection. Separate GCR values are assigned to the deck, superstructure and substructure components of a bridge. A large culvert receives a single GCR. The GCRs are assigned based on a numerical grading system that ranges from 0 (failed condition) to 9 (excellent condition). The table below provides a description of the general condition ratings. The tables in the following pages provide illustrative examples of these ratings.

0	1	2	3	4	5	6	7	8	9
Failed	Imminent Failure	Critical	Serious	Poor	Fair	Satisfactory	Good	Very Good	Excellent
Structurally Deficient									

A structure is defined as SD if one or more of its major components (deck, superstructure, substructure, or large culvert) has a General Condition Rating (GCR) less than or equal to four (4) or if it has an appraisal rating of 2 or less for Structural Evaluation or Waterway Adequacy.

Code	Description
N	**NOT APPLICABLE**
9	**EXCELLENT CONDITION**
8	**VERY GOOD CONDITION**: No problems noted.
7	**GOOD CONDITION**: Some minor problems.
6	**SATISFACTORY CONDITION**: Structural components show some minor deterioration.
5	**FAIR CONDITION**: All primary structural elements are sound but may have some minor section loss, cracking, spalling or scour
4	**POOR CONDITION**: Advanced section loss, deterioration, spalling or scour.
3	**SERIOUS CONDITION**: Loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
2	**CRITICAL CONDITION**: Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.
1	**"IMMINENT" FAILURE CONDITION**: Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put back in light service.
0	**FAILED CONDITION**: Out of service - beyond corrective action.

Typical Examples of General Condition Ratings for Decks	
GCR	Example
4 or less - (Poor Condition) Structurally Deficient	 Bridge Deck with advanced deterioration
5 – Fair Condition (At risk of becoming structurally deficient)	 Bridge Deck with extensive cracking and patching
6 – Satisfactory Condition	 Bridge Deck with minor to no deterioration

Typical Examples of General Condition Ratings for Superstructure

GCR	Example	
	Steel	Concrete
4 or less - (Poor Condition) Structurally Deficient	 Bridge Superstructure with advanced section loss	 Concrete Beam with major spalling (bottom of beam viewed from below)
5 – Fair Condition (At risk of becoming structurally deficient)	 Bridge Superstructure with minor to moderate section loss	 Spall on end of beam with exposed reinforcing with section loss
6 – Satisfactory Condition	 Rust scale and minor section loss	 Concrete Beam with localized spalling

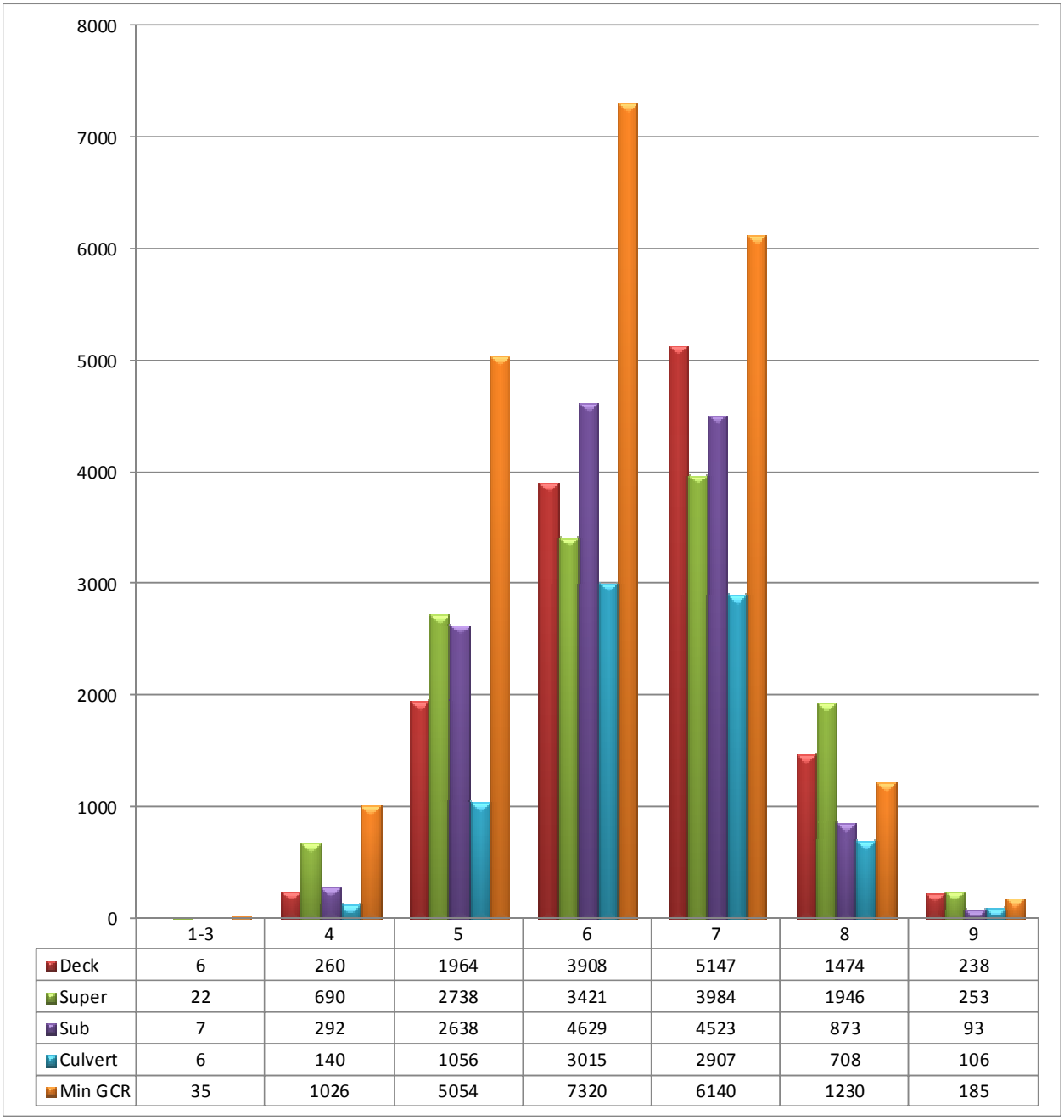
Typical Examples of General Condition Ratings for Substructure	
GCR	Example
4 or less – (Poor Condition) Structurally Deficient	 Bridge Substructure with advanced deterioration
5 – Fair Condition (At risk of becoming structurally deficient)	 Bridge Substructure with moderate cracks and deterioration
6 – Satisfactory Condition	 Bridge Substructure with minor cracks

Typical Examples of General Condition Ratings for Large Culverts

GCR	Example	
	Steel	Concrete
4 or less - (Poor Condition) Structurally Deficient	 Culvert with advanced section loss	 Portion of center wall of box culvert missing
5 – Fair Condition (At risk of becoming structurally deficient)	 Culvert panels separated	 Culvert moderate deterioration
6 – Satisfactory Condition	 Light rust along flowline	 Culvert with minor cracks

The general condition ratings of Virginia's highway structures vary by region, system and age of structure. General condition rating data are provided in Charts C.1 – C.15 below

Chart C.1 – General Condition Ratings for Bridges and Large Culverts by Component - Statewide



	1-3	4	5	6	7	8	9
Deck	6	260	1964	3908	5147	1474	238
Super	22	690	2738	3421	3984	1946	253
Sub	7	292	2638	4629	4523	873	93
Culvert	6	140	1056	3015	2907	708	106
Min GCR	35	1026	5054	7320	6140	1230	185

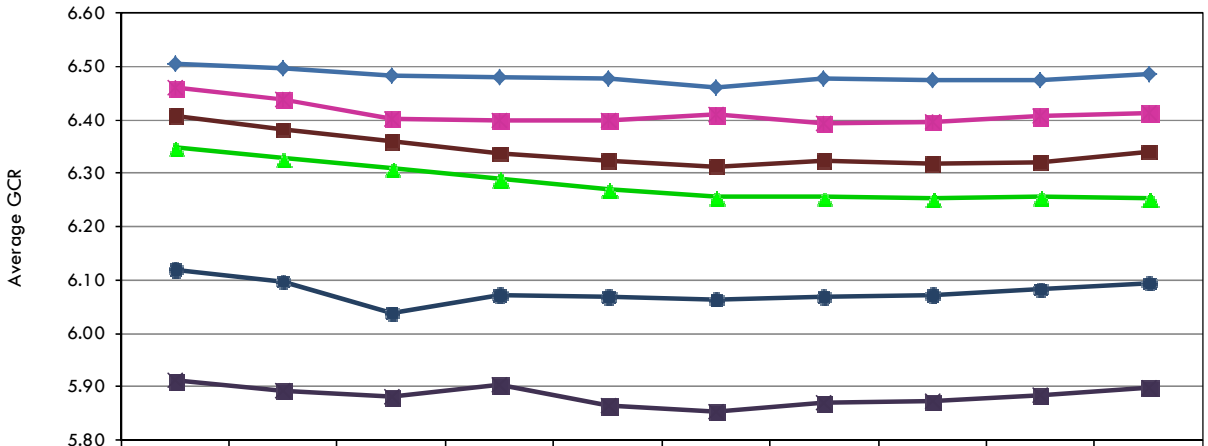
The Min GCR represents the minimum or lowest General Condition Rating (GCR) for the structure (lowest of the 4 component ratings for a particular inspection report; deck, superstructure, substructure, or large culvert)

Table C.1 – Number of Components in Each General Ratings by System

Highway System	Component	GCR										Avg. GCR
		9	8	7	6	5	4	3	2	1	0	
Interstate	Deck	4	45	523	614	224	12	1	0	0	0	6.26
	Superstructure	17	96	363	516	402	29	0	0	0	0	6.10
	Substructure	5	54	308	598	452	6	0	0	0	0	5.98
	Bridge Min GCR	3	36	204	527	613	39	1	0	0	0	5.71
	Large Culvert	0	17	288	547	142	1	0	0	0	0	6.18
	Min GCR	3	53	492	1,074	755	40	1	0	0	0	5.90
Primary	Deck	32	157	1,317	1,161	691	82	3	0	0	0	6.25
	Superstructure	35	363	1,090	1,046	769	144	8	0	0	0	6.24
	Substructure	20	147	1,244	1,258	710	73	3	0	0	0	6.21
	Bridge Min GCR	18	78	840	1,219	1,090	199	11	0	0	0	5.86
	Large Culvert	4	84	768	1,111	325	20	0	0	0	0	6.25
	Min GCR	22	162	1,606	2,330	1,415	219	11	0	0	0	6.02
Secondary	Deck	187	1,222	3,015	1,890	962	136	1	0	0	0	6.65
	Superstructure	180	1,417	2,263	1,676	1,445	463	10	0	0	0	6.43
	Substructure	50	615	2,690	2,547	1,364	187	2	0	0	0	6.31
	Bridge Min GCR	46	385	1,975	2,329	2,134	575	12	0	0	0	5.94
	Large Culvert	102	580	1,729	1,264	562	114	5	0	0	0	6.55
	Min GCR	147	965	3,704	3,593	2,696	689	17	0	0	0	6.17
Urban	Deck	15	50	292	243	87	30	1	0	0	0	6.40
	Superstructure	21	70	268	183	122	54	4	0	0	0	6.32
	Substructure	18	57	281	226	112	26	2	0	0	0	6.39
	Bridge Min GCR	13	23	216	229	161	73	5	0	0	0	5.97
	Large Culvert	0	27	122	93	27	5	1	0	0	0	6.49
	Min GCR	13	50	338	323	188	78	6	0	0	0	6.12
All	Deck	238	1,474	5,147	3,908	1,964	260	6	0	0	0	6.49
	Superstructure	253	1,946	3,984	3,421	2,738	690	22	0	0	0	6.34
	Substructure	93	873	4,523	4,629	2,638	292	7	0	0	0	6.25
	Bridge Min GCR	80	522	3,235	4,304	3,998	886	29	0	0	0	5.90
	Large Culvert	106	708	2,907	3,015	1,056	140	6	0	0	0	6.41
	Min GCR	185	1,230	6,140	7,320	5,054	1,026	35	0	0	0	6.09

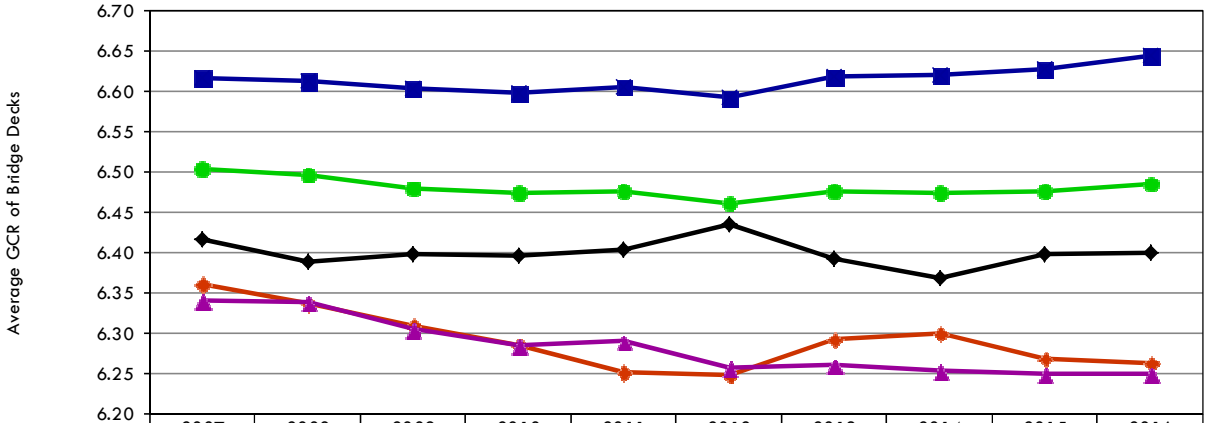
Trend lines showing the average general condition ratings of rated components are provided in Charts C.2 through C.14 below.

Chart C.2 – Trends in Average General Condition Ratings by Component – Statewide



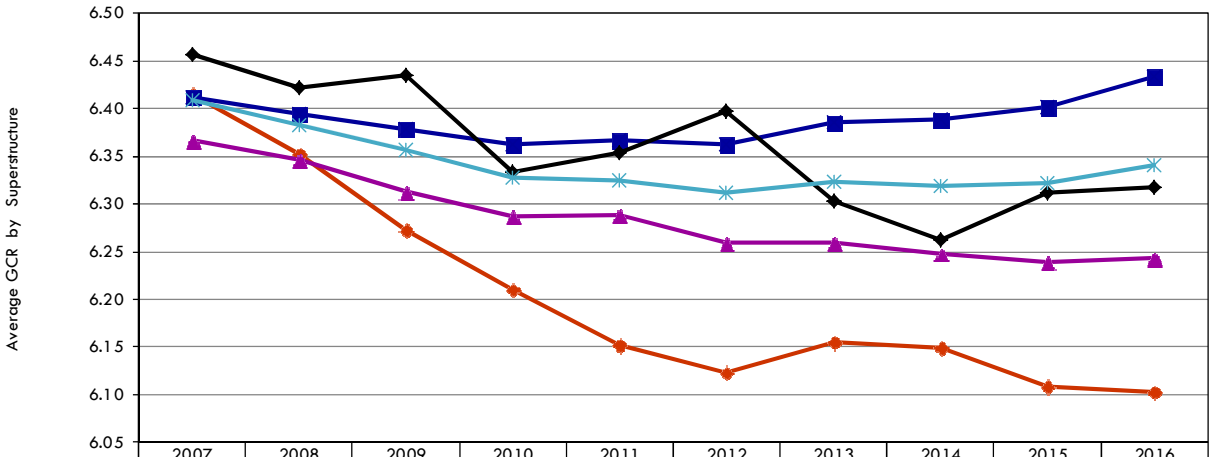
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Deck	6.504	6.496	6.482	6.480	6.476	6.461	6.477	6.475	6.476	6.485
Super	6.408	6.383	6.359	6.338	6.323	6.312	6.323	6.318	6.322	6.341
Sub	6.350	6.330	6.310	6.289	6.270	6.256	6.257	6.253	6.256	6.253
Br Min	5.912	5.892	5.882	5.904	5.863	5.853	5.871	5.873	5.884	5.898
Culvert	6.461	6.437	6.402	6.399	6.399	6.409	6.393	6.397	6.407	6.414
Str Min	6.120	6.097	6.039	6.073	6.068	6.063	6.068	6.071	6.082	6.093

Chart C.3 – Bridge Decks: Trends in Average General Condition Ratings by Highway System



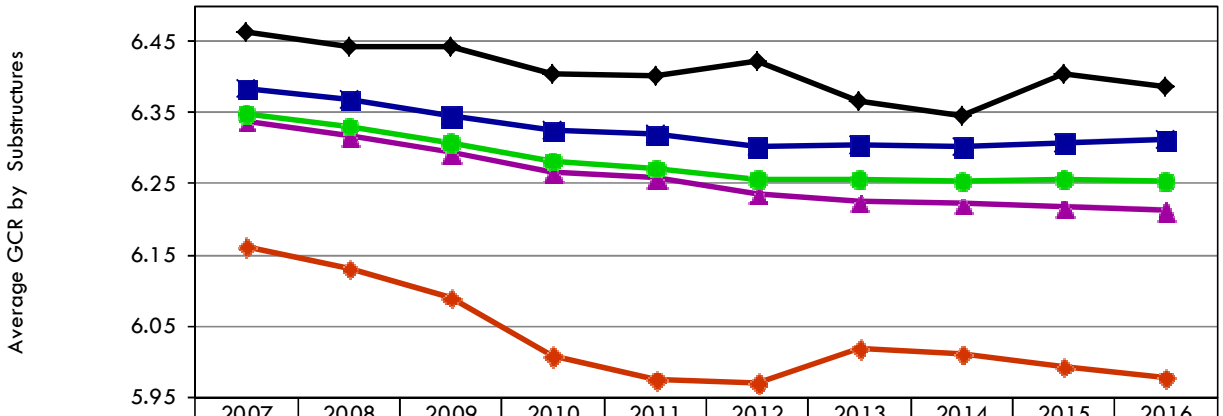
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Interstate	6.361	6.338	6.310	6.285	6.253	6.249	6.293	6.300	6.269	6.263
Primary	6.342	6.340	6.307	6.286	6.292	6.257	6.262	6.254	6.251	6.251
Secondary	6.617	6.613	6.603	6.598	6.606	6.593	6.619	6.620	6.627	6.645
Urban	6.418	6.389	6.400	6.397	6.404	6.436	6.394	6.369	6.398	6.400
Average	6.504	6.497	6.481	6.474	6.477	6.461	6.477	6.475	6.476	6.485

Chart C.4 – Superstructures: Trends in Average General Condition Ratings by Highway System



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Interstate	6.415	6.352	6.273	6.210	6.152	6.124	6.155	6.149	6.109	6.103
Primary	6.367	6.346	6.313	6.287	6.288	6.259	6.260	6.247	6.239	6.243
Secondary	6.411	6.394	6.379	6.362	6.366	6.363	6.386	6.388	6.401	6.434
Urban	6.457	6.422	6.435	6.333	6.354	6.397	6.303	6.262	6.311	6.317
Average	6.408	6.383	6.357	6.328	6.324	6.312	6.323	6.318	6.322	6.341

Chart C.5 – Substructures: Trends in Average General Condition Ratings by Highway System



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Interstate	6.162	6.132	6.091	6.008	5.974	5.971	6.019	6.011	5.993	5.977
Primary	6.338	6.317	6.296	6.268	6.258	6.236	6.227	6.222	6.219	6.212
Secondary	6.386	6.369	6.347	6.326	6.319	6.303	6.306	6.303	6.308	6.312
Urban	6.465	6.443	6.443	6.404	6.402	6.423	6.366	6.346	6.404	6.386
Average	6.350	6.330	6.307	6.283	6.271	6.256	6.257	6.253	6.256	6.253

Chart C.6 – Deck General Condition Ratings by District and Highway System

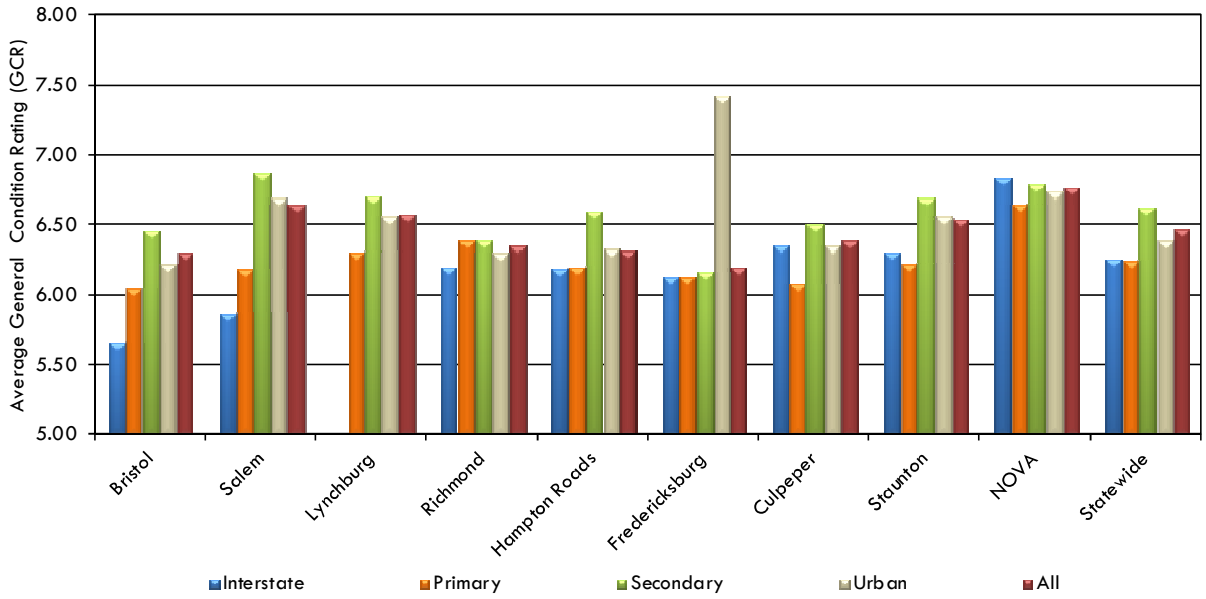


Chart C.7 – Deck General Condition Ratings by Highway System and District

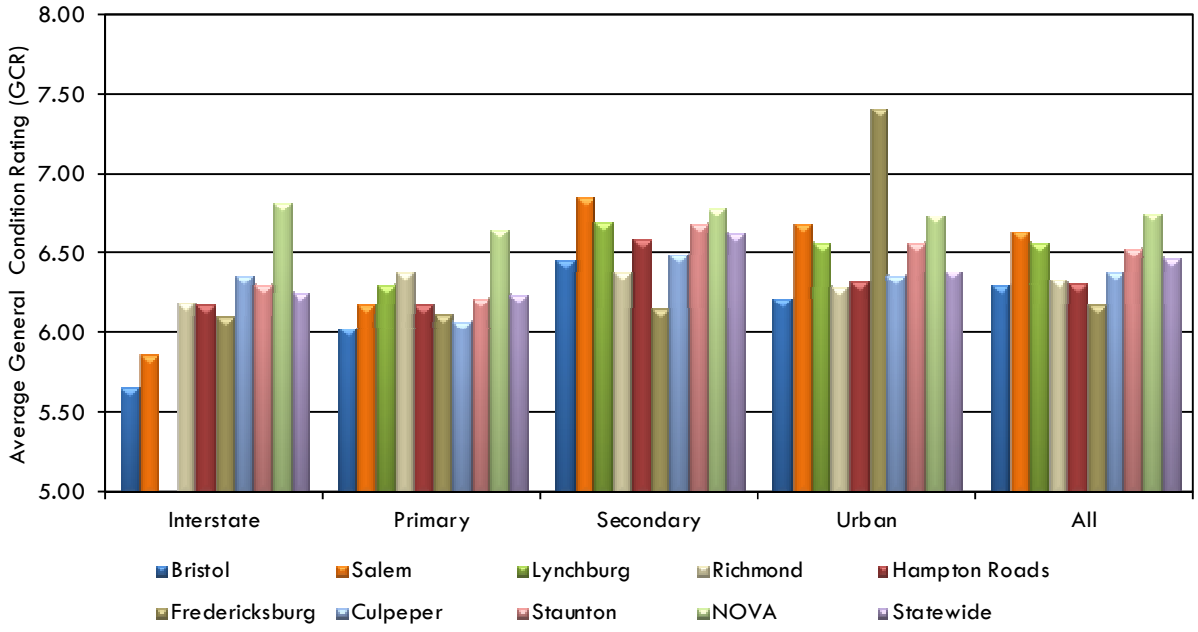


Chart C.8 – Superstructure General Condition Ratings by District and Highway System

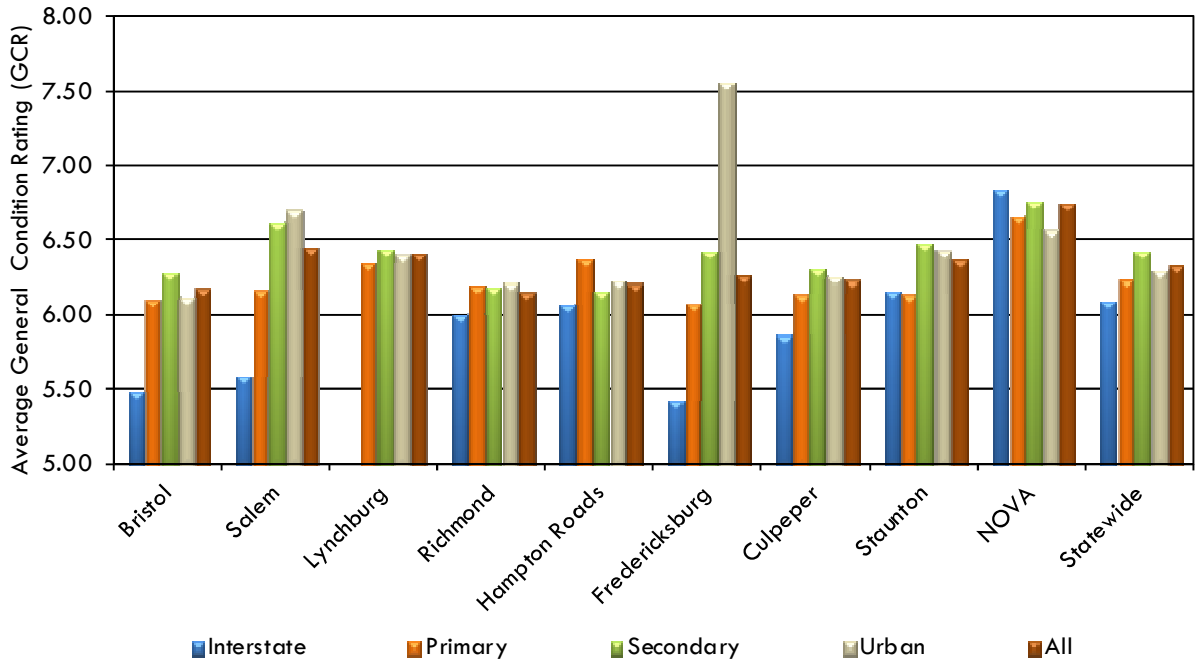


Chart C.9 – Superstructure General Condition Ratings by Highway System and District

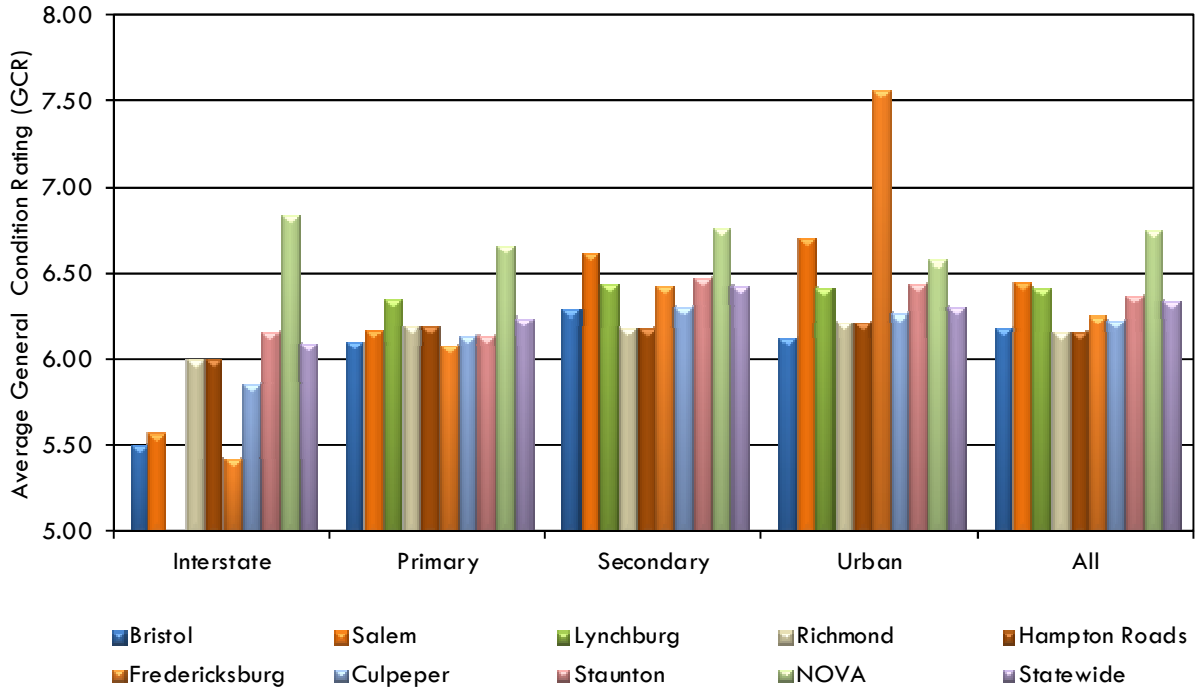


Chart C.10 – Substructure General Condition Ratings by District and Highway System

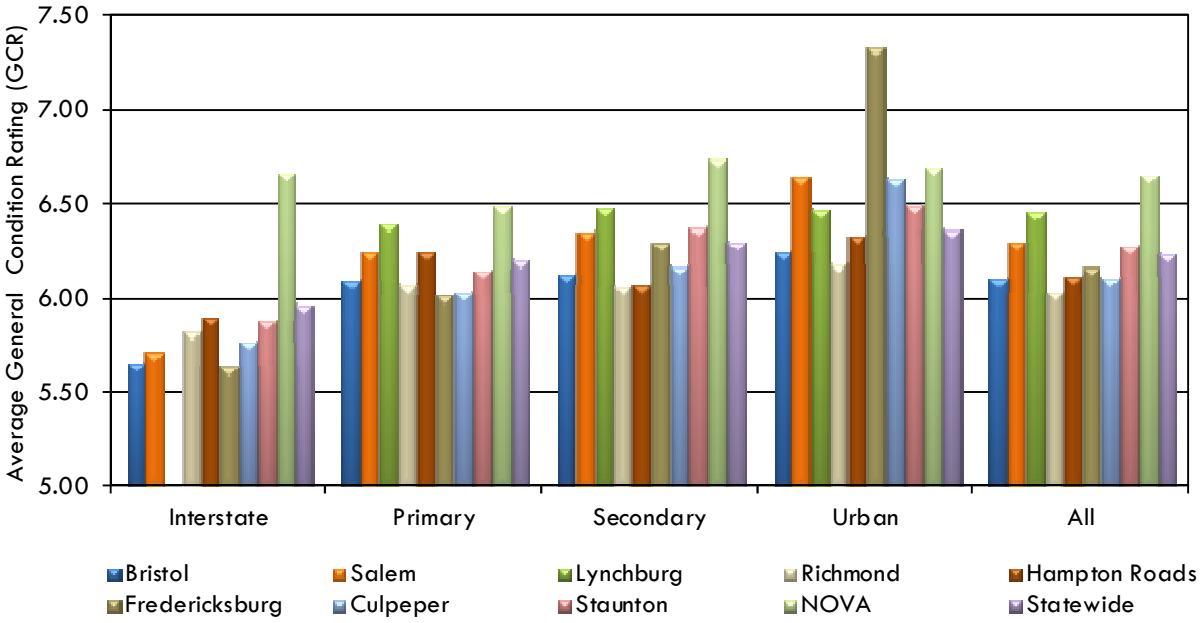


Chart C.11 – Substructure General Condition Ratings by Highway System and District

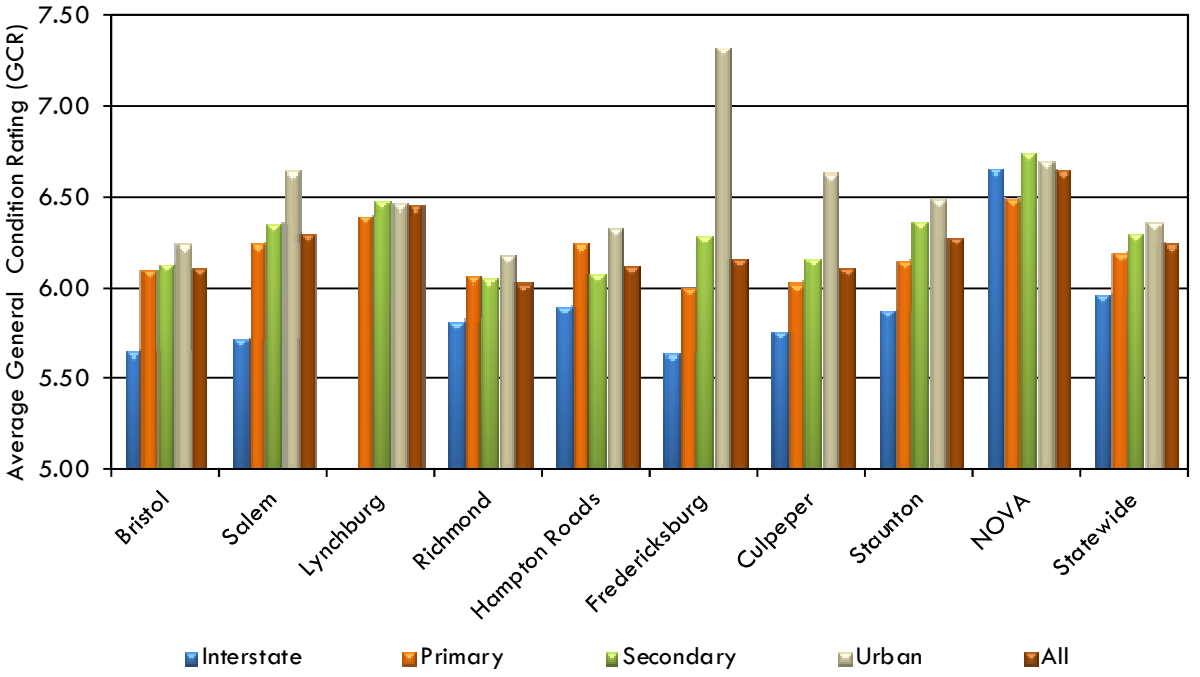


Chart C.12 – Large Culvert General Condition Ratings by District and Highway System

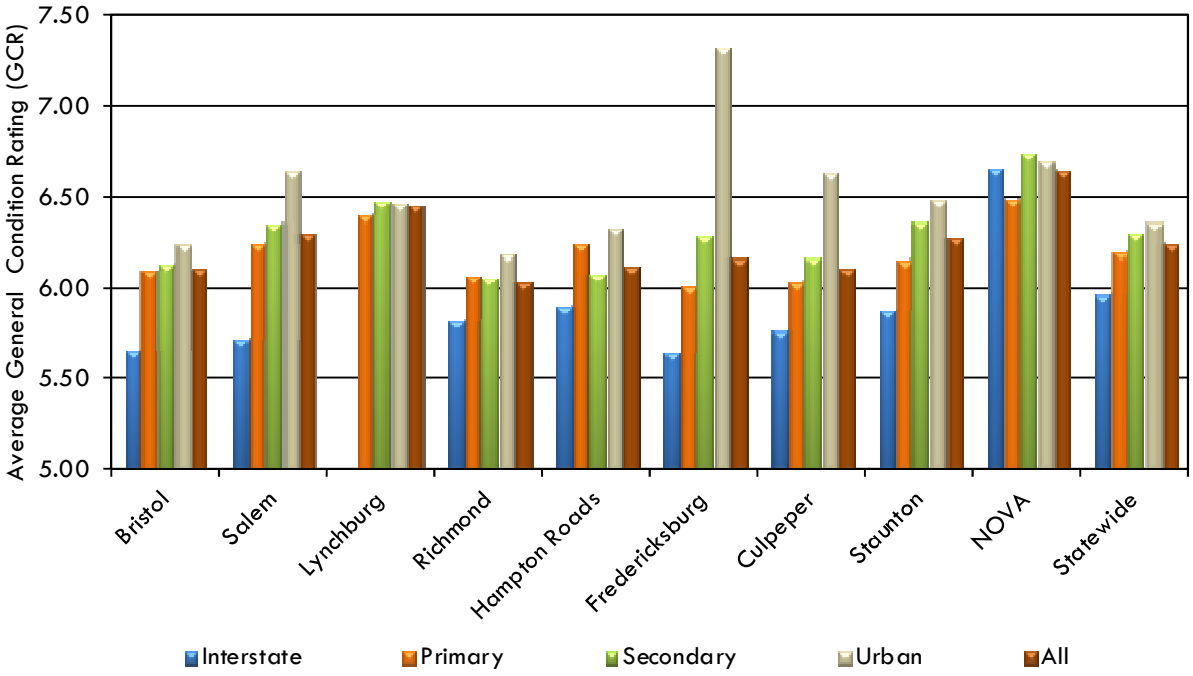


Chart C.13 – Large Culvert General Condition Ratings by Highway System and District

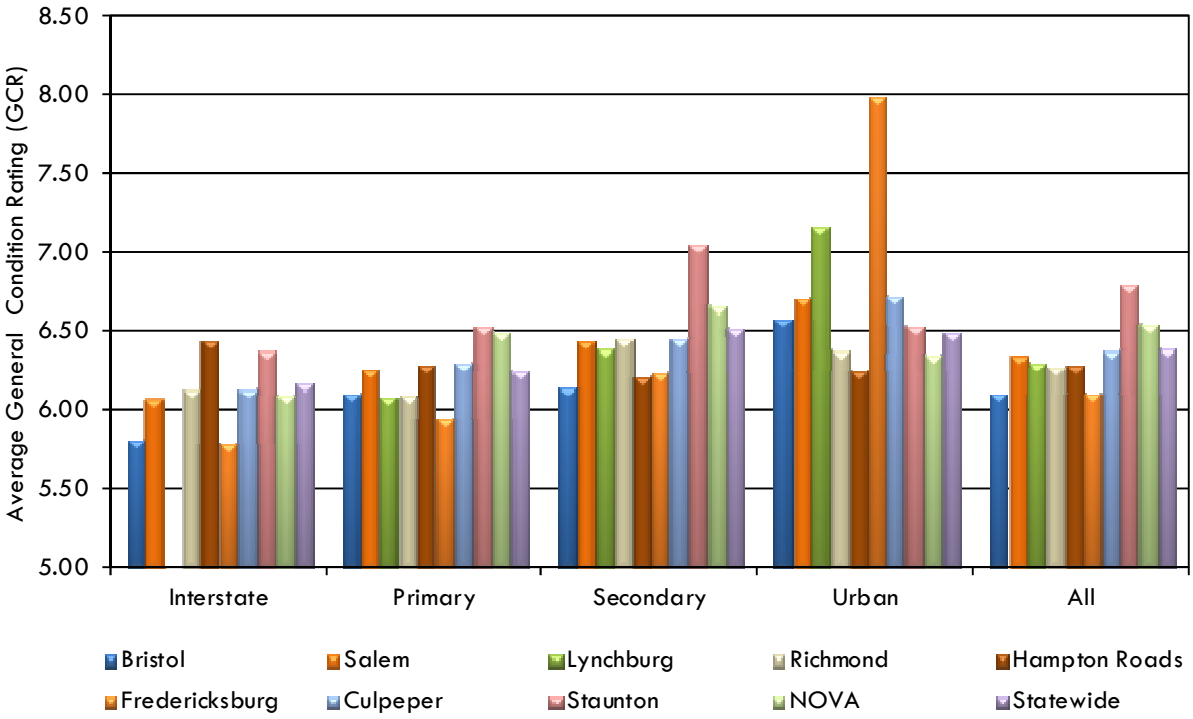


Chart C.14 – Average Minimum General Condition Ratings for Bridges and Large Culverts by District and Highway System

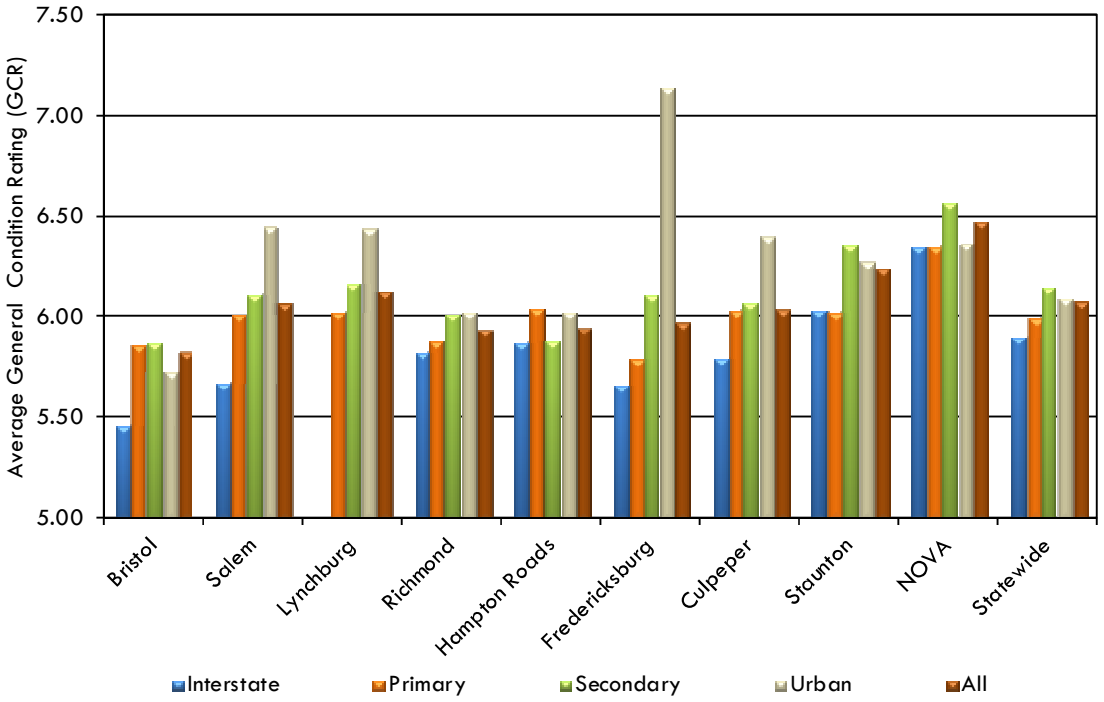
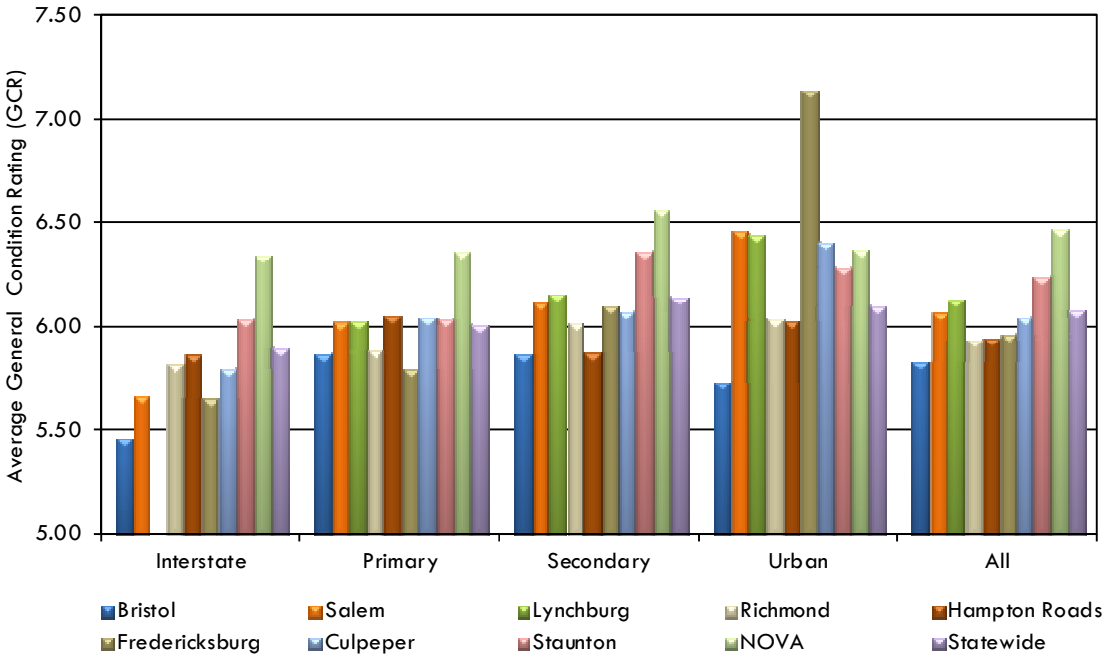


Chart C.15 – Average Minimum General Condition Ratings for Bridges and Large Culverts by Highway System and District



APPENDIX D– INFORMATION ON STRUCTURALLY DEFICIENT STRUCTURES BY HIGHWAY SYSTEM

Chart D.1 – Percentage of Number of Structurally Deficient Structures on Interstate System

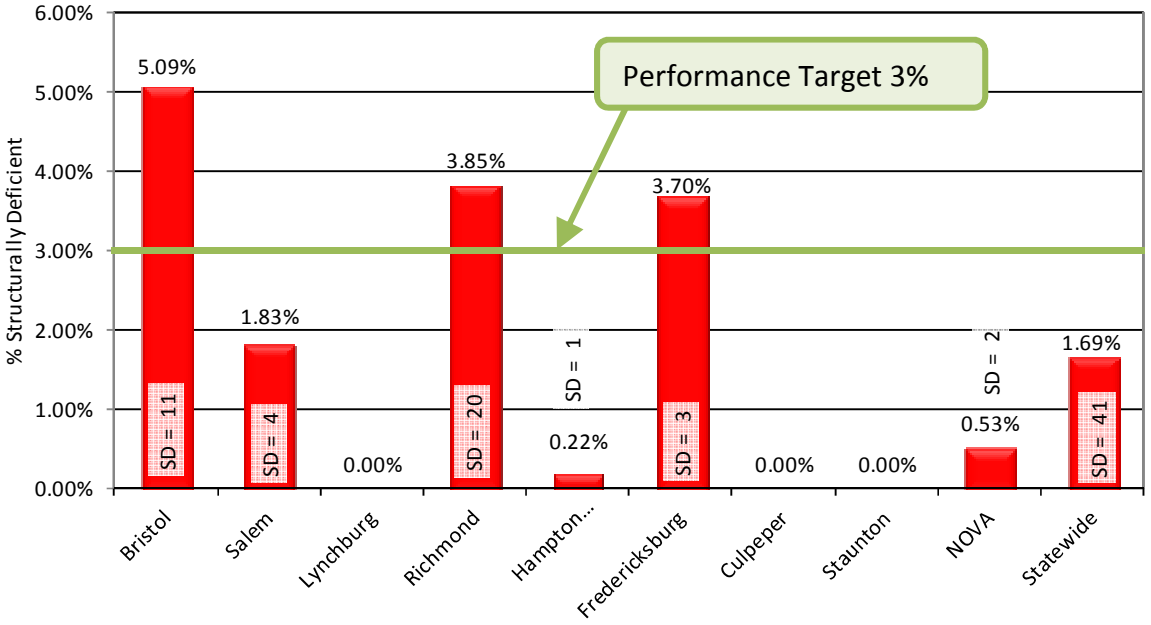
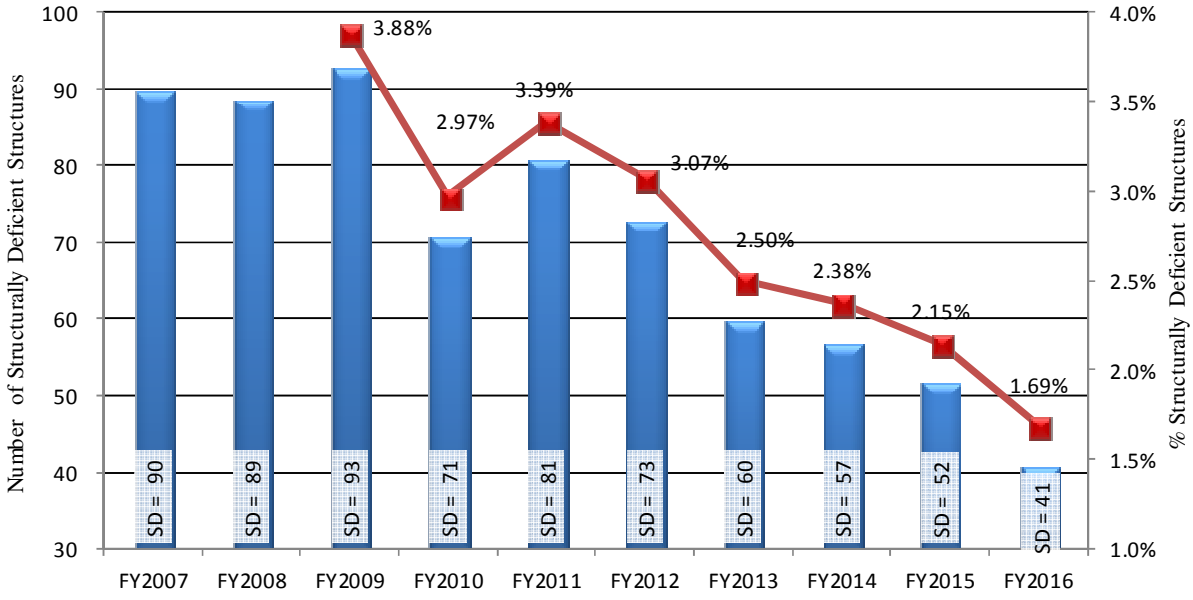


Chart D.2 – Percentage of Structurally Deficient Structures Recent Trend for Interstate System



Note: Method of accounting for the number of structures by system has changed from previous years. See Appendix G for discussion.

Chart D.3 – Percentage of Number of Structurally Deficient Structures on Primary System

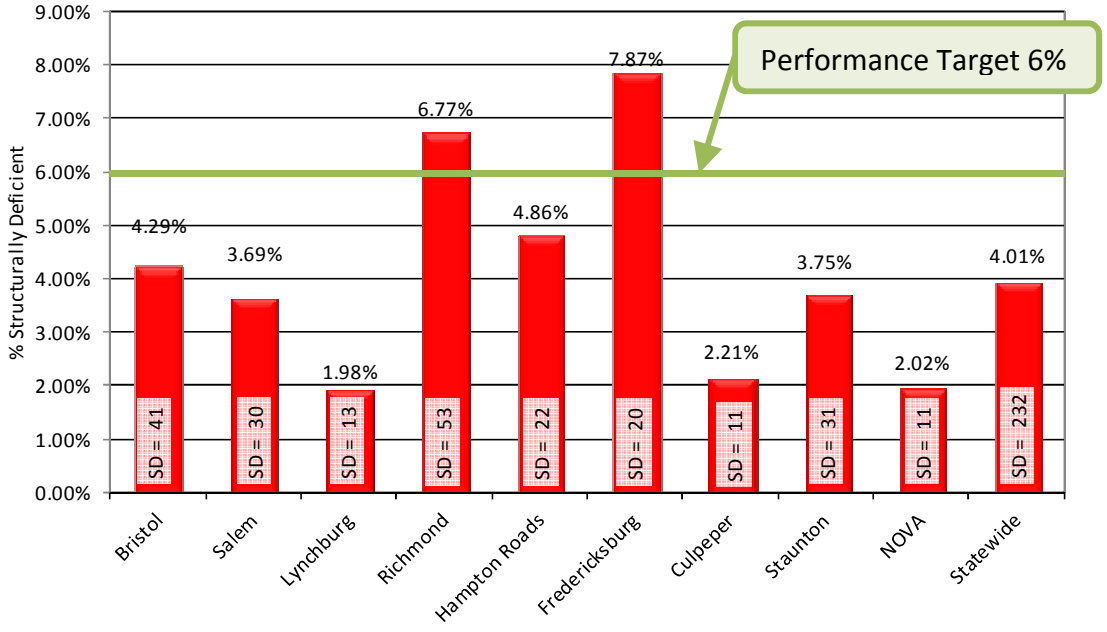
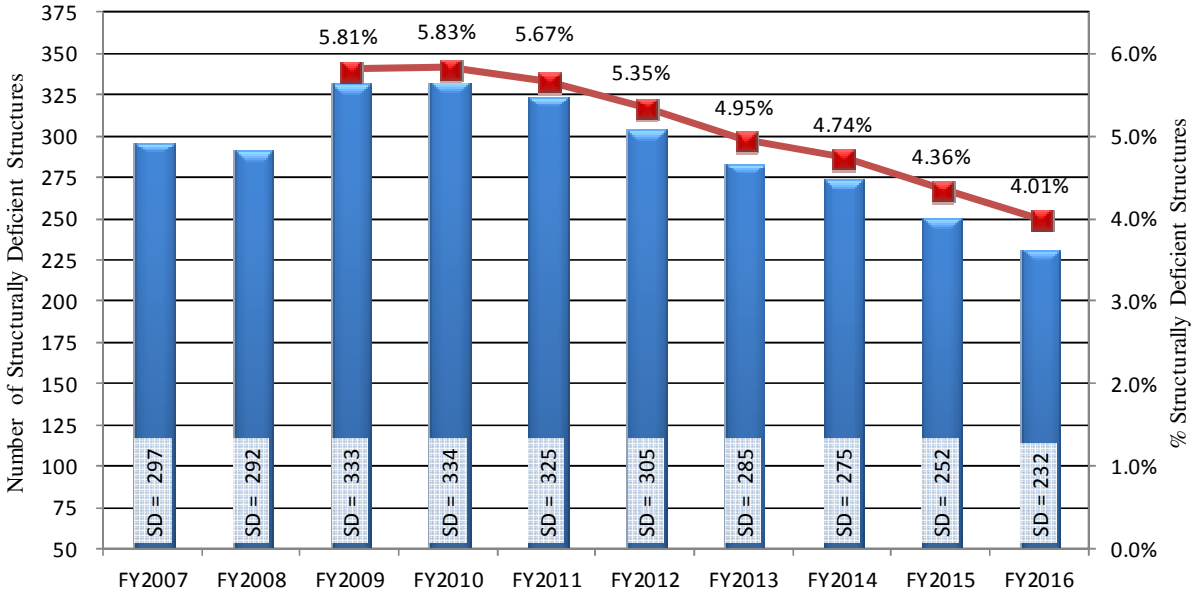


Chart D.4 – Percentage of Structurally Deficient Structures Recent Trend for Primary System



Note: Method of accounting for the number of structures by system has changed from previous years. See Appendix G for discussion.

Chart D.5 – Percentage of Number of Structurally Deficient Structures On Secondary System

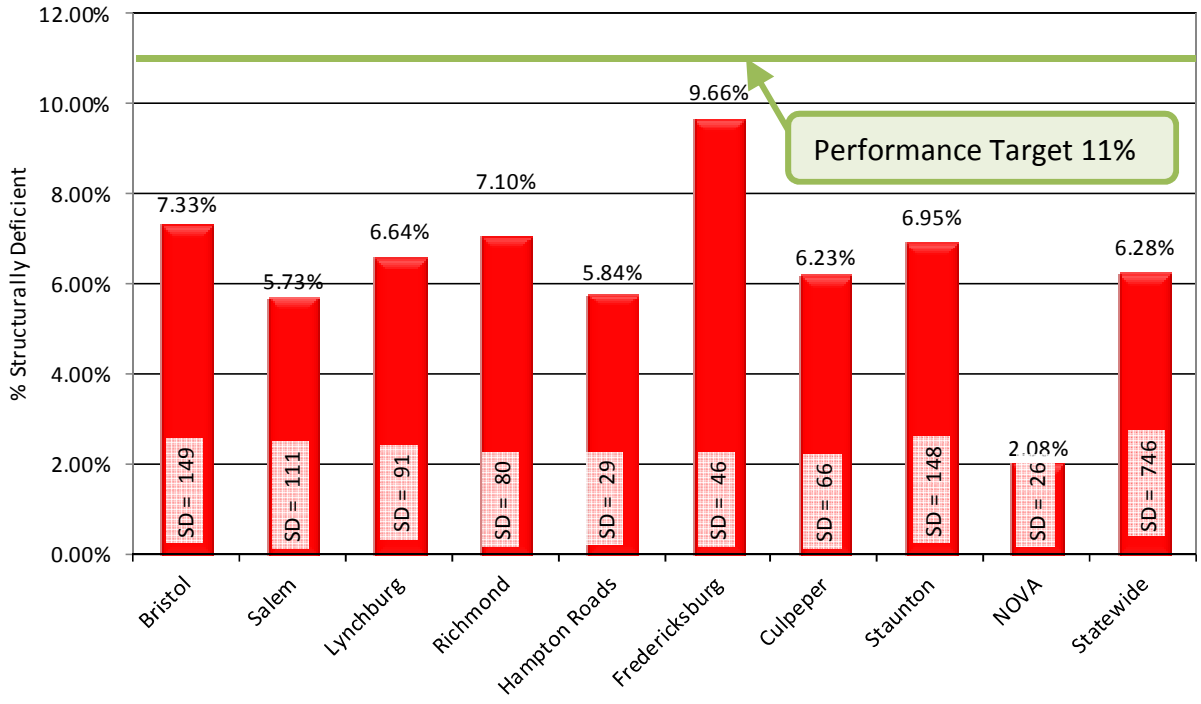
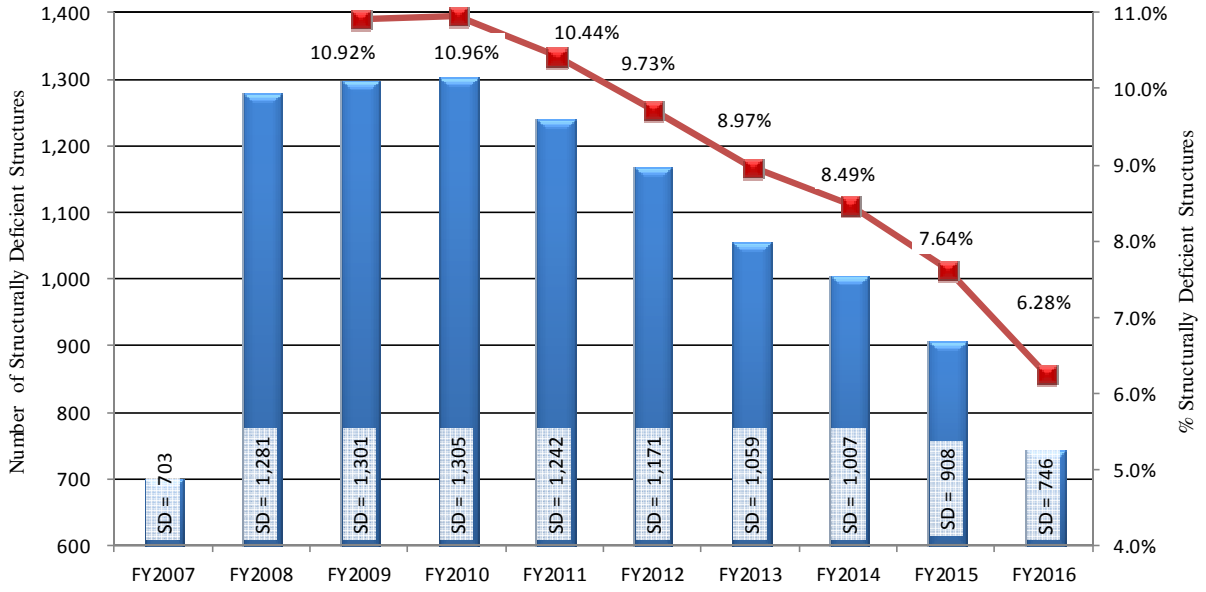
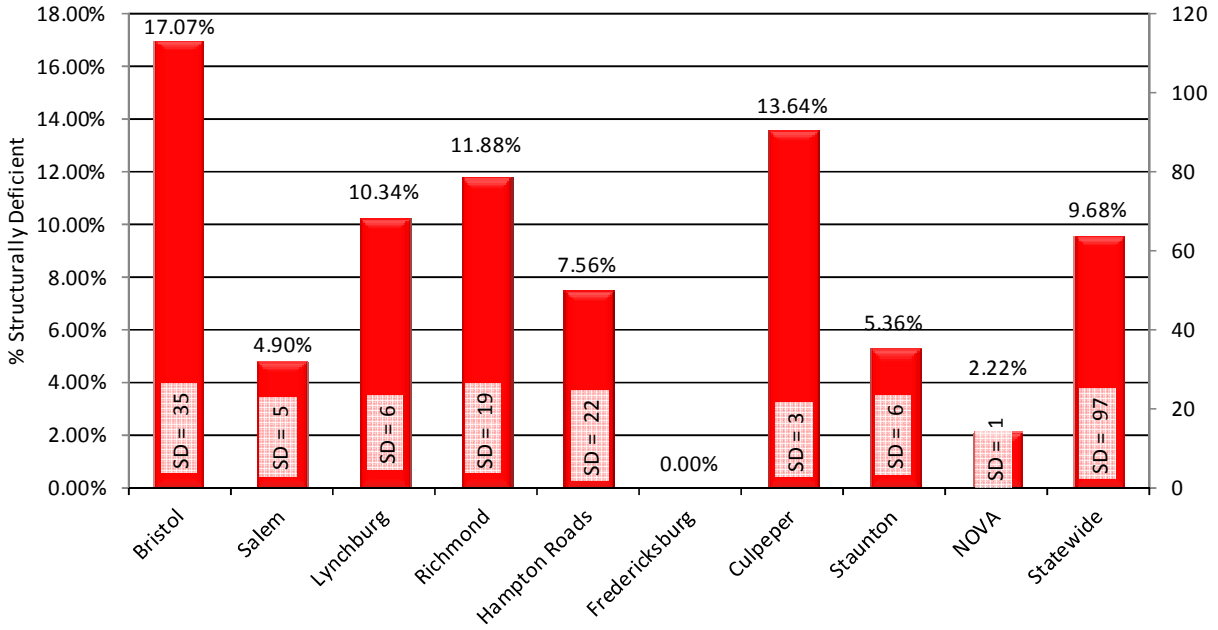


Chart D.6 – Percentage of Structurally Deficient Structures Recent Trend on Secondary System



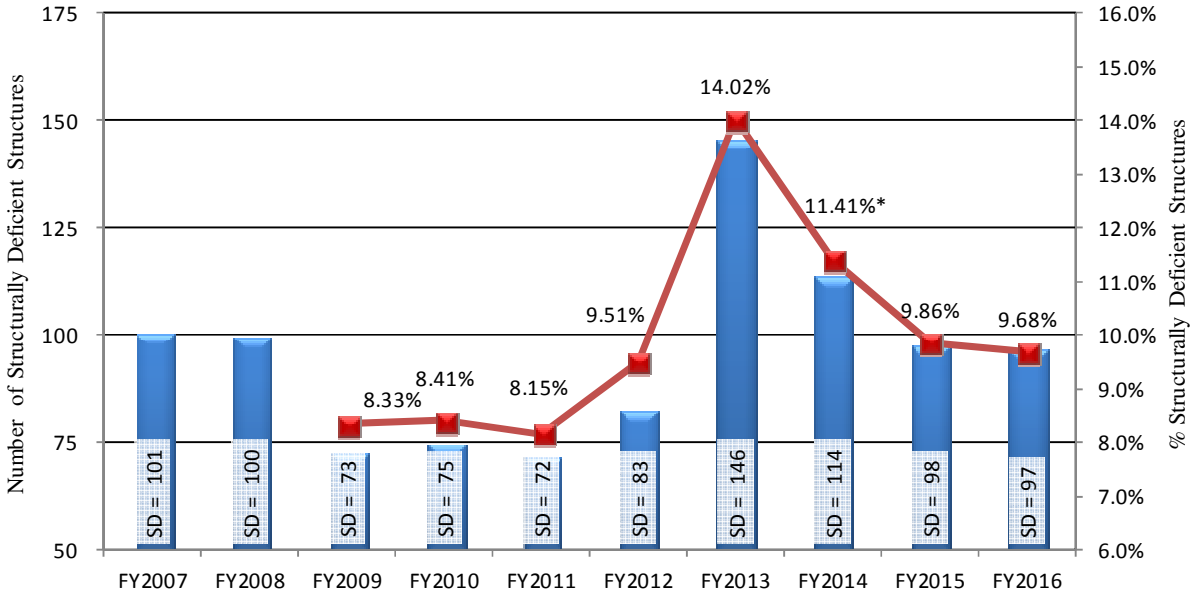
Note: Method of accounting for the number of structures by system has changed from previous years. See Appendix G for discussion.

Chart D.7 – Percentage of Number of Structurally Deficient Structures On Urban System



Note: A number of structures were added in Buchanan County. See Appendix G for discussion.

Chart D.8 – Percentage of Structurally Deficient Structures Recent Trend on Urban System



Note: Method of accounting for the number of structures by system has changed from previous years. See Appendix G for discussion.

** A large number of structures deficient were added in Buchanan County in FY2013. See Appendix G for discussion*

Chart D.9 - Percentage of Number of NBI Structurally Deficient Structures on NHS

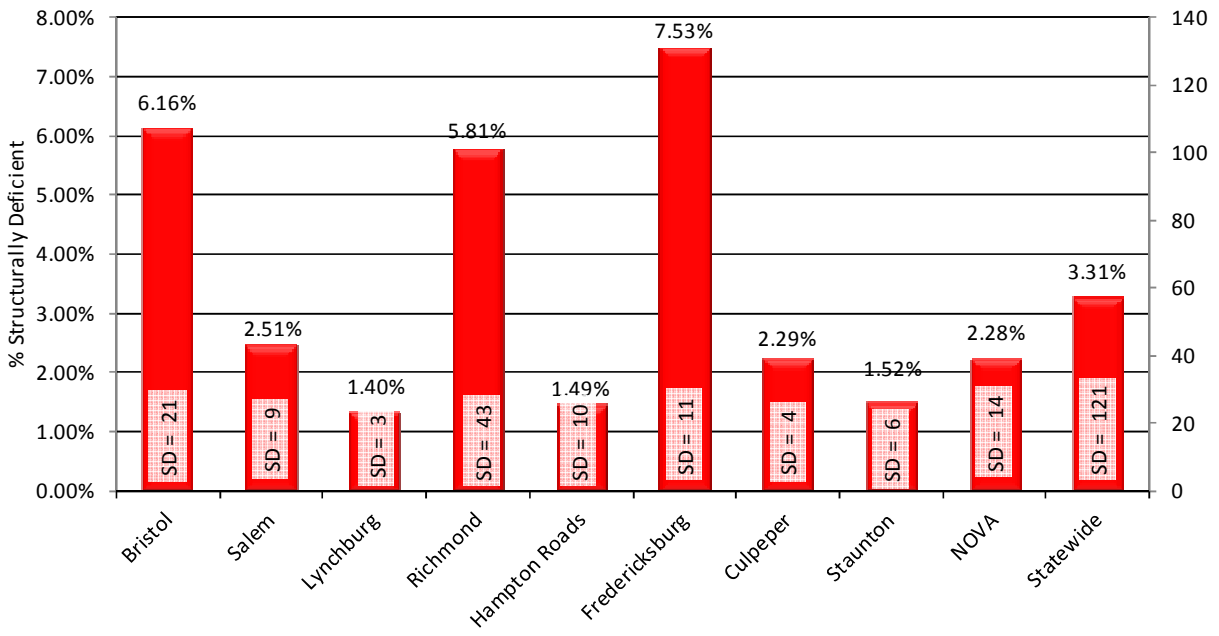


Chart D.10 - Percentage of Number of NBI Structurally Deficient Structures on NHS Recent Trend for Structures

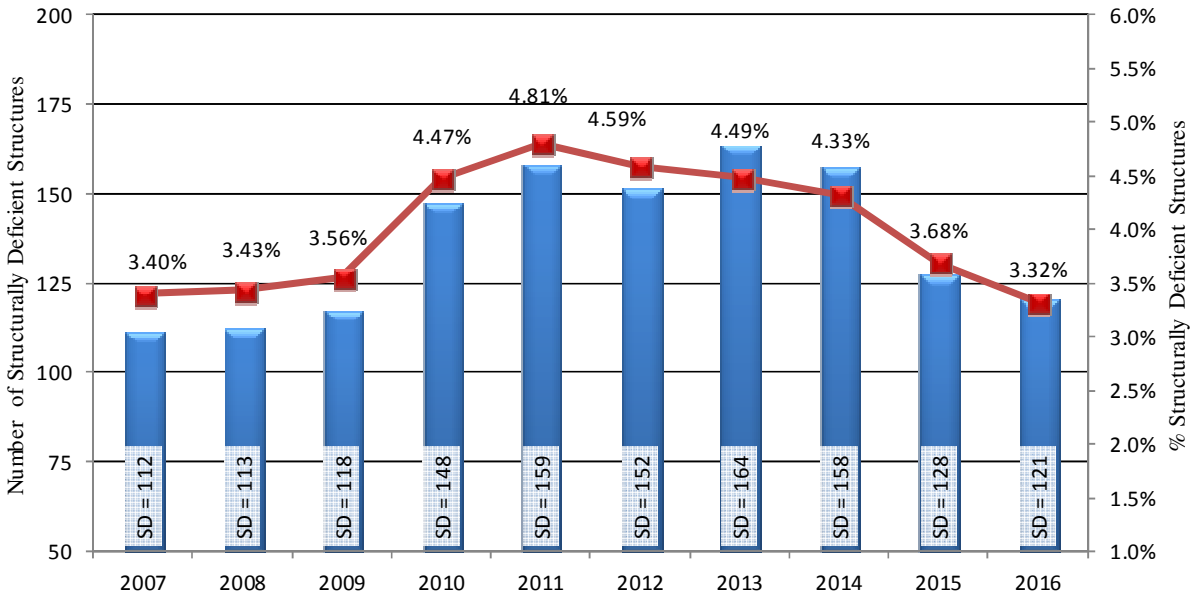


Chart D.11 – Percentage of Number of NBI Structurally Deficient Structures on NHS On Interstate System

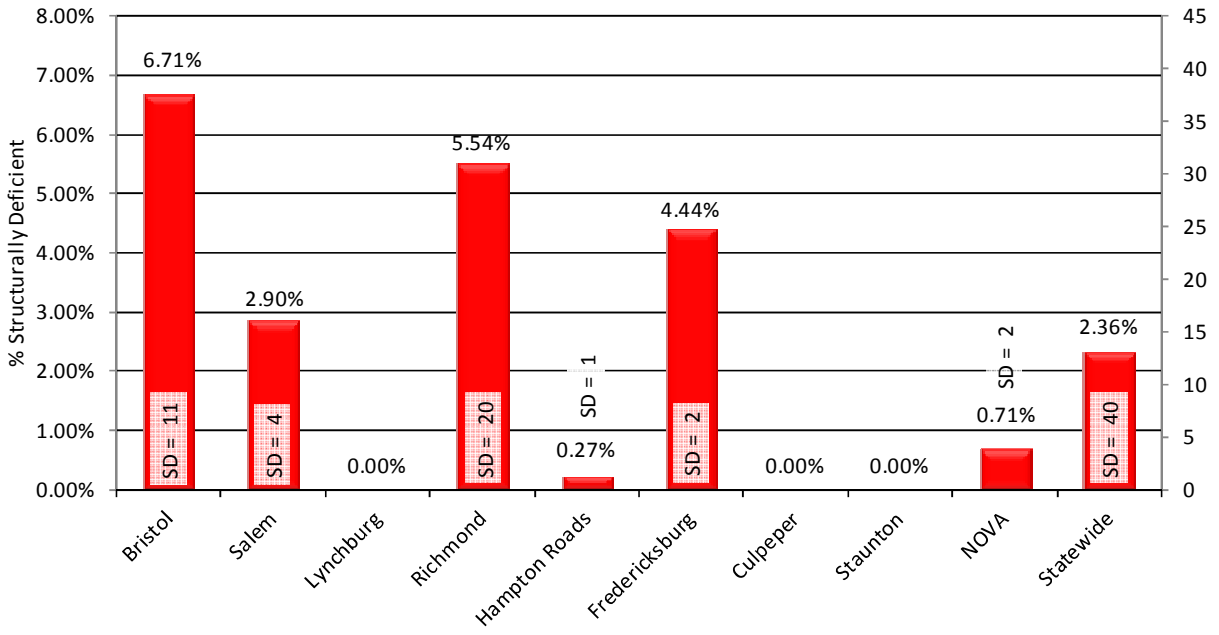


Chart D.12 – Percentage of Number of NBI Structurally Deficient Structures on NHS Recent Trend on Interstate System

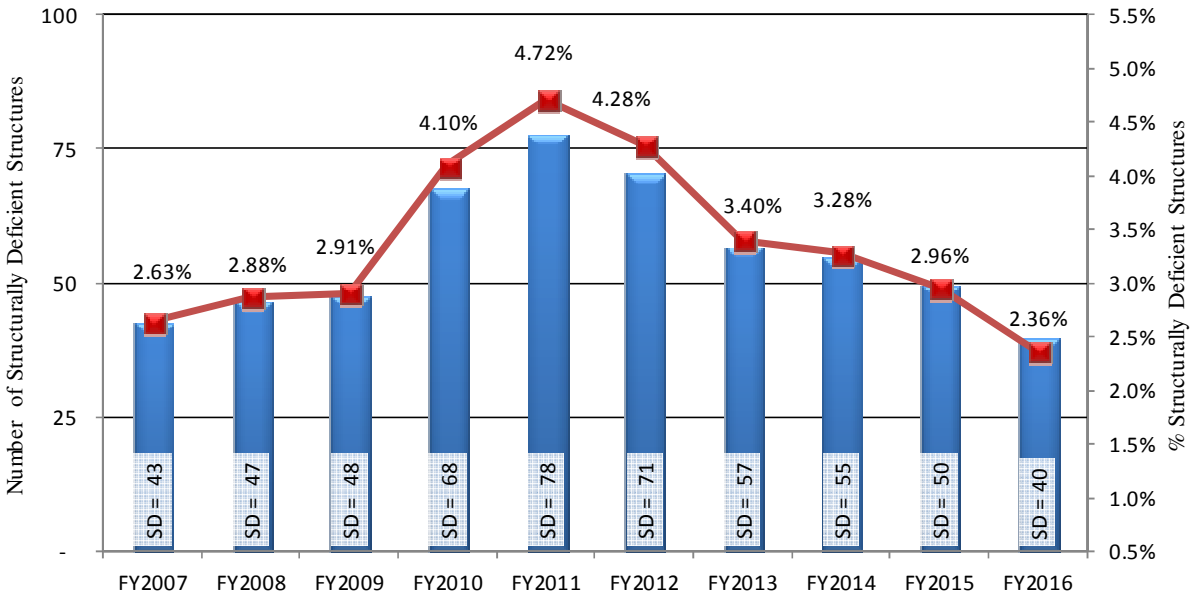


Chart D.13 – Percentage of Number of NBI Structurally Deficient Structures on NHS On Primary System

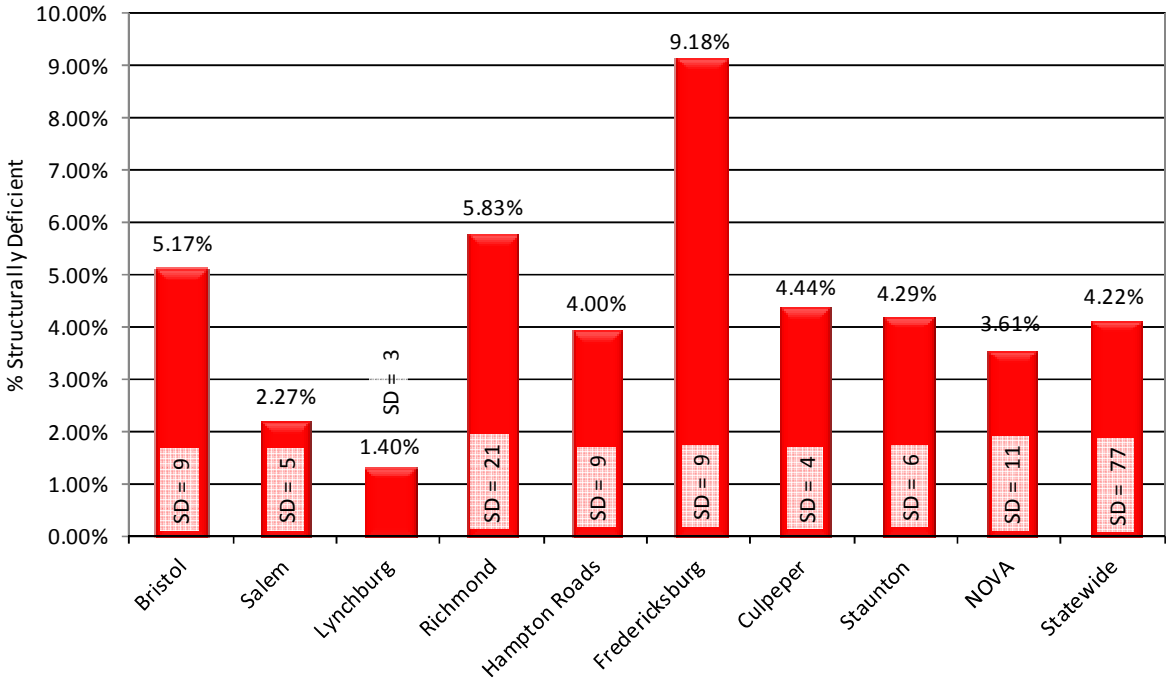
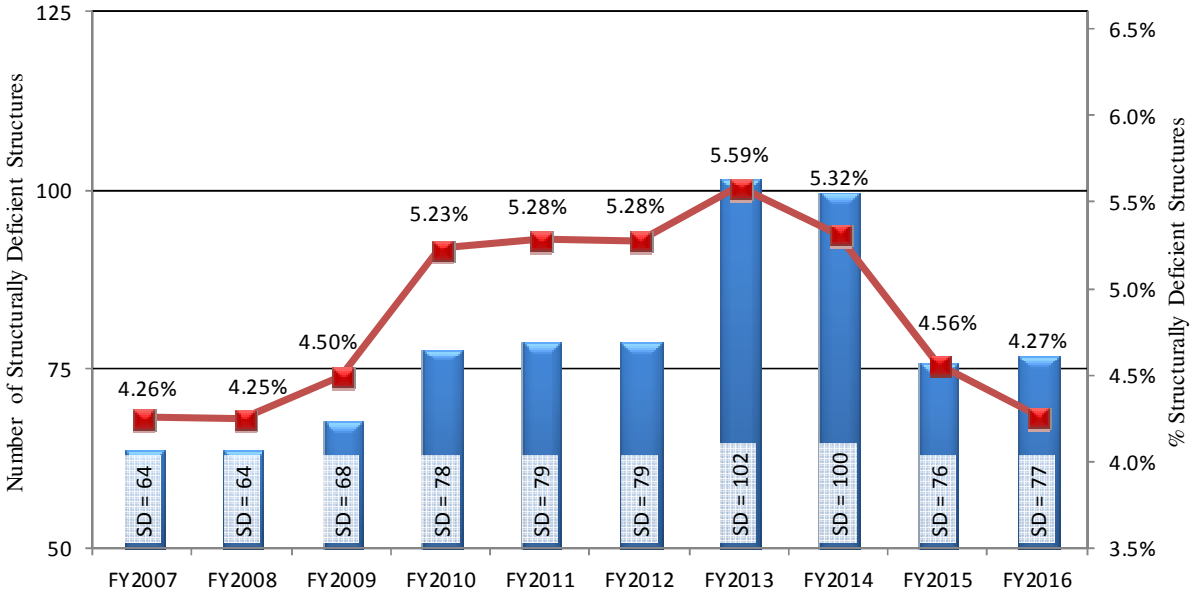


Chart D.14 – Percentage of Number of NBI Structurally Deficient Structures on NHS Recent Trend on Primary System



APPENDIX E – OTHER PERFORMANCE INDICATORS

FUNCTIONALLY OBSOLETE STRUCTURES

A Functionally Obsolete (FO) structure is one that has an appraisal rating of three (3) or less for the Deck Geometry, Underclearance, Approach Roadway Alignment, Structural Condition or Waterway Adequacy. An FO designation means that the structure was built to standards (deck geometry, load carrying capacity, clearances, or approach roadway alignment) that are less conservative than those used for new construction projects today.

Notes:

- Method of accounting for the number of structures by system has changed from previous years. See Appendix G for discussion.
- Federal Highway Administration recently modified the NHS routes. This change was implemented in the 2016 and beyond data.

Chart E.1 – Number and Percentage of Functionally Obsolete Structures
Recent Statewide Trend

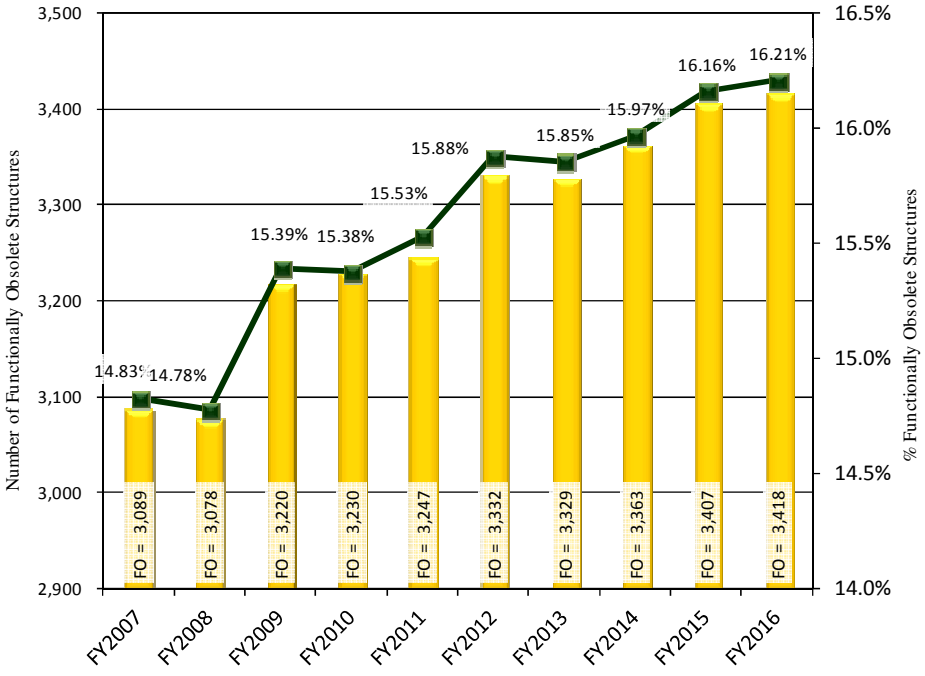


Chart E.2 – Number and Percentage of NBI Functionally Obsolete Structures on the NHS
Recent Statewide Trend

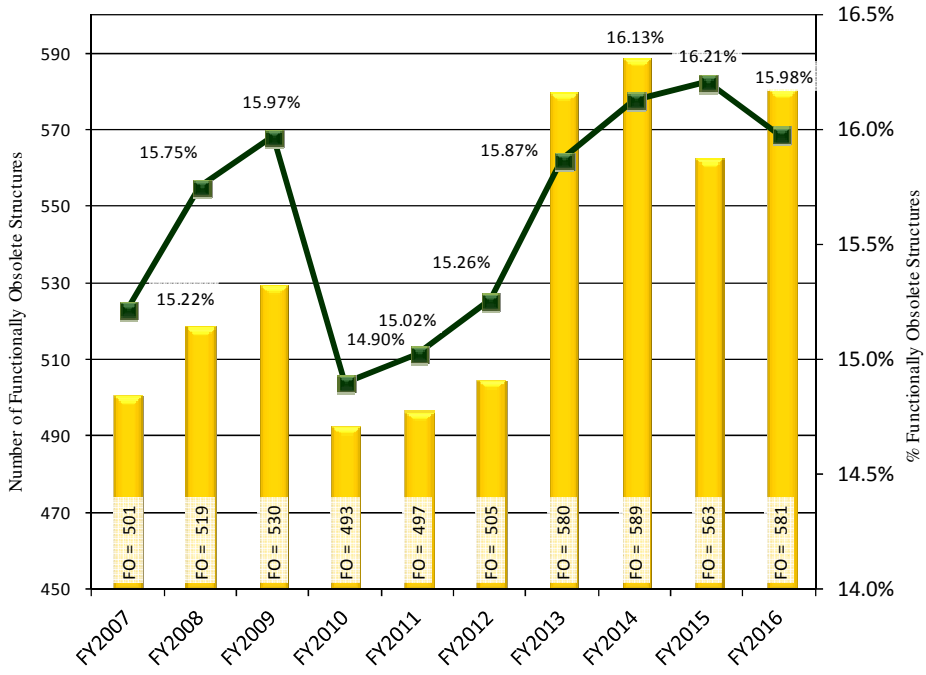


Chart E.3 – Number and Percentage of Functionally Obsolete Structures
Recent Trend on Interstate System

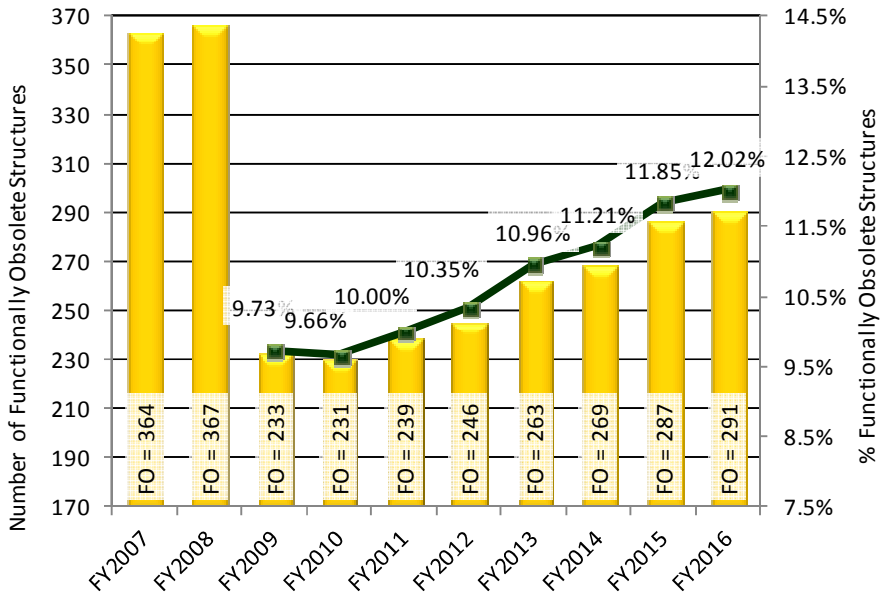


Chart E.4 – Number and Percentage of NBI Functionally Obsolete Structures on the NHS
Recent Trend on Interstate System

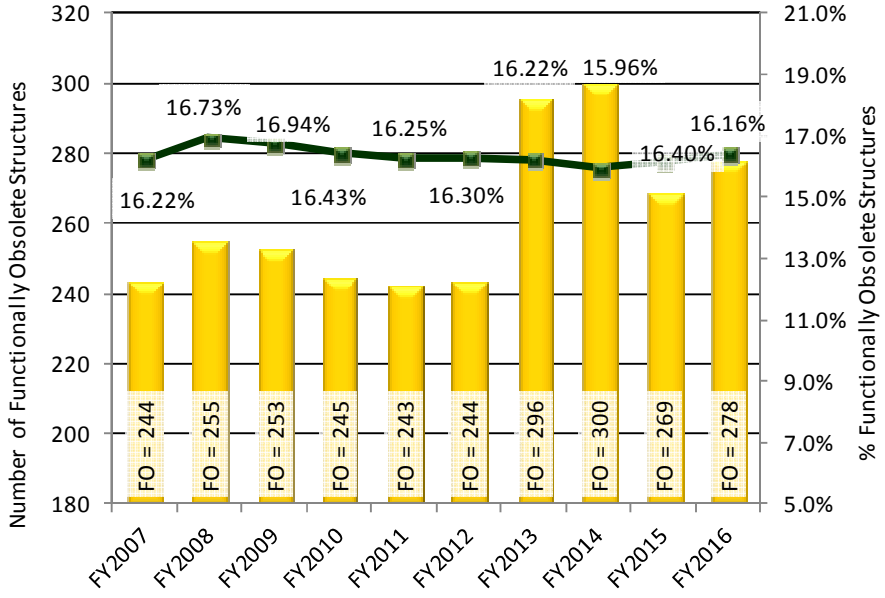


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Chart E.5 – Number and Percentage of Functionally Obsolete Structures
Recent Trend on Primary System

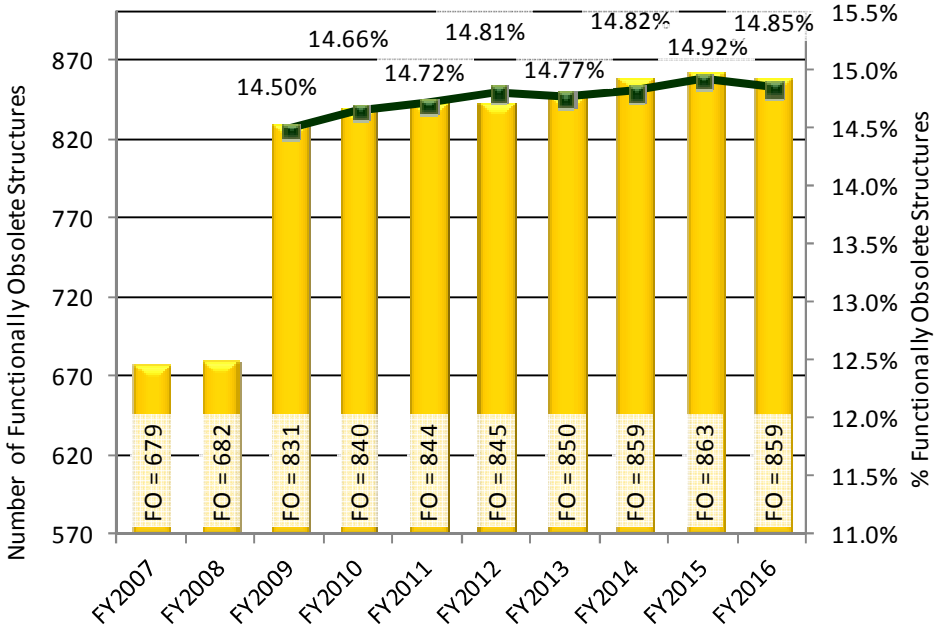


Chart E.6 – Number and Percentage of NBI Functionally Obsolete Structures on the NHS
Recent Trend on Primary System

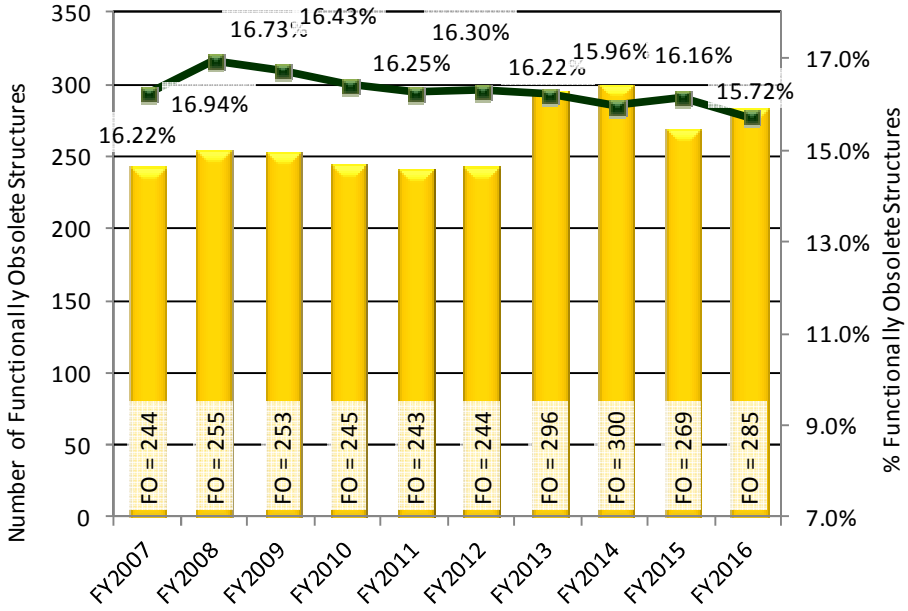


Chart E.7 – Number and Percentage of Functionally Obsolete Structures Recent Trend on Secondary System

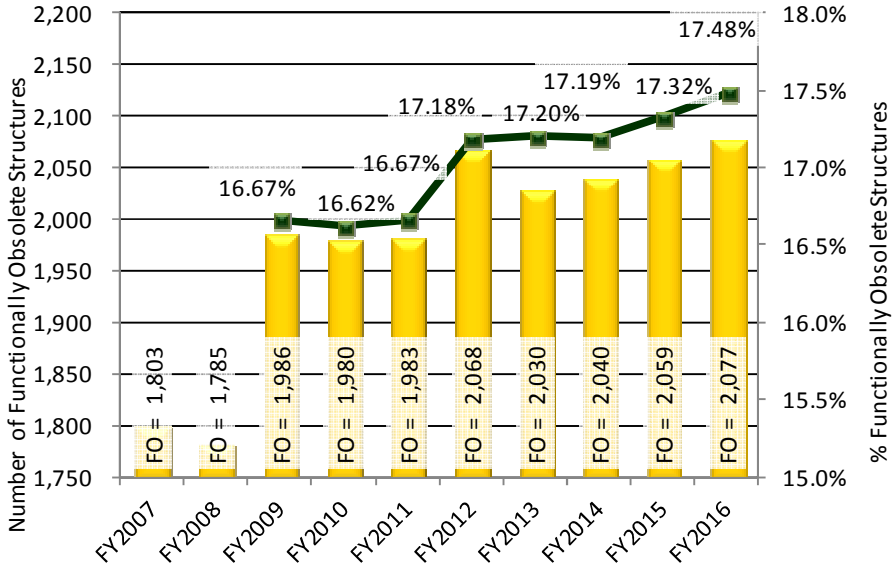
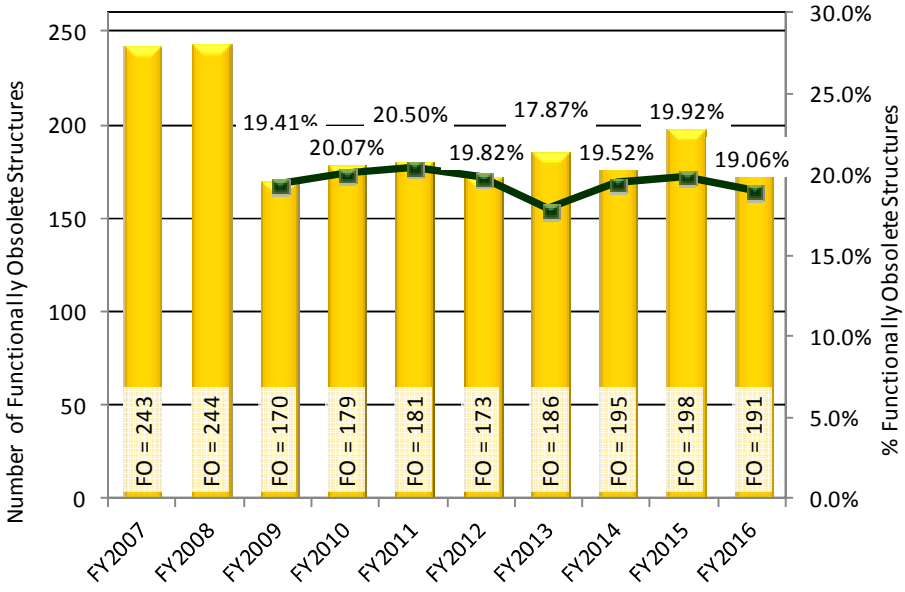


Chart E.8 – Number and Percentage of Functionally Obsolete Structures Recent Trend on Urban System



DEFICIENT STRUCTURES

According to the Federal Highway Administration a structure is deemed “deficient” if it is rated either SD or FO. If a structure is both SD and FO it is designated as deficient. All percentages are based on the number of bridges in the inventory during the fiscal year indicated, so it is possible for the number of SD or FO structures to increase from one year to the next while the percentage decreases.

Note: Method of accounting for the number of structures by system has changed from previous years. See Appendix G for discussion.

Chart E.9 – Number and Percentage of Deficient Structures
Recent Statewide Trend

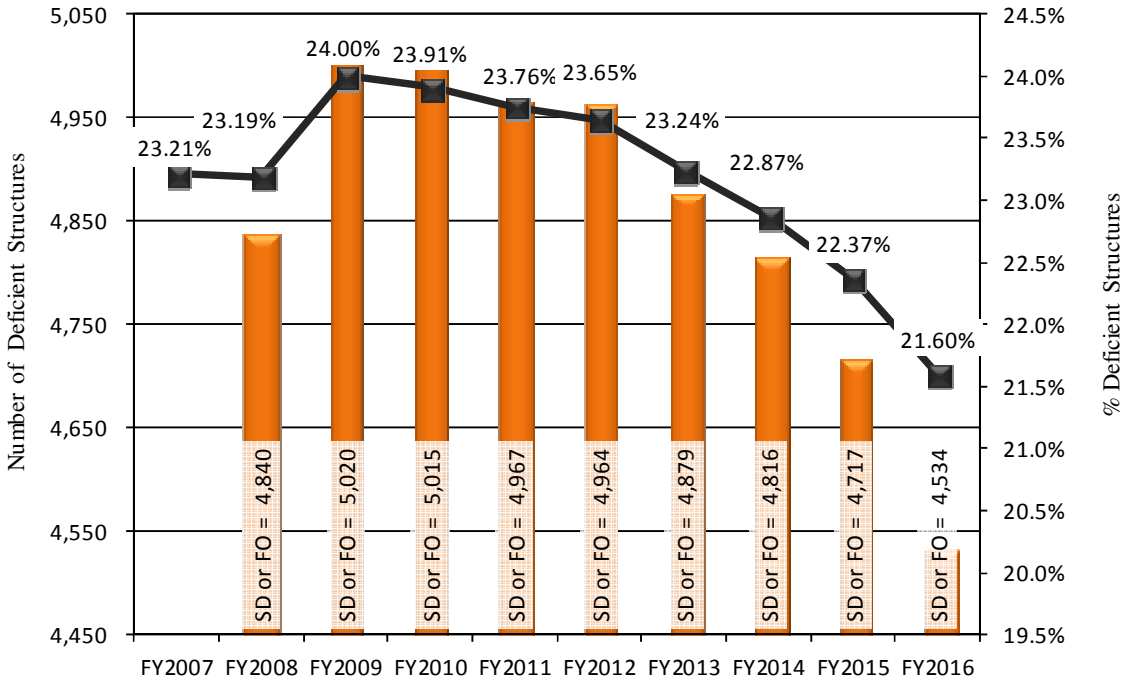


Chart E.10 – Number and Percentage of NBI Deficient Structures on NHS
Recent Statewide Trend

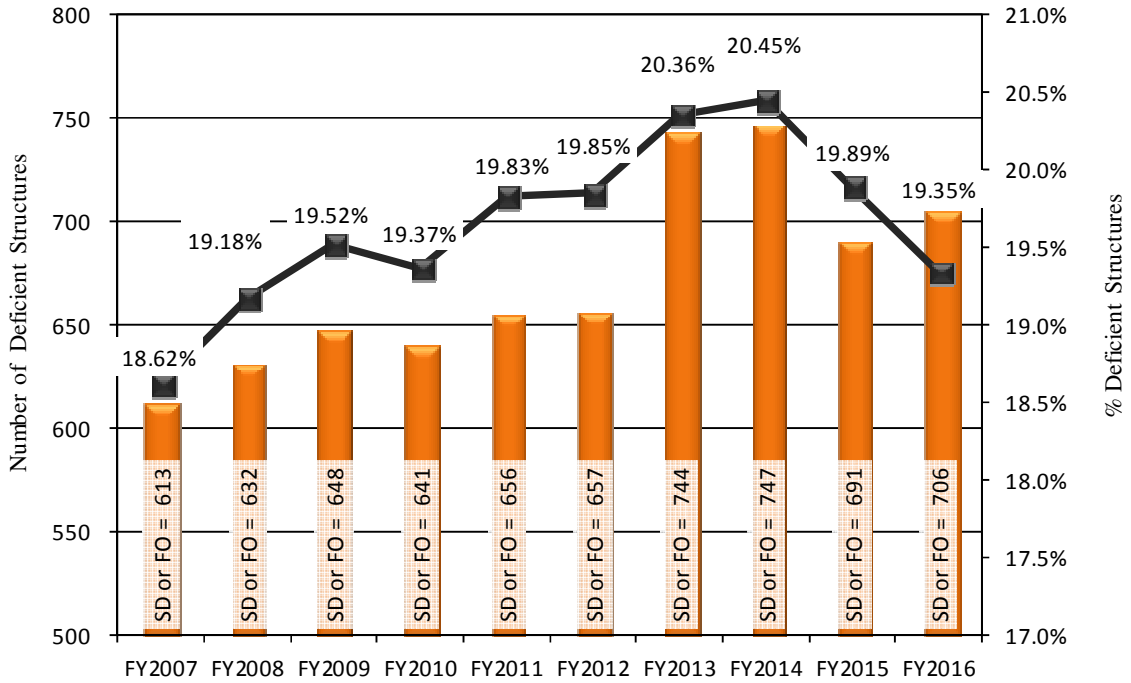


Chart E.11 – Number and Percentage of Deficient Structures
Recent Trend on Interstate System

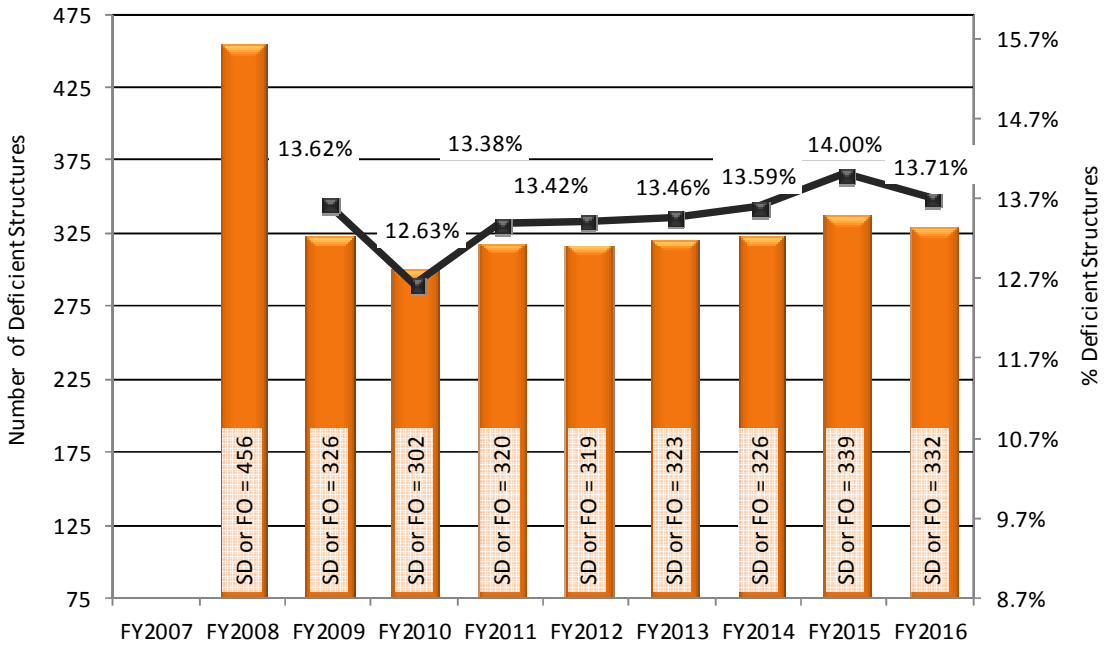


Chart E.12 – Number and Percentage of NBI Deficient Structures on NHS
Recent Trend on Interstate System

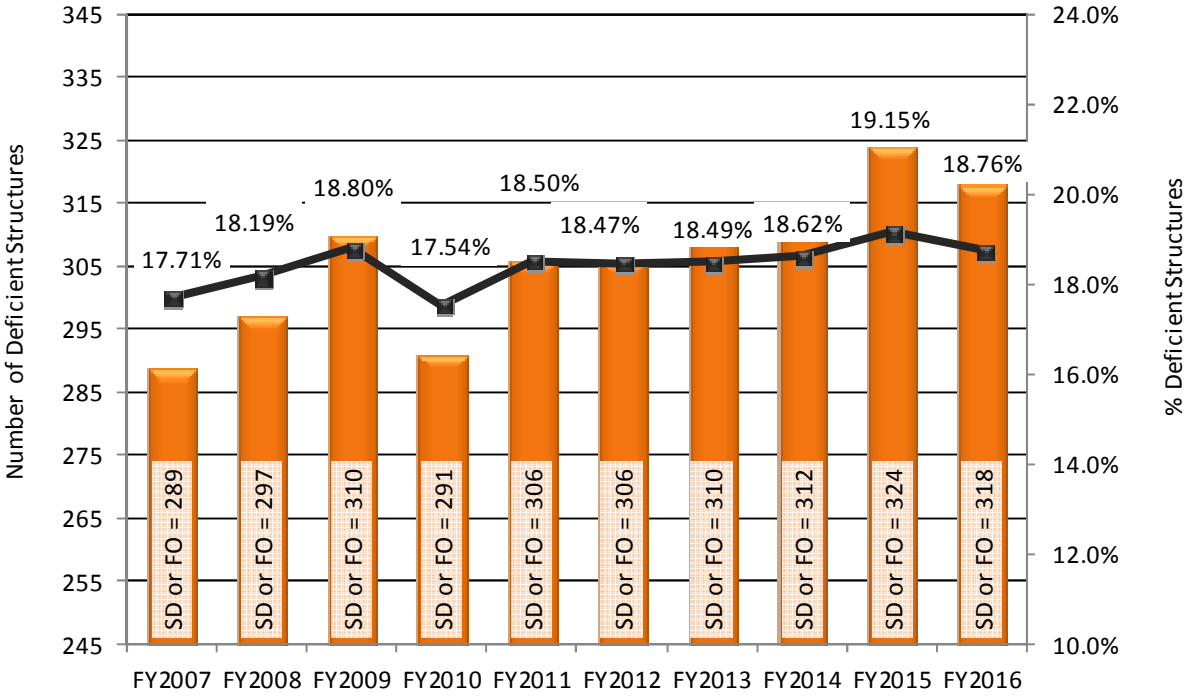


Chart E.13 – Number and Percentage of Deficient Structures
Recent Trend on Primary System

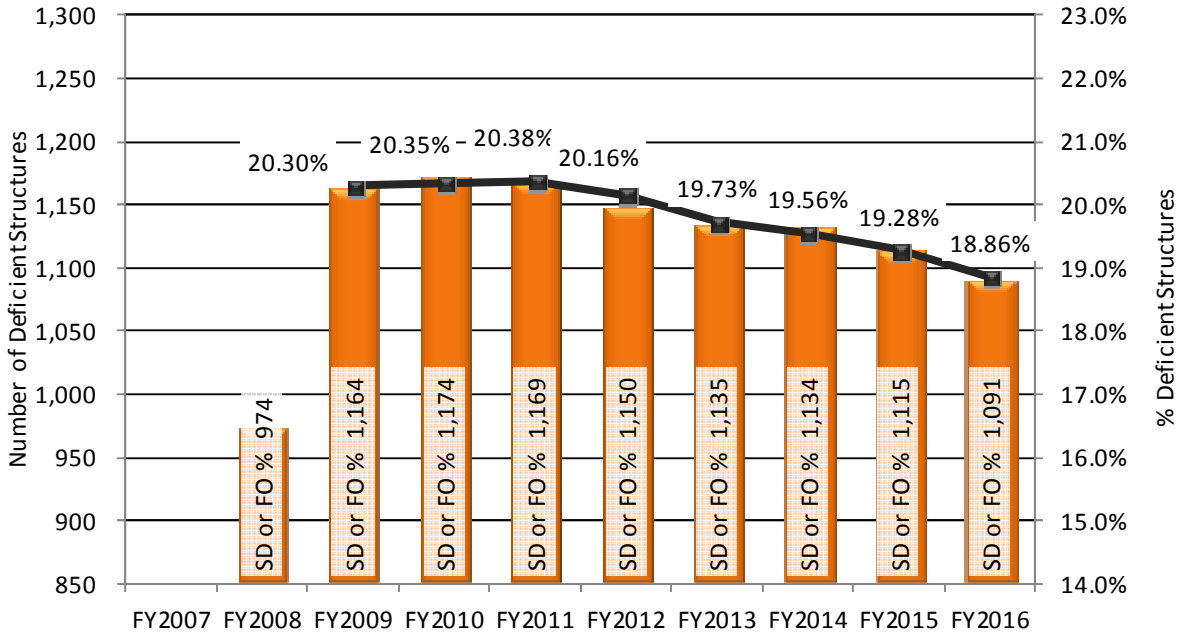


Chart E.14 – Number and Percentage of NBI Deficient Structures on NHS
Recent Trend on Primary System

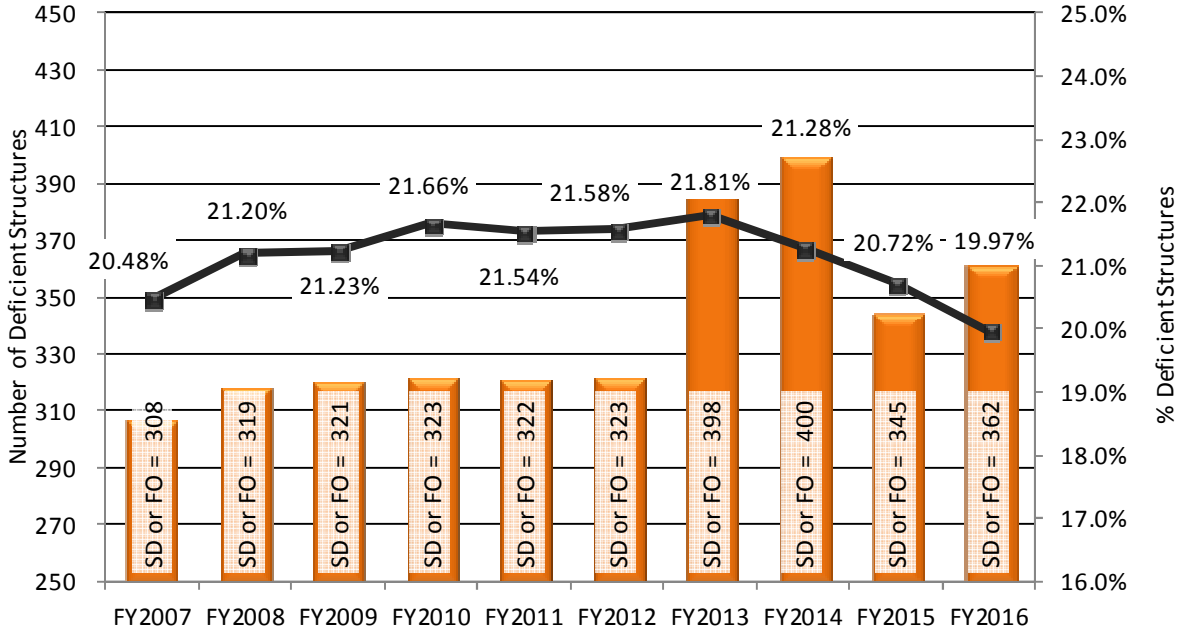


Chart E.15 – Number and Percentage of Deficient Structures Recent Trend on Secondary System

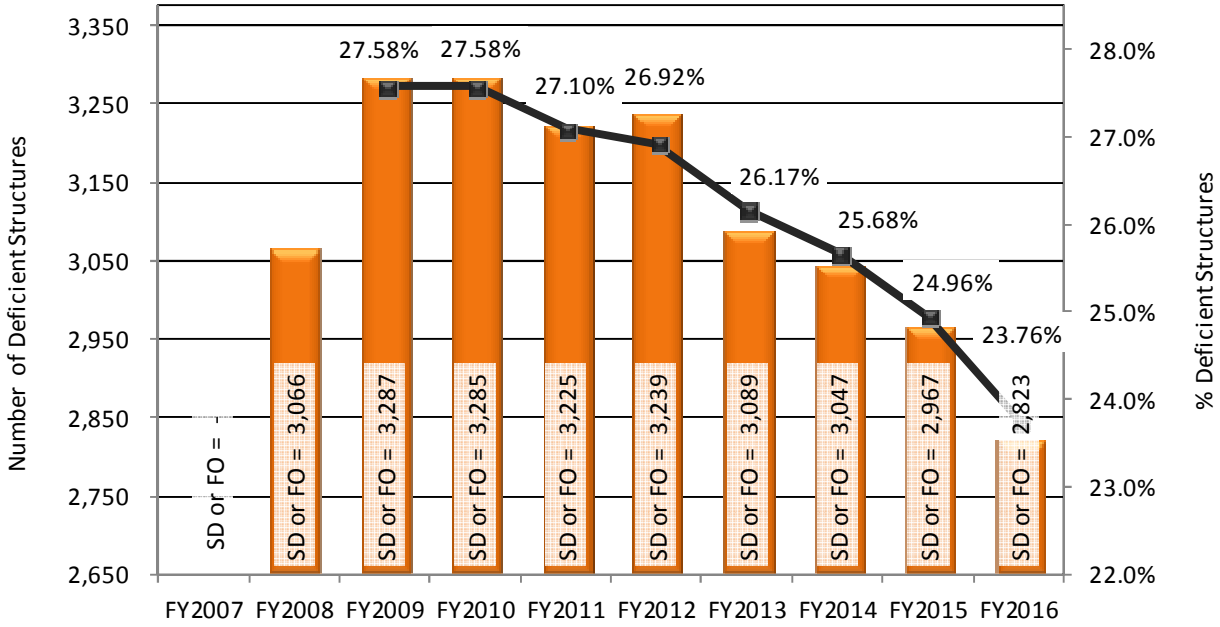
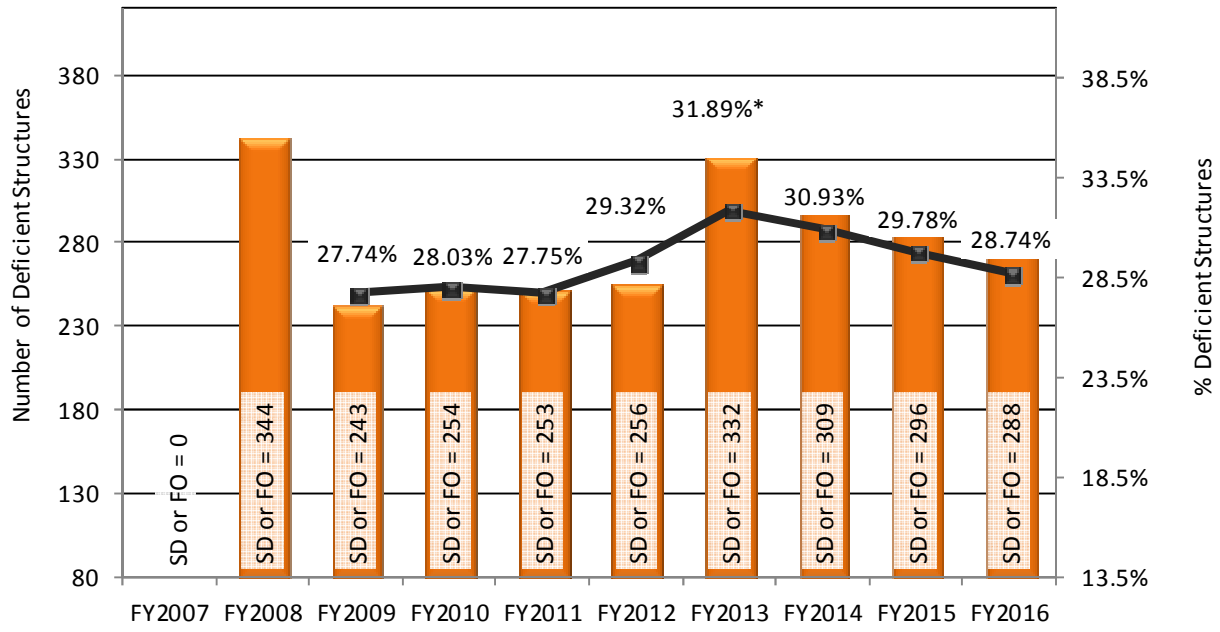


Chart E.16 – Number and Percentage of Deficient Structures Recent Trend on Urban System



**Note: A large number of deficient structures were added in Buchanan County in FY2013. See Appendix G for discussion*

WEIGHT-POSTED STRUCTURES

A weight-posted structure is one that has a rated load-carrying capacity less than the Virginia designated legal loads or the 45 ton blanket vehicle. Virginia legal loads are as follows:

- 27 Tons for a single unit
- 40 Tons for semi-trailers

Virginia's blanket vehicles are as follows:

- 57.5 Tons on 7 axles
- 45 Tons on 5 axles

Charts E.17 thru E.21 illustrate the number and percentages of posted structures statewide and by system.

Note: Method of accounting for the number of structures by system has changed from previous years. See Appendix G for discussion.

Chart E.17 – Number and Percentage of Weight-Posted Structures
Recent Statewide Trend

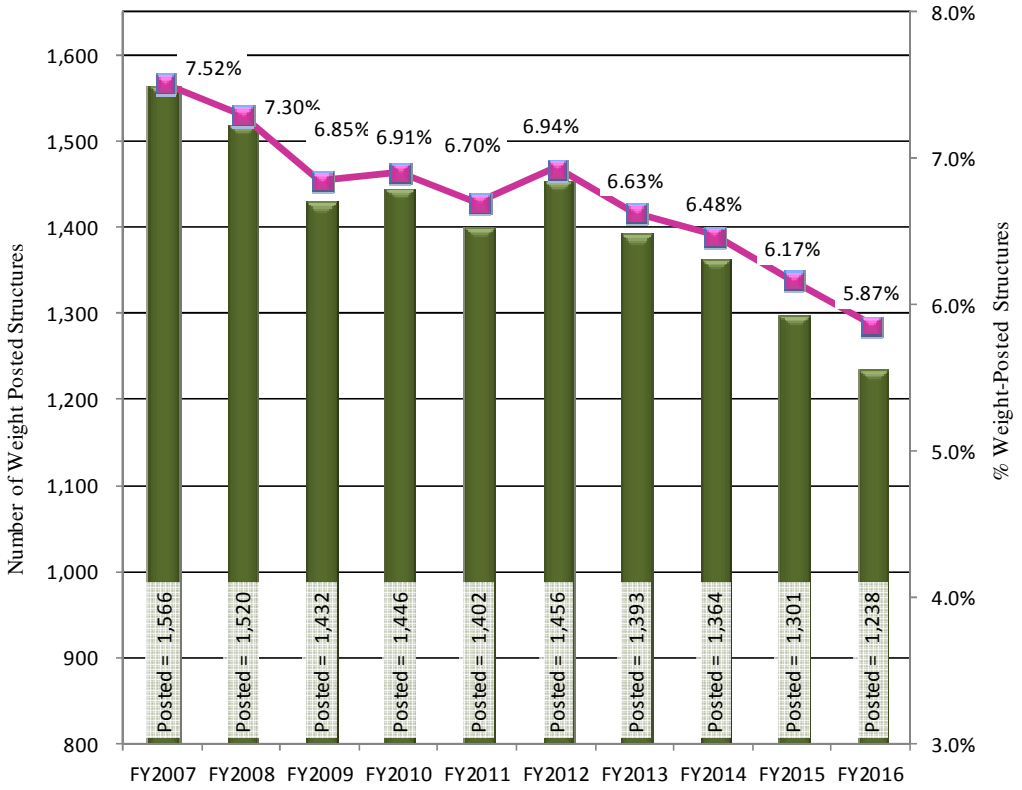


Chart E.18 – Number and Percentage of Weight-Posted Structures
Recent Trend on Interstate System

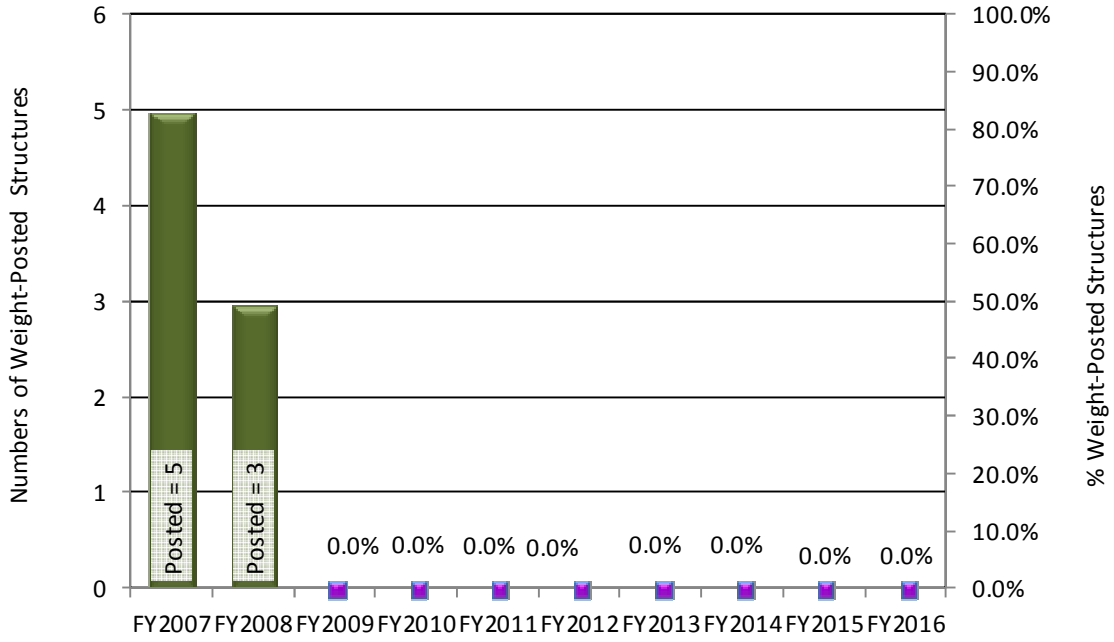


Chart E.19 – Number and Percentage of Weight-Posted Structures
Recent Trend on Primary System

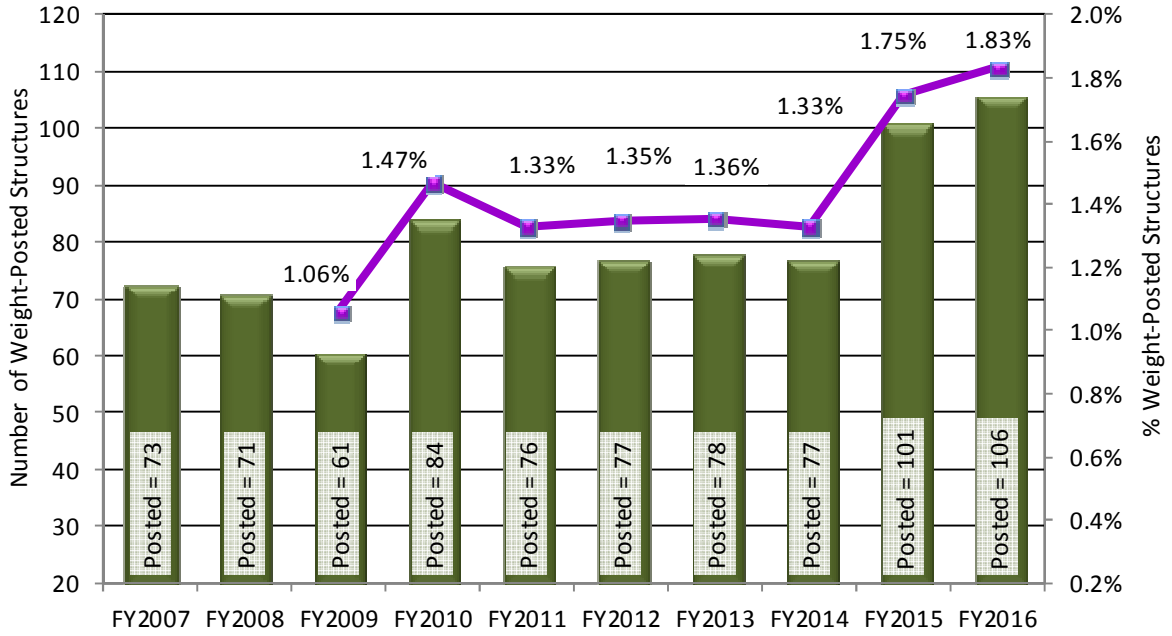


Chart E.20 – Number and Percentage of Weight-Posted Structures
Recent Trend on Secondary System

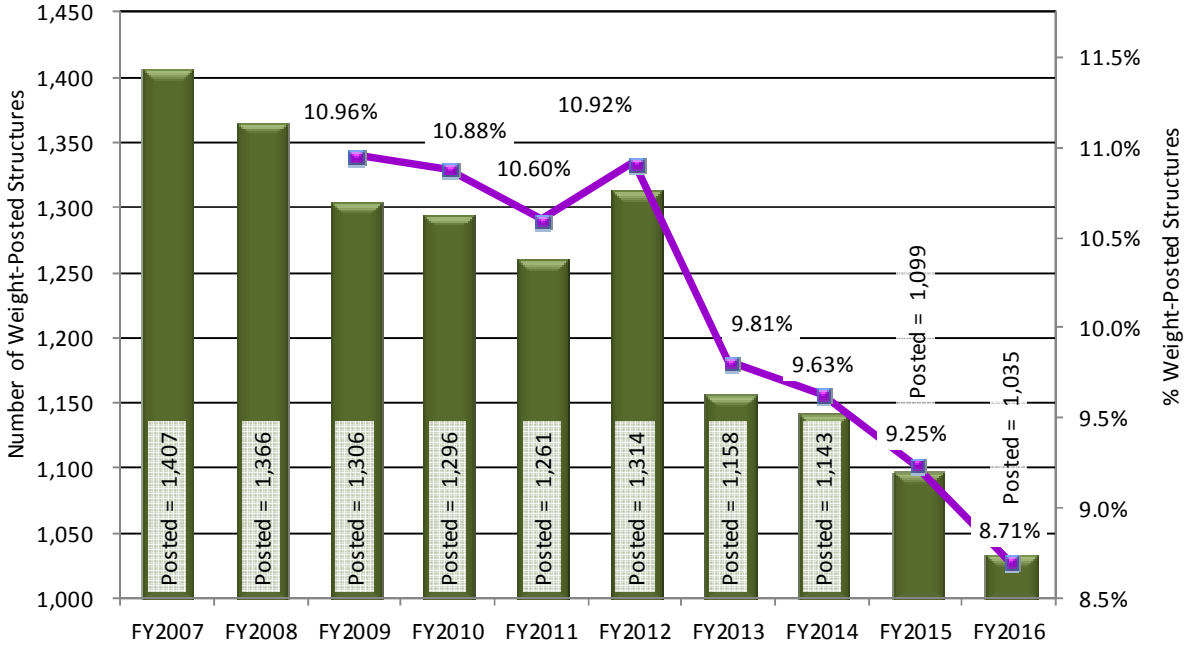
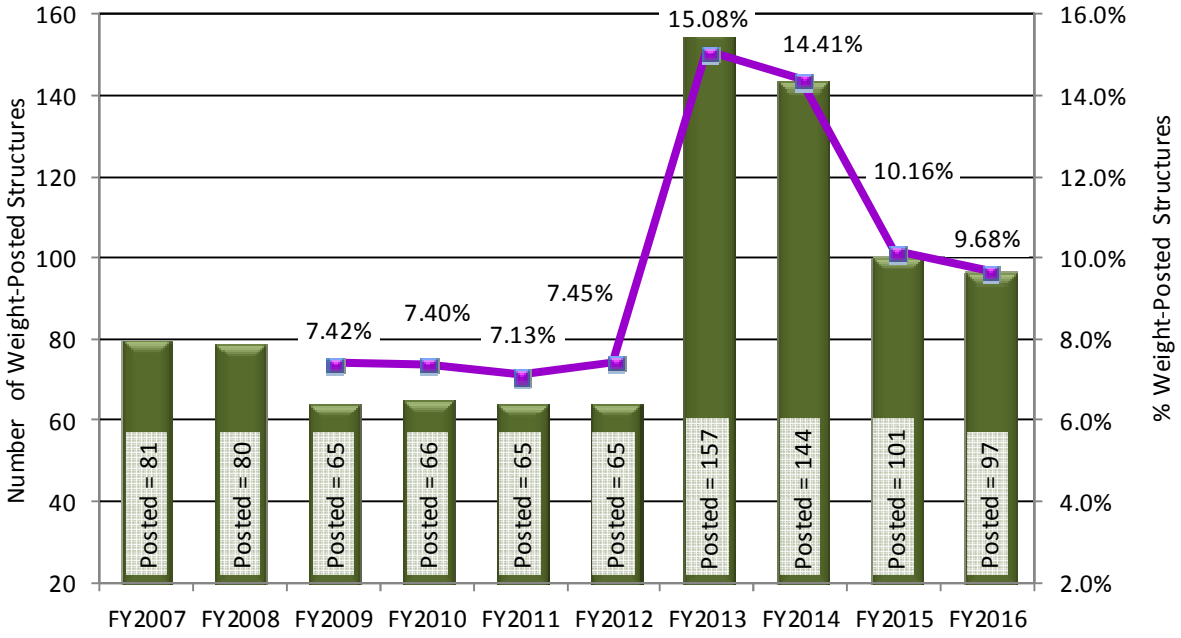


Chart E.21 – Number and Percentage of Weight-Posted Structures Recent Trend on Urban System



Note: A large number of deficient structures were added in Buchanan County in FY2013. See Appendix G for discussion

HEALTH INDEX MEASURE

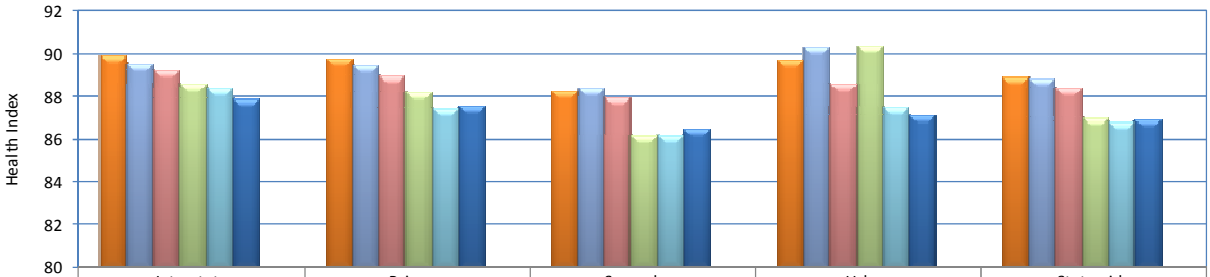
VDOT tracks a performance measure called the Health Index, which is calculated with the AASHTOWare Bridge Management software (BrM). The Health Index is calculated as the sum of the current value of all elements divided by the sum of total value of all elements. The current value is based on the quantity of the elements in each condition state. A Health Index of 100% indicates that all of the condition elements of the structure are in the best possible condition state. A Health Index of 0% indicates that all of the condition elements are in the worst possible condition state. Health index of an individual structure is calculated according to the formula following formula.

$$H = \frac{\sum_e CEVe}{\sum_e TEVe} * 100\%$$

where *CEVe* and *TEVe* are the **current** and **total element values of each element**.

An element is a part of a bridge for which condition is assessed and work maybe recommended. Each bridge element can have up to five condition states. Each condition state categorizes the nature and extent of damage or deterioration of a bridge element. Condition state one is always defined as no damage. The higher the condition state, the more damage there is on the element. Condition states for each element have been precisely defined in terms of the specific types of distresses that the elements can develop. Charts E.22 and E.23 show the average Health Index (HI) by highway system and by District from FY2010 to FY2016. HI data for earlier years is not available.

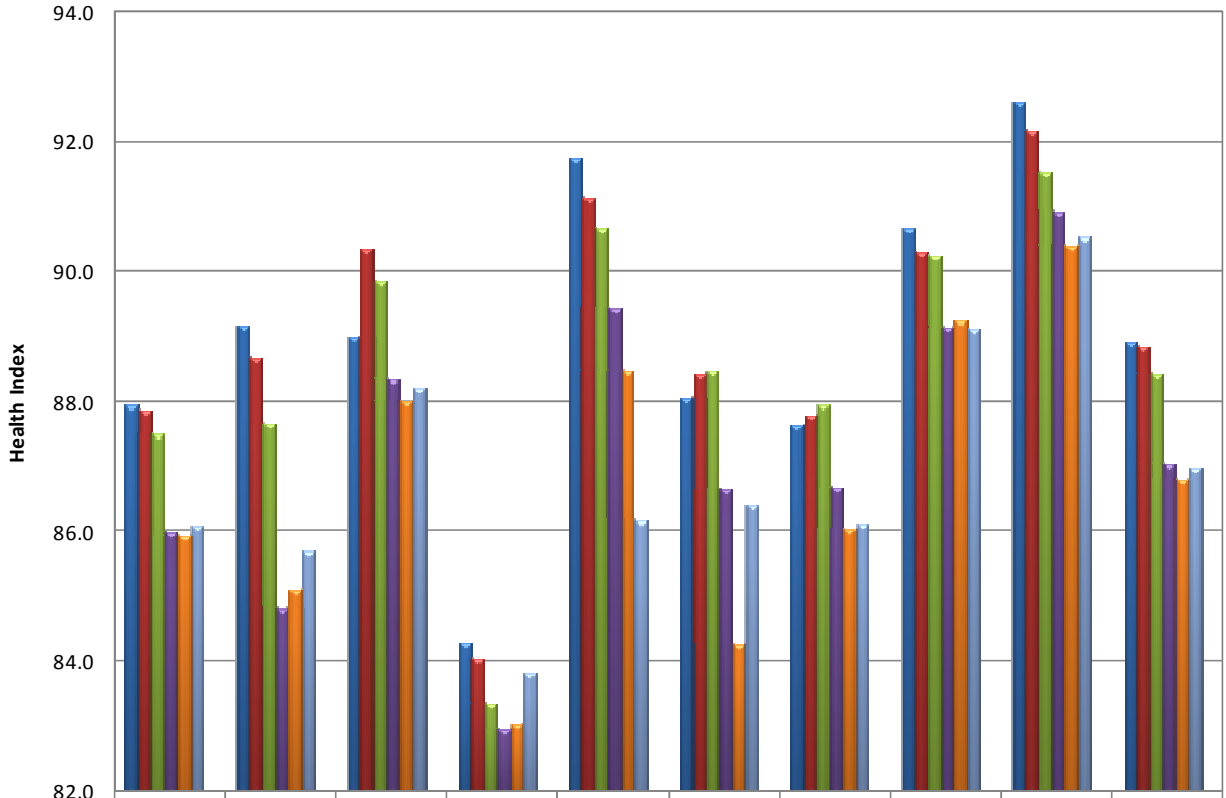
Chart E.22 – Average Health Index of VDOT Structures by System and Statewide



	Interstate	Primary	Secondary	Urban	Statewide
2010	89.98	89.88	88.33	89.79	88.95
2011	89.59	89.56	88.43	90.35	88.88
2012	89.26	89.00	88.04	88.68	88.45
2013	88.64	88.24	86.21	90.42	87.07
2014	88.43	87.48	86.22	87.58	86.84
2015	87.93	87.61	86.58	87.18	87.02
2016*	*	*	*	*	*

*Due to a transition in the BrM software and processes involved in calculating the Health Index, 2016 values are unavailable at the time of reporting

Chart E.23 – Average Health Index of VDOT Structures by District and Statewide



	Bristol	Salem	Lynchburg	Richmond	Hampton Roads	Fredericksburg	Culpeper	Staunton	Northern Virginia	Statewide
2010	88.0	89.2	89.0	84.3	91.8	88.1	87.7	90.7	92.6	89.0
2011	87.9	88.7	90.4	84.1	91.2	88.5	87.8	90.3	92.2	88.9
2012	87.5	87.7	89.9	83.4	90.7	88.5	88.0	90.3	91.6	88.4
2013	86.0	84.9	88.4	83.0	89.5	86.7	86.7	89.2	90.9	87.1
2014	86.0	85.1	88.0	83.1	88.5	84.3	86.1	89.3	90.4	86.8
2015	86.1	85.7	88.3	83.9	86.2	86.4	86.2	89.2	90.6	87.0
2016*	*	*	*	*	*	*	*	*	*	*

*Due to a transition in the BrM software and processes involved in calculating the Health Index, 2016 values are unavailable at the time of reporting.

APPENDIX F – STRUCTURE DATA BY AREA

Table F.1 – Total Deck Area of Structures by District

DISTRICT	Deck Area of Structures (Square Feet)				
	Interstate	Primary	Secondary	Urban	Total
Bristol	1,871,818	5,466,114	2,676,270	321,878	10,336,080
Salem	1,699,385	4,738,766	3,079,911	649,052	10,167,114
Lynchburg	0	4,556,284	2,579,697	373,040	7,509,022
Richmond	6,459,474	9,686,425	3,880,251	1,170,221	21,196,371
Hampton Roads	10,868,423	14,597,903	1,280,943	2,982,586	29,729,855
Fredericksburg	614,434	2,823,618	1,235,931	61,988	4,735,971
Culpeper	1,048,430	1,824,692	1,781,709	89,525	4,744,355
Staunton	3,203,132	3,627,783	3,228,560	495,537	10,555,013
NOVA	6,465,730	6,471,776	6,470,693	495,364	19,903,563
Statewide	**32,230,826**	**53,793,360**	**26,213,966**	**6,639,191**	**118,877,344**

Chart F.1 – Total Deck Area of Structures by District

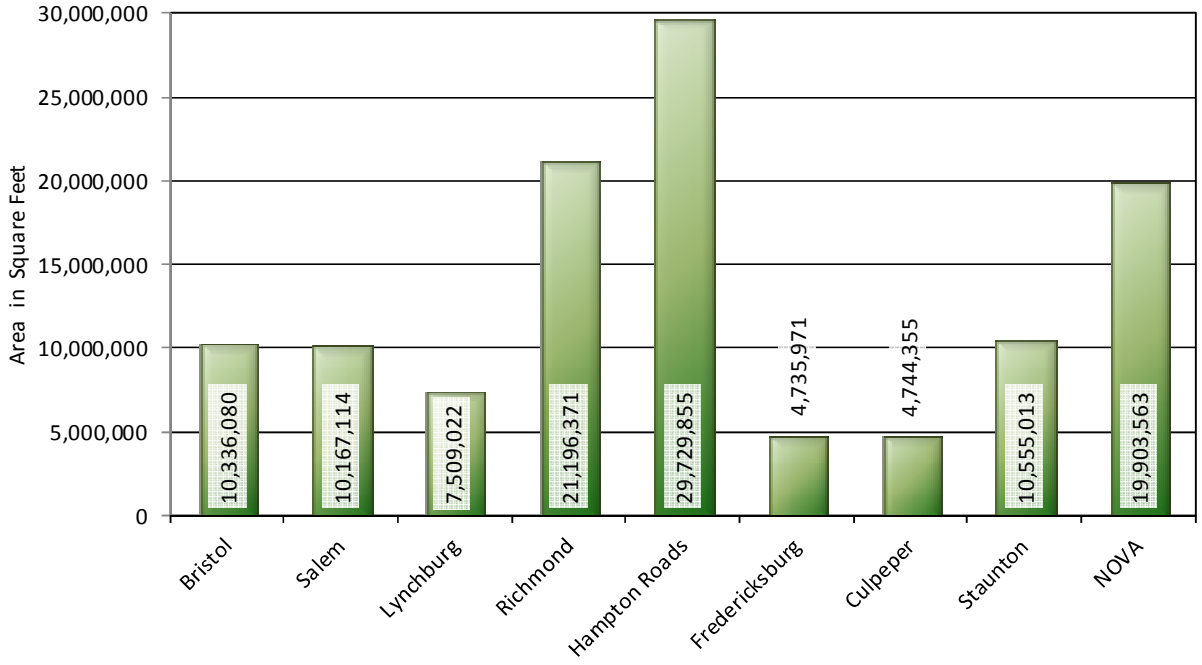


Table F.2 – Total Deck Area of NBI Structures on NHS by District

DISTRICT	Deck Area of Structures (Square Feet)				
	Interstate	Primary	Secondary	Urban	Total
Bristol	1,629,702	2,134,486	15,537	4,337	3,784,063
Salem	1,466,155	2,563,837	0	15,364	4,045,356
Lynchburg	0	2,743,542	4,862	0	2,748,405
Richmond	6,031,808	7,268,892	221,293	45,904	13,567,897
Hampton Roads	10,618,753	12,208,695	60,970	1,409,483	24,297,901
Fredericksburg	518,441	1,434,510	32,042	36,683	2,021,676
Culpeper	904,996	804,593	0	12,916	1,722,506
Staunton	2,713,174	1,325,521	0	22,543	4,061,238
NOVA	5,844,733	4,924,371	365,801	0	11,134,905
Statewide	**29,727,762**	**35,408,447**	**700,506**	**1,547,231**	**67,383,946**

Chart F.2 – Total Deck Area of NBI Structures on NHS by District

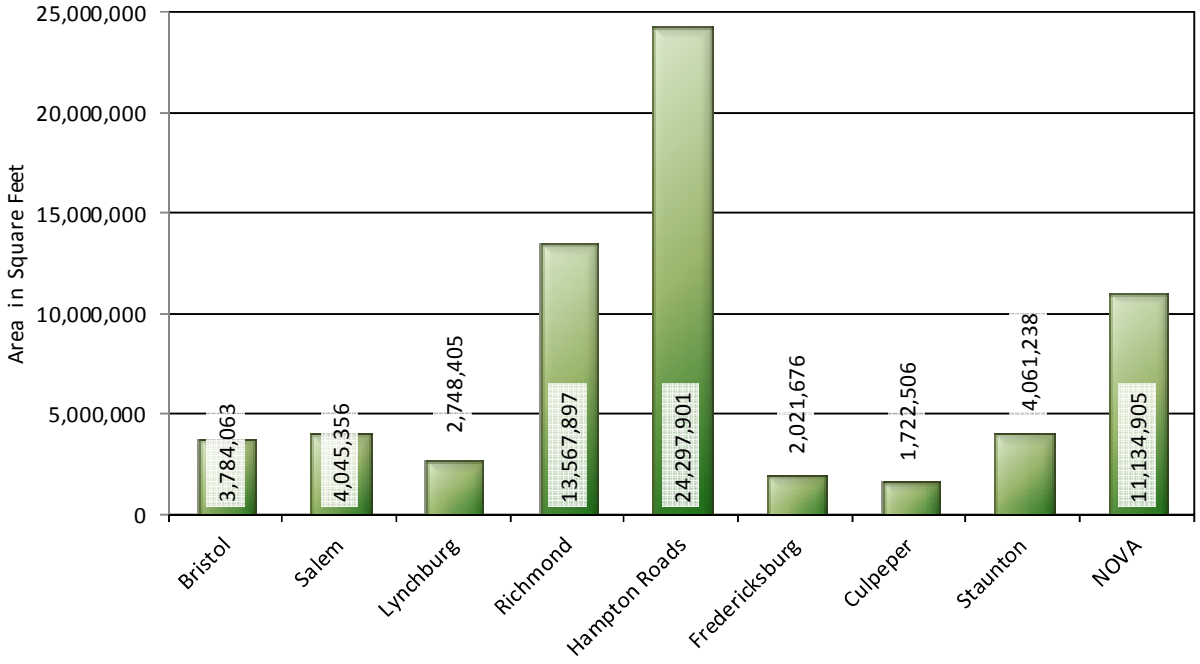


Table F.3 – Total Deck Area of Structurally Deficient Structures by District

DISTRICT	Area of Structurally Deficient Structures (Square Feet)				
	Interstate	Primary	Secondary	Urban	Total
Bristol	107,983	224,374	141,561	91,730	565,649
Salem	105,631	141,912	169,424	15,980	432,947
Lynchburg	0	122,221	109,027	17,049	248,297
Richmond	319,522	566,727	168,622	130,124	1,184,994
Hampton Roads	282,900	586,653	44,556	49,889	963,998
Fredericksburg	28,857	413,038	71,990	0	513,885
Culpeper	0	100,558	66,908	15,898	183,364
Staunton	0	192,694	146,241	20,308	359,242
NOVA	24,370	204,517	77,772	731	307,389
Statewide	**869,263**	**2,552,693**	**996,100**	**341,709**	**4,759,765**

Chart F.3 – Total Deck Area of Structurally Deficient Structures by District

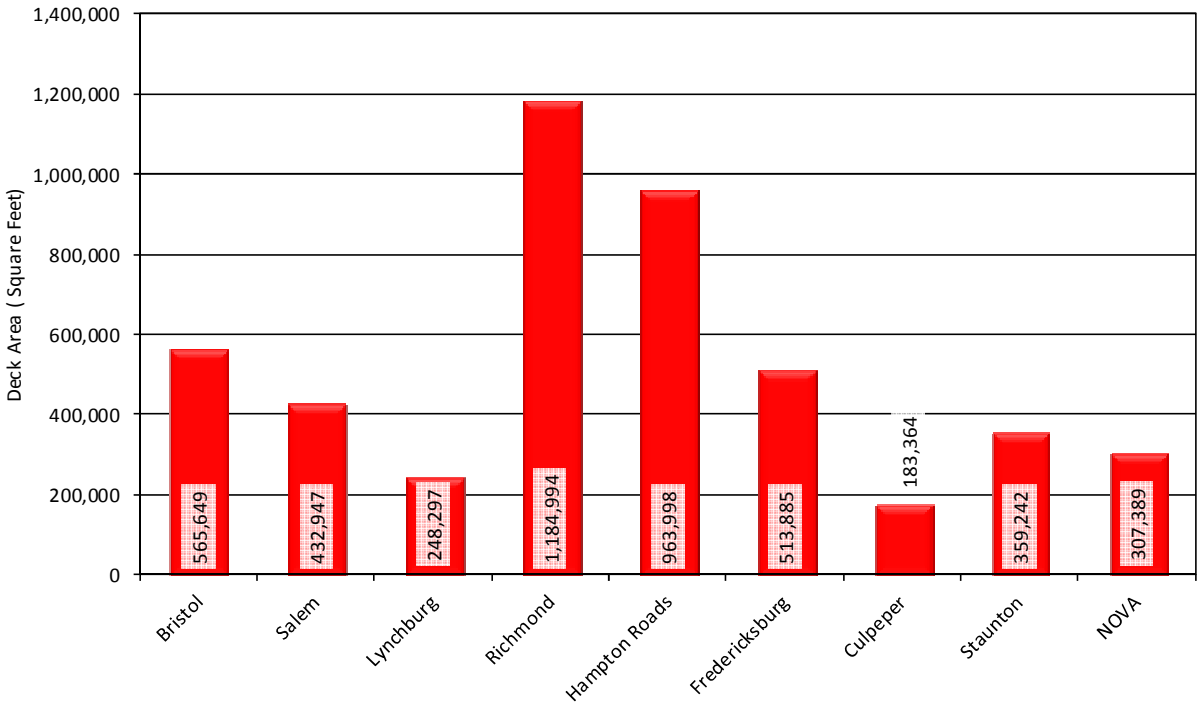


Table F.4 – Total Deck Area of NBI Structurally Deficient Structures on NHS by District

DISTRICT	Area of Structurally Deficient Structures (Square Feet)				
	Interstate	Primary	Secondary	Urban	Total
Bristol	107,983	139,181	0	4,337	251,501
Salem	105,631	39,852	0	0	145,483
Lynchburg	0	15,828	0	0	15,828
Richmond	319,522	288,947	0	17,369	625,838
Hampton Roads	282,900	378,864	0	0	661,764
Fredericksburg	26,280	349,630	0	0	375,910
Culpeper	0	52,652	0	0	52,652
Staunton	0	71,930	0	0	71,930
NOVA	24,370	204,517	3,130	0	232,017
Statewide	**866,686**	**1,541,400**	**3,130**	**21,707**	**2,432,923**

Chart F.4 – Total Deck Area of NBI Structurally Deficient Structures on NHS by District

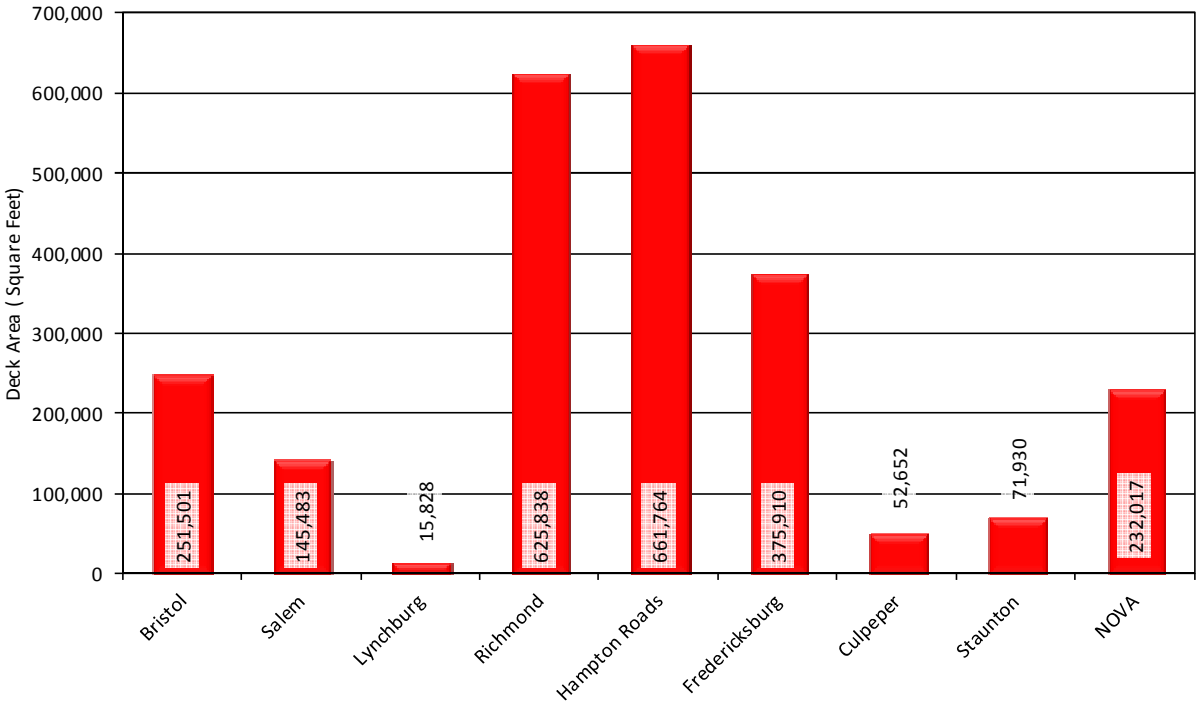


Table F.5 – Percentage of Total Deck Area of Structurally Deficient Structures by District

DISTRICT	Percent Area of Structurally Deficient Structures				
	Interstate	Primary	Secondary	Urban	Total
Bristol	5.8%	4.1%	5.3%	28.5%	5.5%
Salem	6.2%	3.0%	5.5%	2.5%	4.3%
Lynchburg	0.0%	2.7%	4.2%	4.6%	3.3%
Richmond	4.9%	5.9%	4.2%	11.1%	5.6%
Hampton Roads	2.6%	4.0%	3.5%	1.7%	3.2%
Fredericksburg	4.7%	14.6%	5.8%	0.0%	10.9%
Culpeper	0.0%	5.5%	3.8%	17.8%	3.9%
Staunton	0.0%	5.3%	4.5%	4.1%	3.4%
NOVA	0.4%	3.2%	1.2%	0.1%	1.5%
Statewide	**2.7%**	**4.7%**	**3.8%**	**5.1%**	**4.0%**

Percentages are calculated by dividing the SD area for the District by the total area for the District by highway system (example - SD Bristol Interstate area divided by all Bristol Interstate area 107,983/ 1,871,818= 5.8%)

Chart F.5 – Percentage of Total Deck Area of Structurally Deficient Structures by District

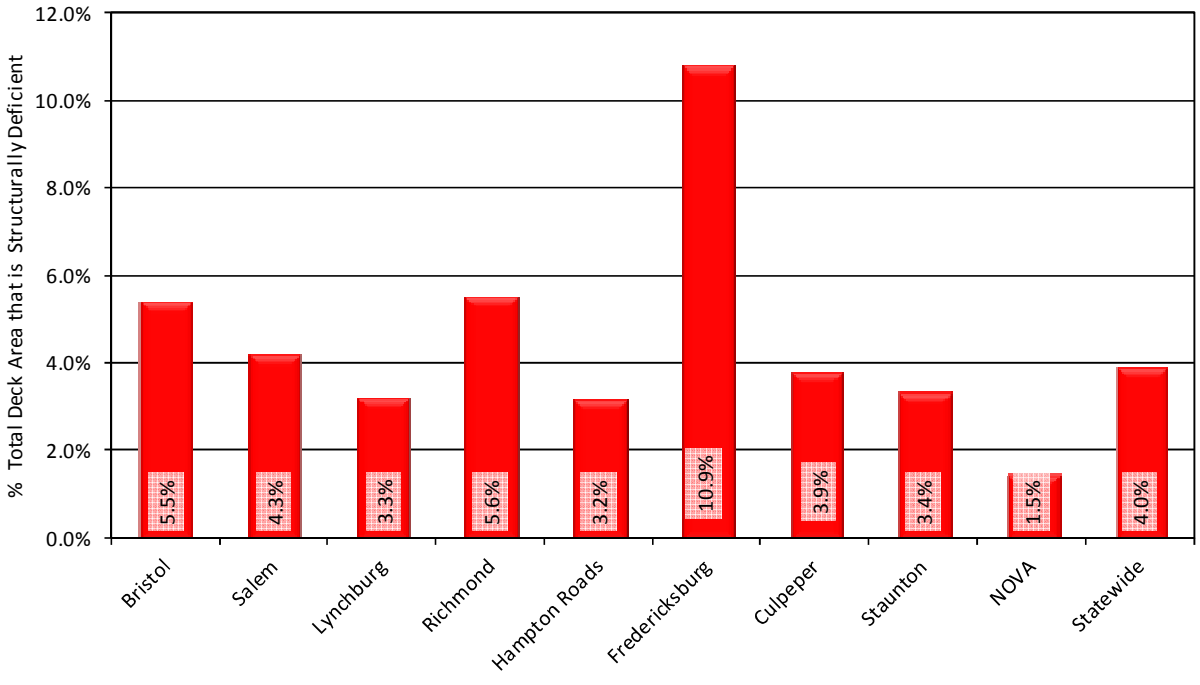


Table F.6 – Percentage of Total Deck Area of NBI Structurally Deficient Structures on NHS by District

DISTRICT	Percent Area of Structurally Deficient Structures				
	Interstate	Primary	Secondary	Urban	Total
Bristol	6.6%	6.5%	0.0%	0.0%	6.6%
Salem	7.2%	1.6%	0.0%	0.0%	3.6%
Lynchburg	0.0%	0.6%	0.0%	0.0%	0.6%
Richmond	5.3%	4.0%	0.0%	37.8%	4.6%
Hampton Roads	2.7%	3.1%	0.0%	0.0%	2.7%
Fredericksburg	5.1%	24.4%	0.0%	0.0%	18.6%
Culpeper	0.0%	6.5%	0.0%	0.0%	3.1%
Staunton	0.0%	5.4%	0.0%	0.0%	1.8%
NOVA	0.4%	4.2%	0.0%	0.0%	2.1%
Statewide	**2.9%**	**4.4%**	**0.0%**	**1.4%**	**3.6%**

Chart F.6 – Percentage of Total Deck Area of NBI Structurally Deficient Structures on NHS by District

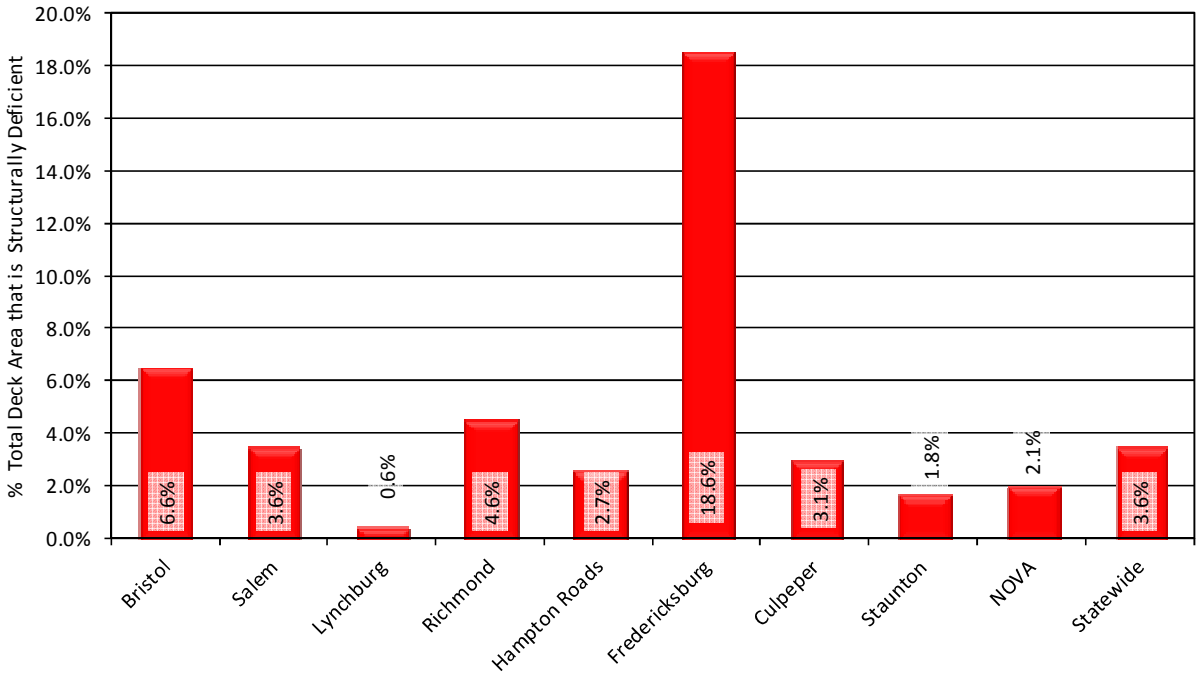


Table F.7 – Total Deck Area of Functionally Obsolete Structures by District

DISTRICT	Area of Functionally Obsolete Structures (Square Feet)				
	Interstate	Primary	Secondary	Urban	Grand Total
Bristol	269,167	945,560	274,022	34,225	1,522,975
Salem	199,372	831,107	550,728	216,622	1,797,829
Lynchburg	0	424,444	152,789	61,695	638,928
Richmond	1,057,548	2,053,389	368,174	286,065	3,765,176
Hampton Roads	1,990,633	4,675,996	120,624	629,966	7,417,220
Fredericksburg	51,437	553,050	78,446	4,375	687,309
Culpeper	6,192	103,107	273,076	9,257	391,631
Staunton	146,899	601,801	380,734	102,051	1,231,485
NOVA	2,616,058	1,812,031	1,788,643	175,611	6,392,344
Statewide	**6,337,307**	**12,000,485**	**3,987,236**	**1,519,868**	**23,844,896**

If a structure is both structurally deficient and functionally obsolete, structure is counted as structurally deficient only.

Chart F.7– Total Deck Area of Functionally Obsolete Structures by District

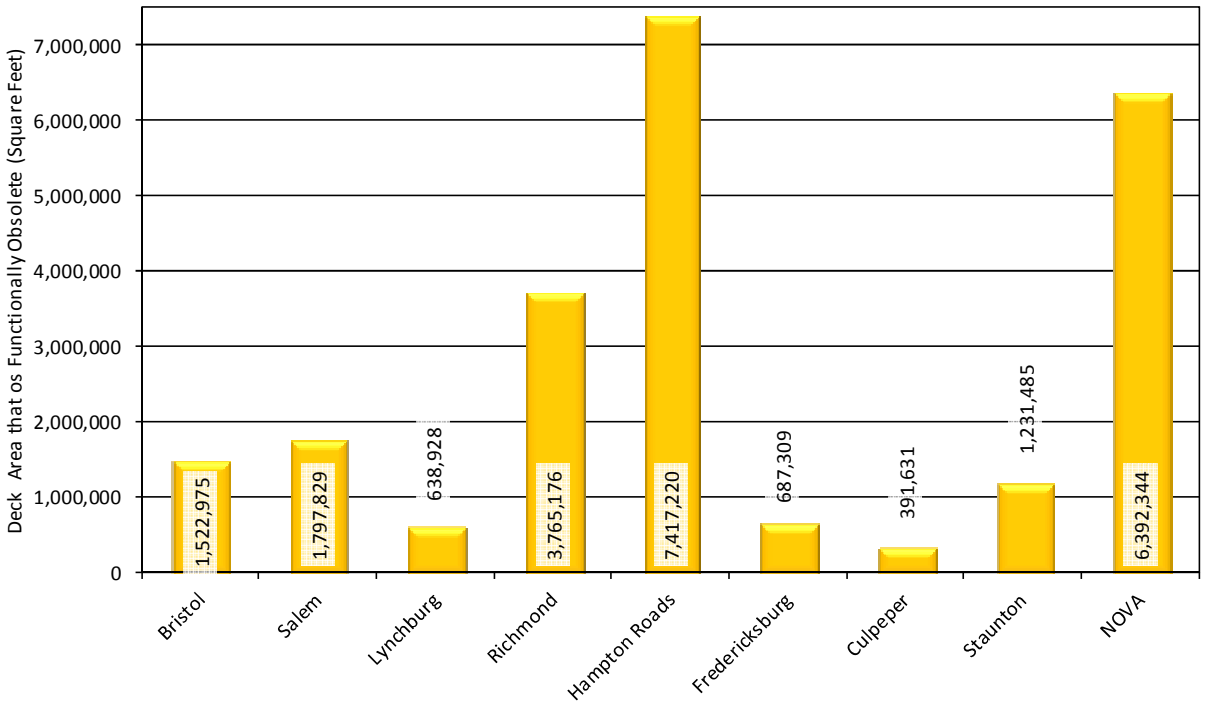


Table F.8 – Total Deck Area of NBI Functionally Obsolete Structures on NHS by District

DISTRICT	Area of Functionally Obsolete Structures (Square Feet)				
	Interstate	Primary	Secondary	Urban	Grand Total
Bristol	267,051	689,518	0	0	956,569
Salem	199,372	341,653	0	0	541,026
Lynchburg	0	232,575	0	0	232,575
Richmond	1,041,324	1,601,065	24,514	5,885	2,672,788
Hampton Roads	1,979,565	4,258,972	0	158,746	6,397,283
Fredericksburg	51,437	131,952	0	0	183,389
Culpeper	0	22,601	0	2,771	25,371
Staunton	143,947	180,208	0	0	324,155
NOVA	2,518,212	1,398,973	150,579	0	4,067,765
Statewide	**6,200,909**	**8,857,518**	**175,094**	**167,401**	**15,400,921**

If a structure is both structurally deficient and functionally obsolete, structure is counted as structurally deficient only.

Chart F.8– Total Deck Area of NBI Functionally Obsolete Structures on NHS by District

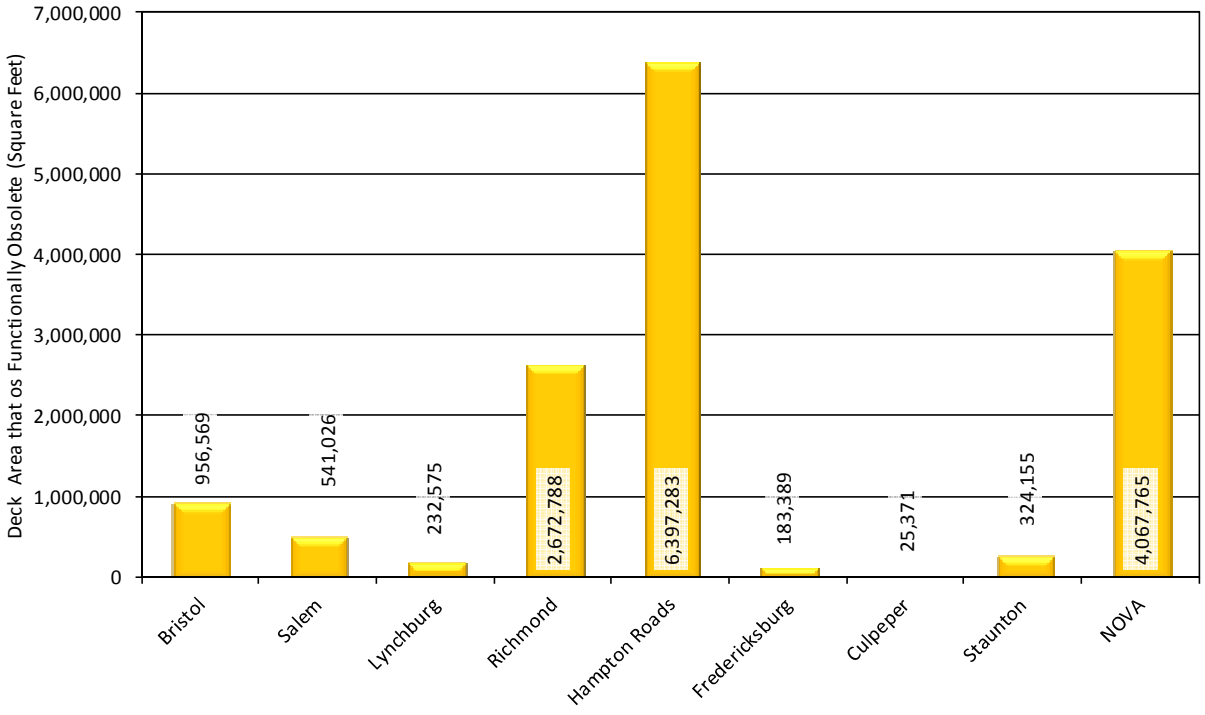


Table F.9 – Percentage of Total Deck Area that is Functionally Obsolete by District

DISTRICT	Percent of Deck Area that is Functionally Obsolete				
	Interstate	Primary	Secondary	Urban	Grand Total
Bristol	14.4%	17.3%	10.2%	10.6%	14.7%
Salem	11.7%	17.5%	17.9%	33.4%	17.7%
Lynchburg	0.0%	9.3%	5.9%	16.5%	8.5%
Richmond	16.4%	21.2%	9.5%	24.4%	17.8%
Hampton Roads	18.3%	32.0%	9.4%	21.1%	24.9%
Fredericksburg	8.4%	19.6%	6.3%	7.1%	14.5%
Culpeper	0.6%	5.7%	15.3%	10.3%	8.3%
Staunton	4.6%	16.6%	11.8%	20.6%	11.7%
NOVA	40.5%	28.0%	27.6%	35.5%	32.1%
Statewide	**19.7%**	**22.3%**	**15.2%**	**22.9%**	**20.1%**

Percentages are calculated by dividing the FO area for the District by the total area for the District by highway system (example - FO Bristol Interstate area divided by all Bristol Interstate area 269,167 / 1,871,818 = 14.4%)

Chart F.9 – Percentage of Total Deck Area that is Functionally Obsolete by District

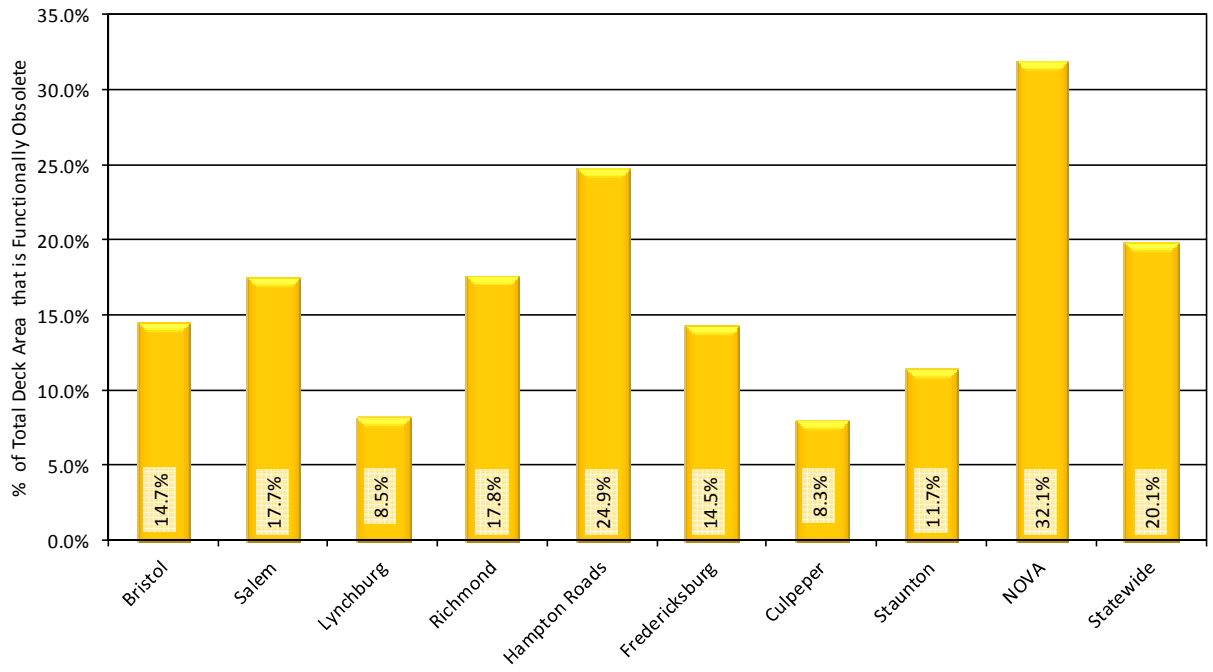


Table F.10 – Deck Area of Deficient (SD & FO) Structures by District

DISTRICT	Area of Deficient (SD or FO) Structures (Square Feet)				
	Interstate	Primary	Secondary	Urban	Grand Total
Bristol	377,150	1,169,934	415,583	125,956	2,088,624
Salem	305,003	973,019	720,151	232,602	2,230,775
Lynchburg	0	546,665	261,816	78,744	887,225
Richmond	1,377,070	2,620,115	536,796	416,189	4,950,170
Hampton Roads	2,273,533	5,262,649	165,180	679,855	8,381,218
Fredericksburg	80,294	966,088	150,437	4,375	1,201,194
Culpeper	6,192	203,665	339,984	25,154	574,995
Staunton	146,899	794,494	526,975	122,359	1,590,727
NOVA	2,640,428	2,016,548	1,866,415	176,343	6,699,733
Statewide	**7,206,570**	**14,553,178**	**4,983,336**	**1,861,577**	**28,604,661**

Chart F.10 – Deck Area of Deficient (SD & FO) Structures by District

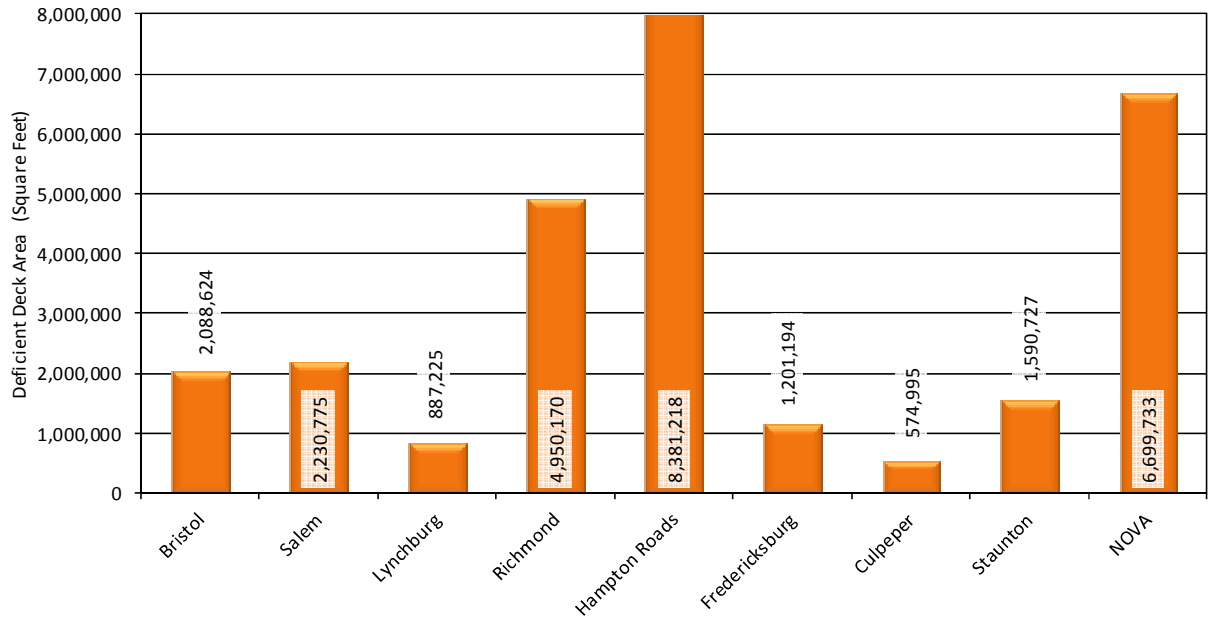


Table F.11 – Percentage of Deck Foot Area that is Deficient (SD & FO) Structures by District

DISTRICT	Percent Deck Area of Deficient (SD or FO) Structures (Square Feet)				
	Interstate	Primary	Secondary	Urban	Grand Total
Bristol	20.1%	21.4%	15.5%	39.1%	20.2%
Salem	17.9%	20.5%	23.4%	35.8%	21.9%
Lynchburg	0.0%	12.0%	10.1%	21.1%	11.8%
Richmond	21.3%	27.0%	13.8%	35.6%	23.4%
Hampton Roads	20.9%	36.1%	12.9%	22.8%	28.2%
Fredericksburg	13.1%	34.2%	12.2%	7.1%	25.4%
Culpeper	0.6%	11.2%	19.1%	28.1%	12.1%
Staunton	4.6%	21.9%	16.3%	24.7%	15.1%
NOVA	40.8%	31.2%	28.8%	35.6%	33.7%
Statewide	**22.4%**	**27.1%**	**19.0%**	**28.0%**	**24.1%**

Chart F.11 – Percentage of Deck Area that is Deficient (SD & FO) Structures by District

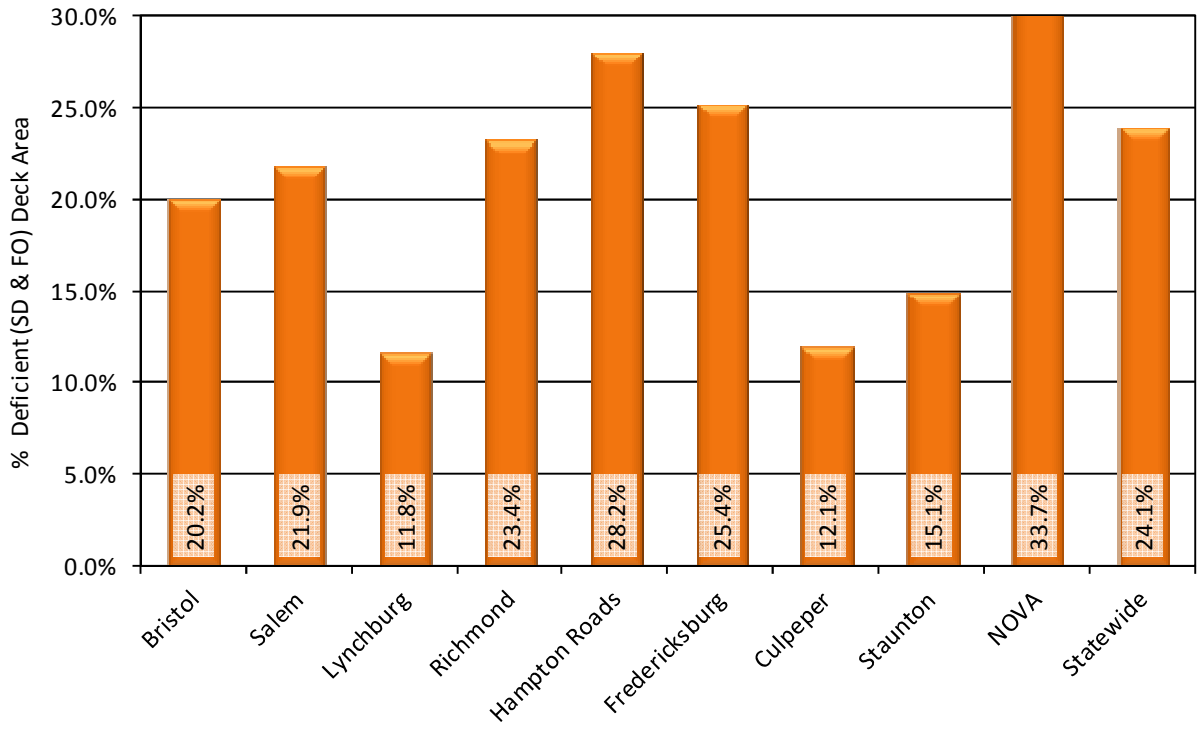


Table F.12 – Total Deck Area of Weight-Posted Structures by District

DISTRICT	Deck Area of Weight Posted Structures (Square Feet)				
	Interstate	Primary	Secondary	Urban	Grand Total
Bristol	0	67,102	133,860	90,539	291,501
Salem	0	27,607	233,952	7,186	268,744
Lynchburg	0	39,660	133,674	3,711	177,044
Richmond	0	109,717	153,062	15,786	278,565
Hampton Roads	0	129,393	64,937	33,681	228,011
Fredericksburg	0	61,823	38,572	0	100,395
Culpeper	0	6,456	66,507	4,992	77,954
Staunton	0	15,355	105,777	10,122	131,255
NOVA	0	44,850	35,350	731	80,931
Statewide	**0**	**501,961**	**965,690**	**166,748**	**1,634,400**

Chart F.12 – Total Deck Area of Weight-Posted Structures by District

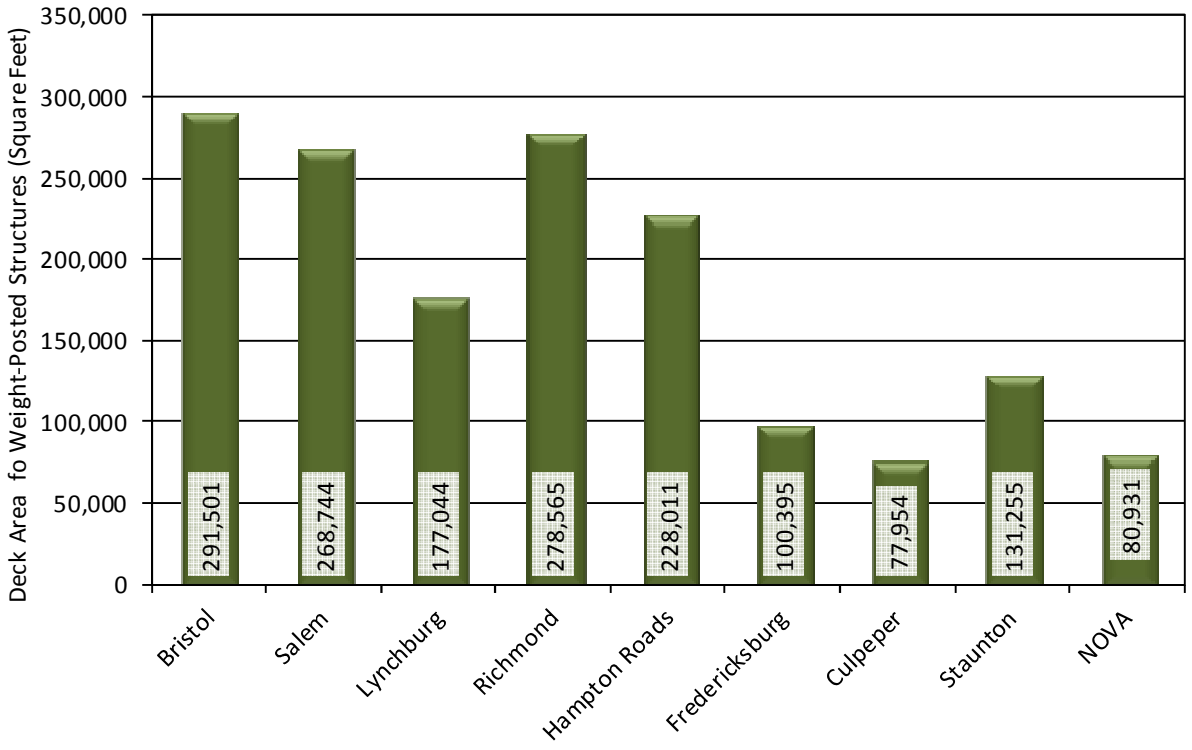
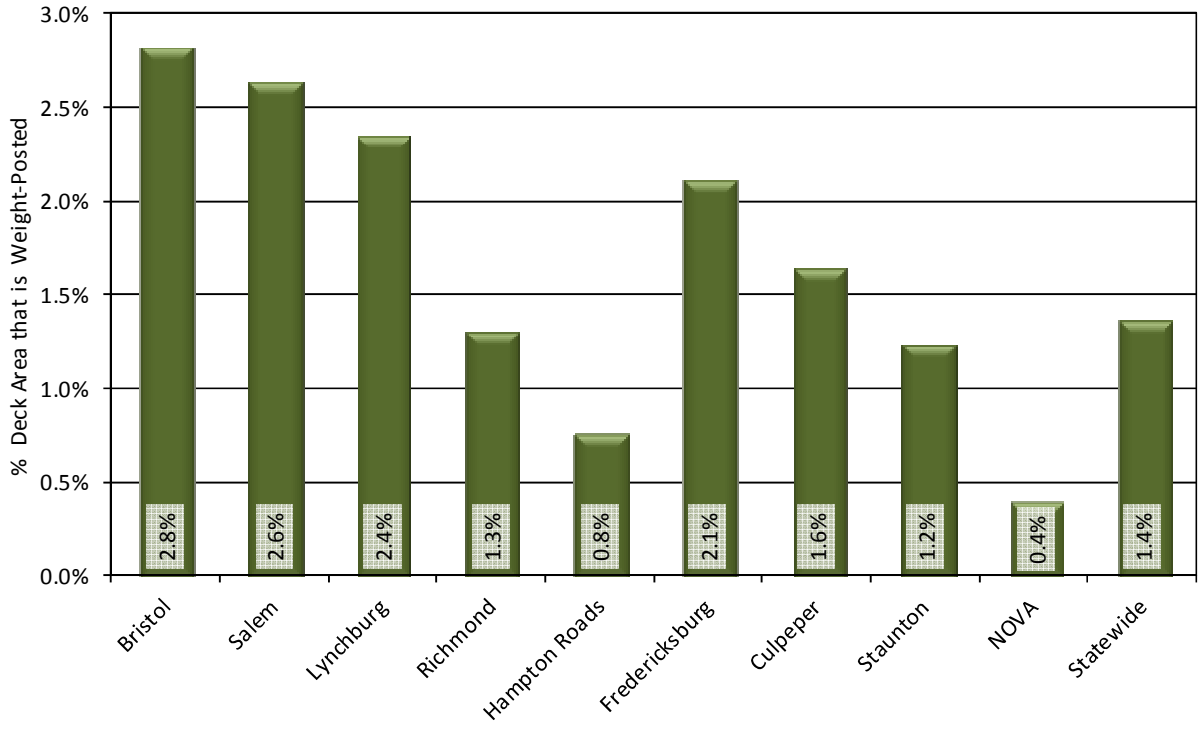


Table F.13 – Percentage of Deck area that is Weight-Posted By District

DISTRICT	Percent of Deck Area of Weight Posted Structures (Square Feet)				
	Interstate	Primary	Secondary	Urban	Grand Total
Bristol	0.0%	1.2%	5.0%	28.1%	2.8%
Salem	0.0%	0.6%	7.6%	1.1%	2.6%
Lynchburg	0.0%	0.9%	1.5%	1.0%	2.4%
Richmond	0.0%	1.1%	3.9%	1.3%	1.3%
Hampton Roads	0.0%	0.4%	5.1%	1.1%	0.8%
Fredericksburg	0.0%	1.4%	3.1%	0.0%	2.1%
Culpeper	0.0%	0.4%	3.7%	5.6%	1.6%
Staunton	0.0%	0.4%	3.3%	2.0%	1.2%
NOVA	0.0%	0.5%	0.5%	0.1%	0.4%
Statewide	**0.0%**	**0.9%**	**3.7%**	**2.5%**	**1.4%**

Chart F.13 – Percentage of Deck Area that is Weight-Posted per District



APPENDIX G – INVENTORY CHANGES FROM PREVIOUS YEARS

Some of the charts in the report provide multi-year trends for various performance measures. Inventory numbers provided in this report for the years 2007-2011 may vary from numbers provided in previous reports. This is due primarily to a change in the reporting period. Some previous reports were based on calendar year (January 1 through December 31) whereas more recent reports are based on the fiscal year (July 1 through June 30). This change was made to align the reporting period of the State of the Structures Report with the fiscal year and with reports developed by other divisions.

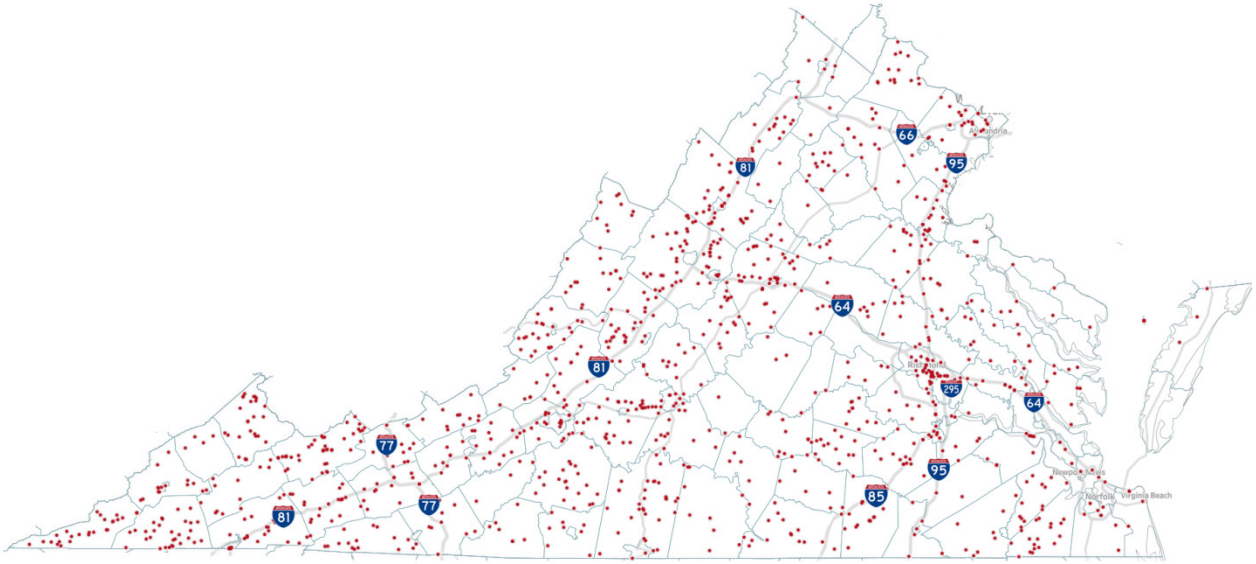
Other factors causing changes in inventory numbers for previous years between this report and previous reports include:

- Definition of Interstate Highway Bridges: From 2007 to 2009 Interstate overpasses were categorized as Interstate structures, and prior reports summarized the data accordingly. Values shown in this report for 2009 have been adjusted from those included in previous reports to reflect the removal of Interstate overpasses from the Interstate inventory. Values for 2007 and 2008 have not been adjusted due to a lack of sufficient data. Values for 2010 to the current report are based on the new criteria.
- Changes in bridge inventory: Until 2009, pedestrian and footbridge structures were included in the State of the Structures Report. They have not been included since the 2010 report. Pedestrian structures, when included, tend to provide misleading data regarding the number of SD and FO structures.
- In Fiscal Year 2010 Metropolitan Washington Airport Authority Structures are no longer reported as part of VDOT's inventory. This Authority owns these structures and reports directly to FHWA.
- In Fiscal Year 2012 VDOT added to its inventory 144 existing structures from Buchanan County in the Bristol District. Prior to FY2012 year these structures had not been included in VDOT's inventory. Buchanan County retains responsibility for these bridges.
- In Fiscal Year 2013 all the bridges that were added from Buchanan County in Bristol District had a change in the system type from Secondary to Urban, which is reflected in charts presented in the report.
- Since Fiscal Year 2013 VDOT has used both of the federal inventory fields, Year Built (F27) and Year Reconstructed (F106) to determine the actual age of the structure. Charts 4 to 6 reflect this change.
- In FY2014, VDOT transferred the ownership and maintenance responsibility for 15 railroad bridges to the Norfolk Southern (NS) Railway. As part of the agreement VDOT took over the ownership and maintenance responsibility of 31 highway bridges over railroad property from the NS Railway.
- Changes to NHS: In 2016, there was a significant increase in NHS structures and decrease in non-NHS structures as this is the first year that the updated NHS map was incorporated in the S&B Division inventory http://www.fhwa.dot.gov/planning/national_highway_system/nhs_maps/updatenhsgm.cfm

APPENDIX H– LOCATIONS OF STRUCTURALLY DEFICIENT STRUCTURES

Statewide – Current Fiscal Year Structurally Deficient Structures

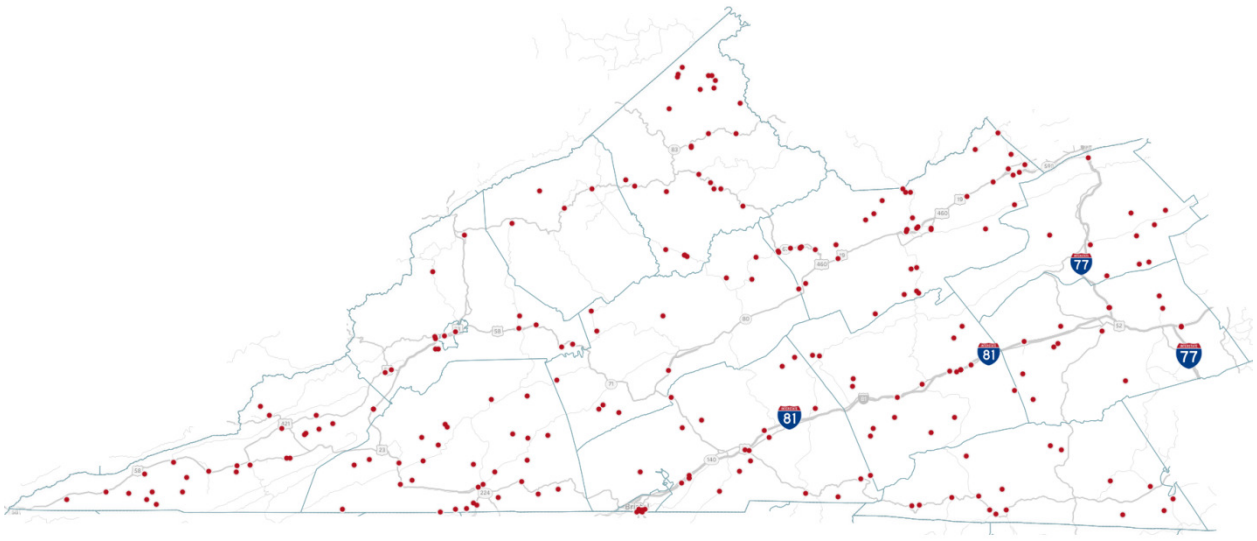
Total Number of Structures = 21,090
Number of SD structures = 1,116 (5.29%)
Total Square Foot Area of Structures = 118,877,344
Square Foot Area of SD Structures = 4,759,765 (4.0%)
● Denotes SD Structure



STATEWIDE

Bristol District – Current Fiscal Year Structurally Deficient Structures

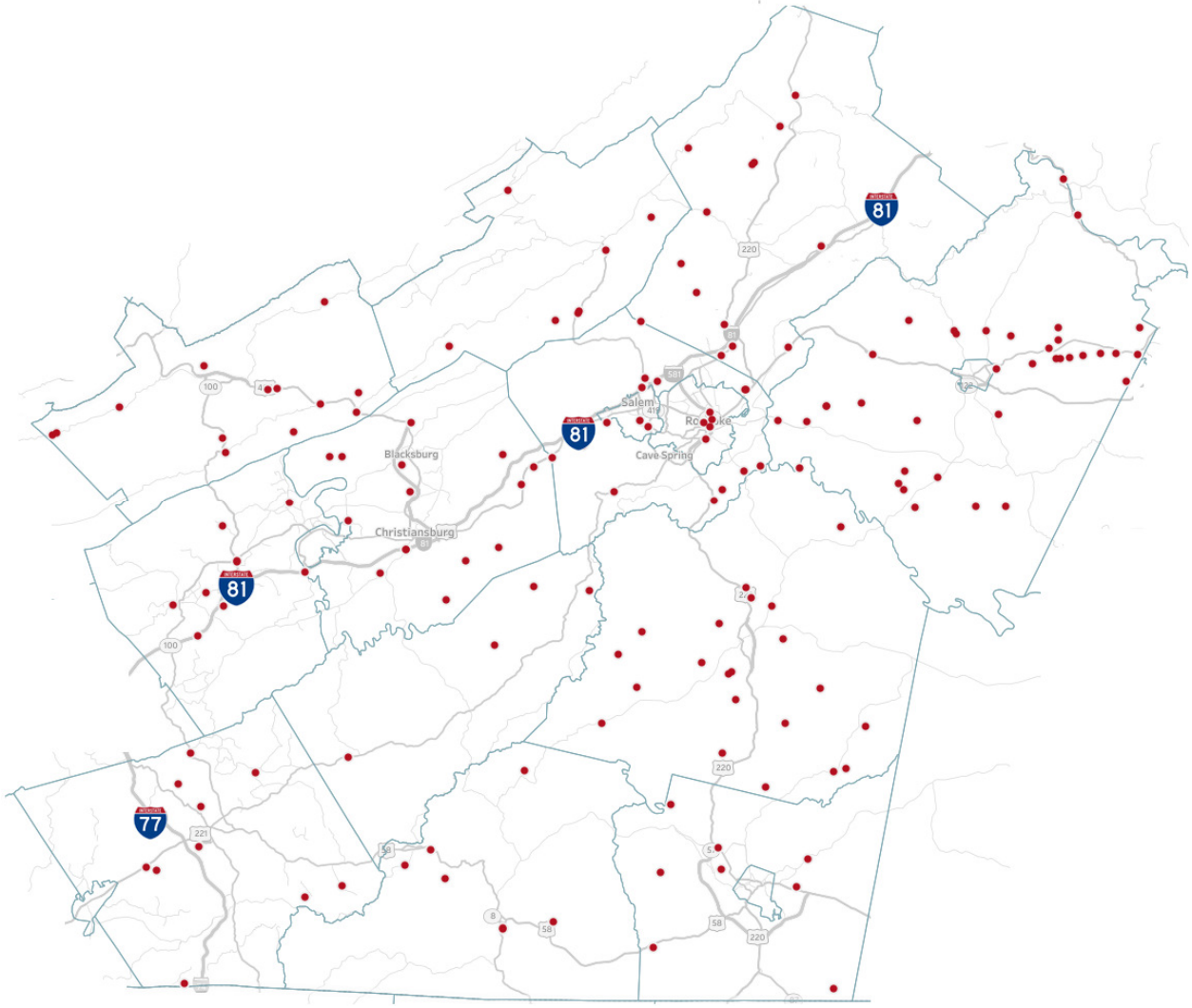
Number of SD structures = 236
Square Foot Area of SD Structures = 565,649
Denotes SD Structure



BRISTOL

Salem District – Current Fiscal Year Structurally Deficient Structures

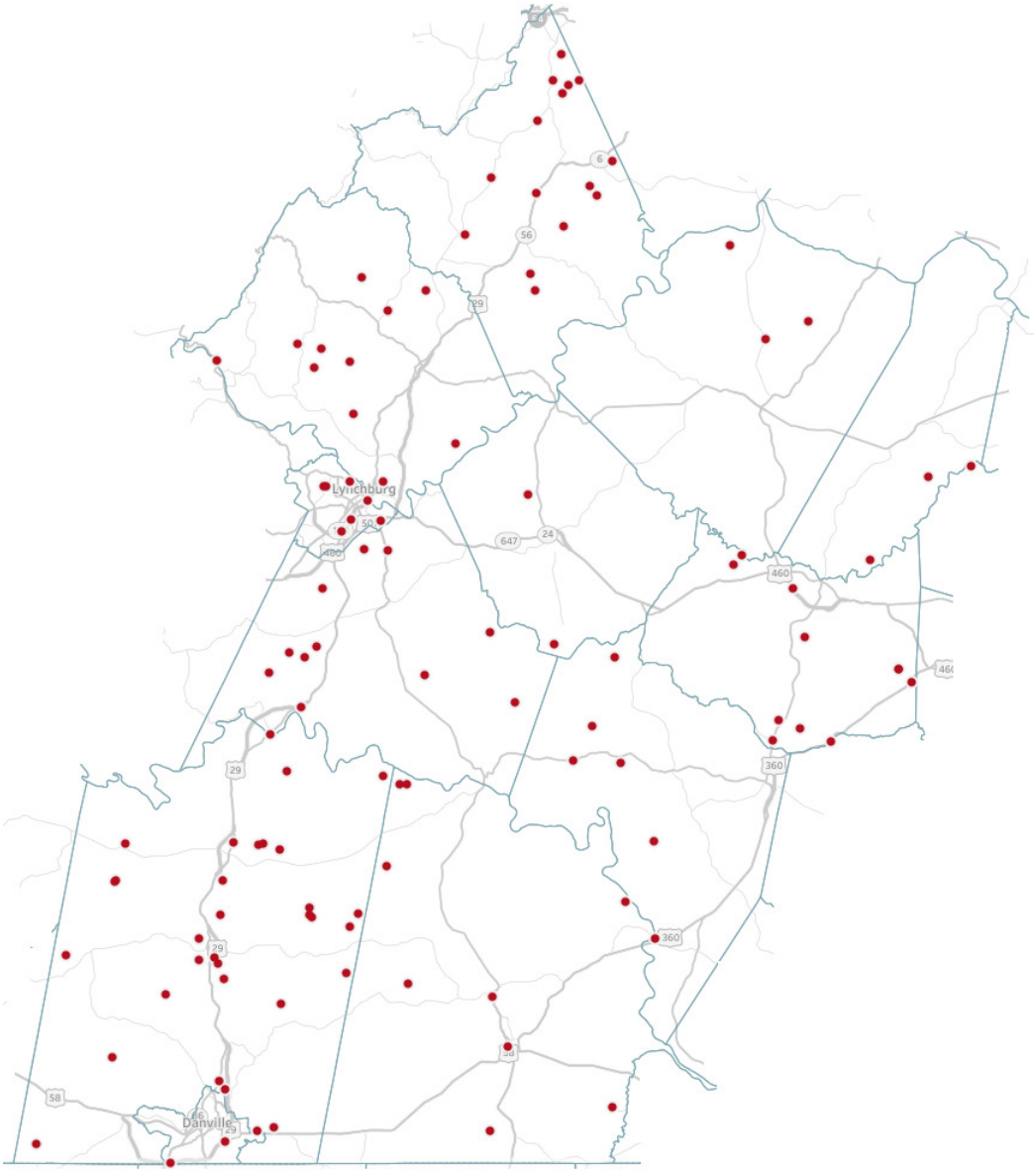
Number of SD structures = 150
Square Foot Area of SD Structures = 432,947
● Denotes SD Structure



SALEM

Lynchburg District – Current Fiscal Year Structurally Deficient Structures

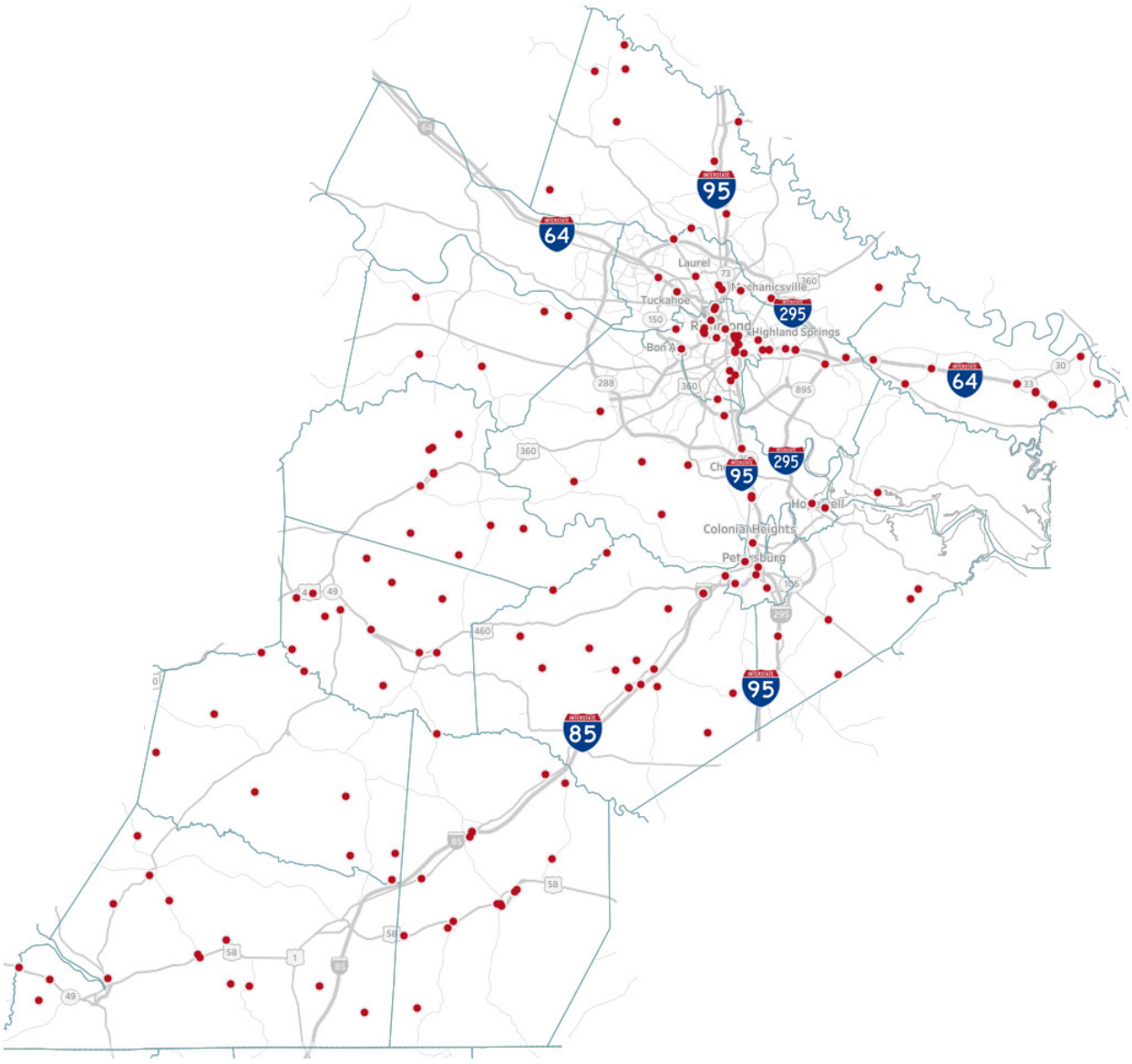
Number of SD structures = 110
Square Foot Area of SD Structures = 248,297
● Denotes SD Structure



LYNCHBURG

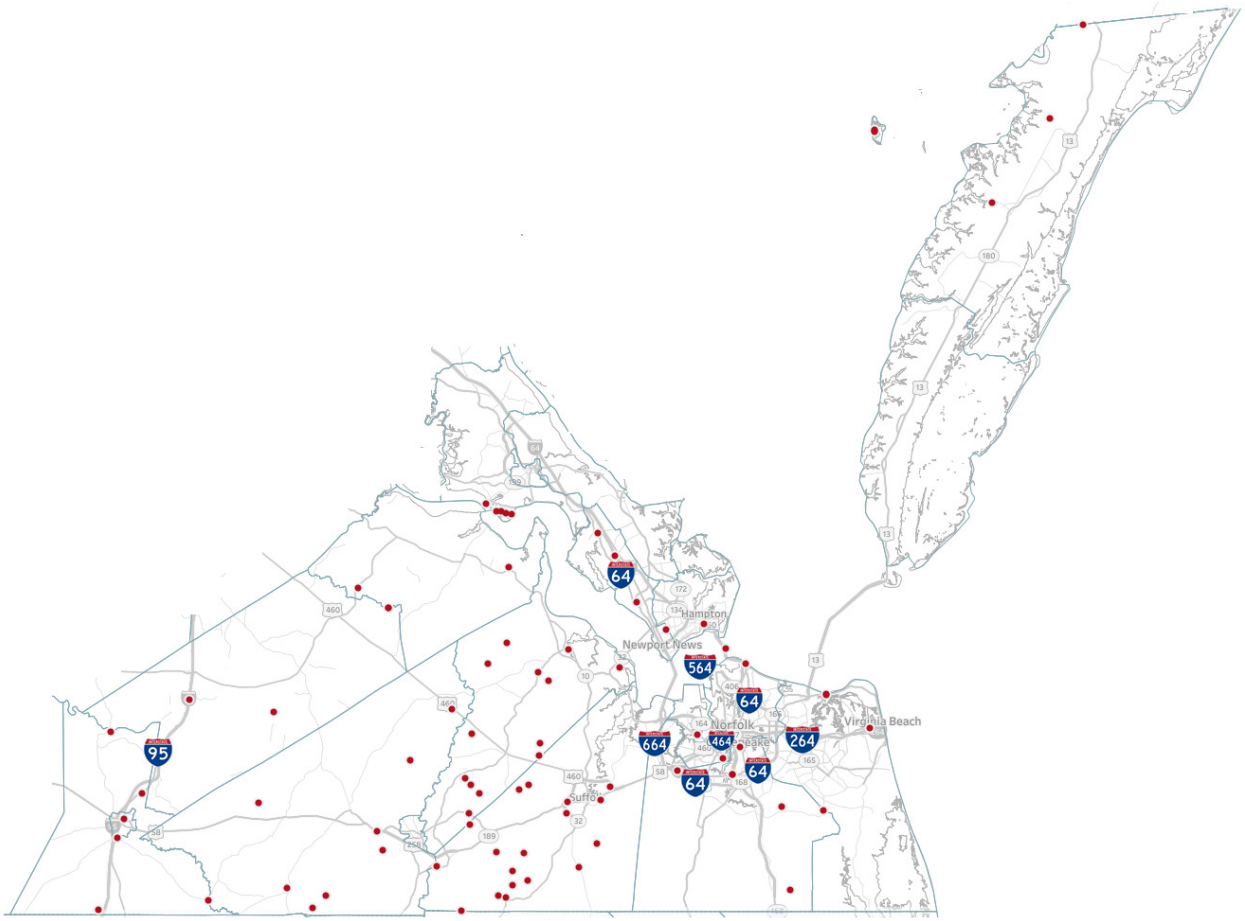
Richmond District – Current Fiscal Year Structurally Deficient Structures

Number of SD structures = 172
Square Foot Area of SD Structures = 1,184,994
● Denotes SD Structure



Hampton Roads District – Current Fiscal Year Structurally Deficient Structures

Number of SD structures = 74
Square Foot Area of SD Structures = 963,998
● Denotes SD Structure



HAMPTON ROADS

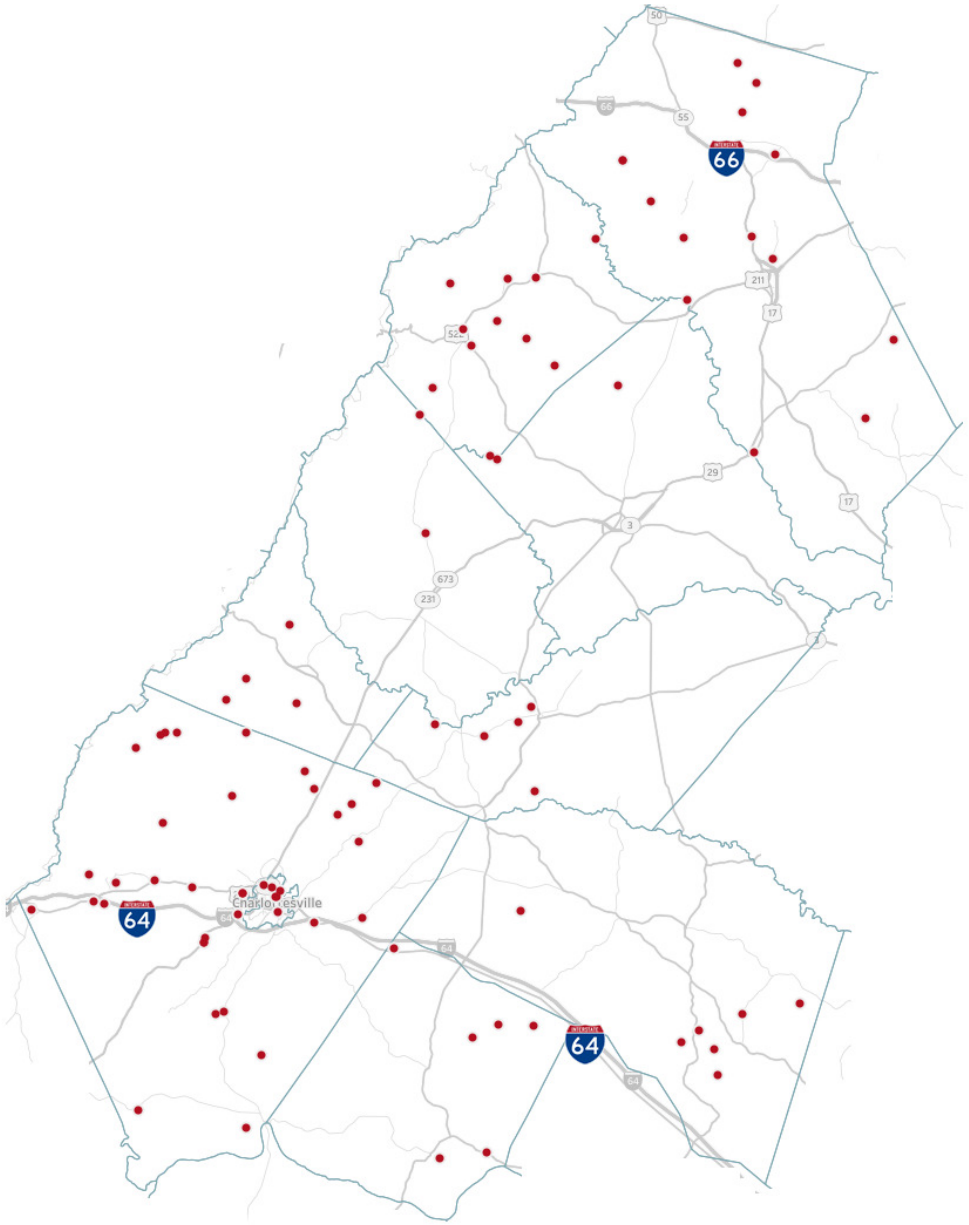
Fredericksburg District – Current Fiscal Year Structurally Deficient Structures

Number of SD structures = 69
Square Foot Area of SD Structures = 513,885
● Denotes SD Structure

FREDERICKSBURG

Culpeper District – Current Fiscal Year Structurally Deficient Structures

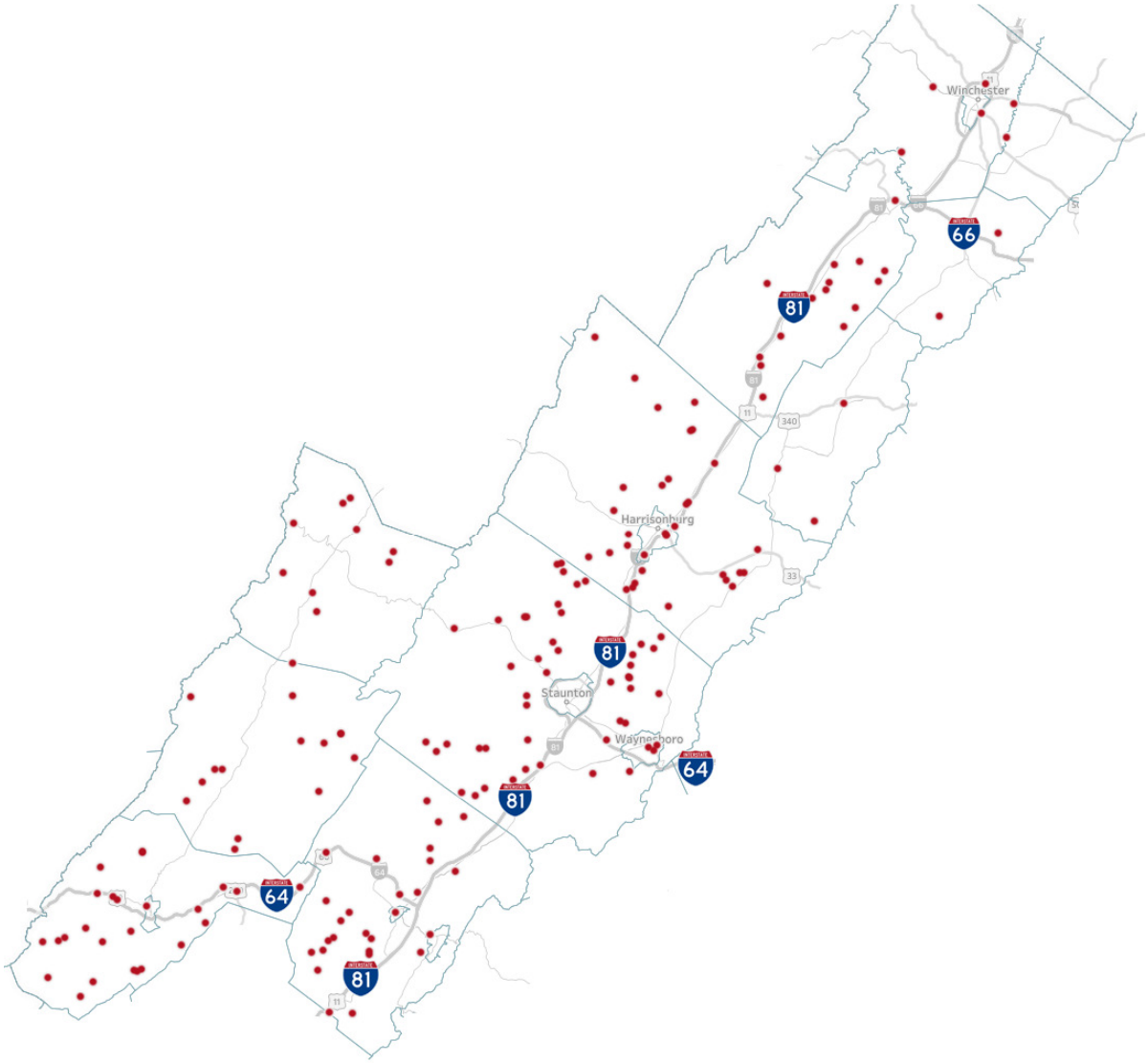
Number of SD structures = 80
Square Foot Area of SD Structures = 183,364
● Denotes SD Structure



CULPEPER

Staunton District – Current Fiscal Year Structurally Deficient Structures

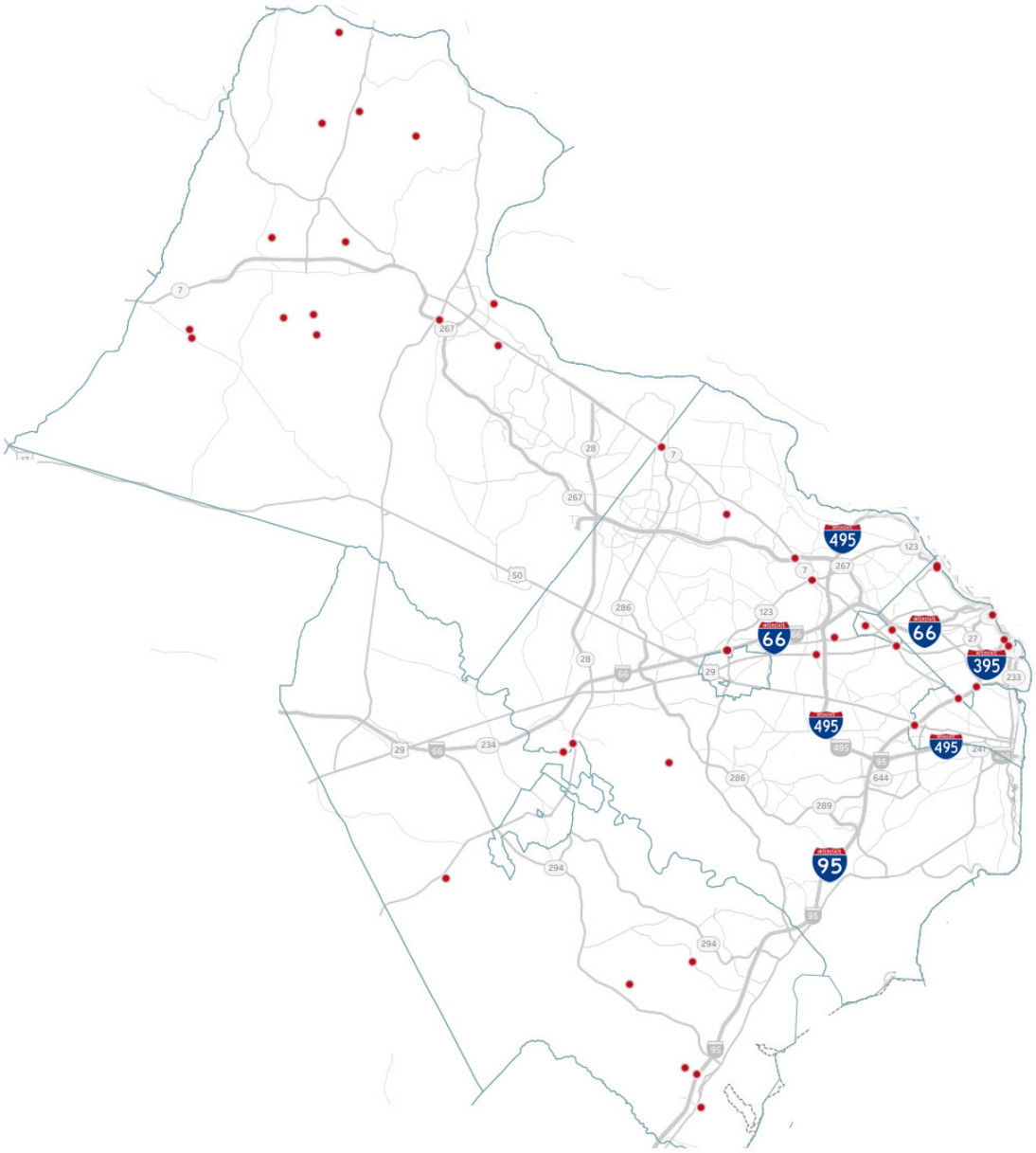
Number of SD structures = 185
Square Foot Area of SD Structures = 359,242
● Denotes SD Structure



STAUNTON

NOVA District – Current Fiscal Year Structurally Deficient Structures

Number of SD structures = 40
Square Foot Area of SD Structures = 307,389
● Denotes SD Structure



NOVA

APPENDIX I – FUNCTIONALLY OBSOLETE CRITERIA

The table below provides visual examples of some of the criteria that cause a structure to be classified as Functionally Obsolete.

Typical Examples of Functionally Obsolete Structures	
Appraisal Rating	Example
Deck Geometry (No shoulder)	
Water Adequacy (Inadequate free board. Bridge is susceptible to overtopping and/or flooding)	
Roadway Approach Alignment (Sharp curve at the approach to the bridge requires substantial reduction in speed)	

Typical Examples of Functionally Obsolete Structures	
Appraisal Rating	Example
Under Clearance Vertical (Inadequate under bridge vertical clearance)	
Under Clearance Horizontal (Inadequate under bridge horizontal clearance)	
Structural Adequacy (Low bridge weight carrying capacity)	

APPENDIX J – BRIDGE SAFETY INSPECTION QUALITY ASSURANCE PROGRAM

The structure (bridge and large culvert) safety inspection program provides the basis for most of the Commonwealth's maintenance and bridge management decisions. In Fiscal Year 2016, VDOT inspected 10,321 bridges/large culverts at an expense of $34.20 million utilizing in-house inspection staff and consultant contracts. Also, VDOT inspected 5,192 ancillary structures at an expense of $6.30 million. There are a total of 18 consultant contracts as follows: 14 for bridge and large culvert Inspection; One (1) for ancillary structures inspection; One (1) of the statewide underwater inspection contract; and Two (2) contracts for load rating. Table J.1 shows VDOT's inspection practices for inspection frequency compared to the National Bridge Inspection Standards (NBIS) and includes the ancillary structures inspection requirements. Table J.2 shows the number of bridge, large culvert and ancillary structure inspections conducted by each District.

Table J.1 – Inspection Practices

District	Number of Inspections	
	NBIS	VDOT*
Bridges	2 Years	2 Year or 1 Year (SD or Posted)
Culverts	2 Years	2 Year (NBI) or 4 Year (Non-NBI)
Fracture Critical Structures	2 Years	1 Year
Fatigue Prone detaile	2 Years	1 or 2 Years
Underwater	5 Years	5 Years
Sign Structures	No Requirement	2 - 5 Years
Signal Structures	No Requirement	4 Years
Highmast Light Poles	No Requirement	2 - 4 Years
Camera Poles	No Requirement	4 Years
Luminaires	No Requirement	4 Years

*District Structure and Bridge Engineers may choose to inspect structures more frequently based on the conditions found during the inspections.

The accuracy, thoroughness, and completeness of the bridge safety inspections are essential. The inspections are used to evaluate each structure's safety and are used for decisions on planning, budgeting, and performance of maintenance, repair, rehabilitation, and replacement of our structures. Since 1991, it has been the policy of the Structure and Bridge Division (S&B) to provide rigorous quality control and quality assurance (QC/QA) of the structure safety inspection program. In January 2005, the National Bridge Inspection Standards (NBIS) portion of the Code of Federal Regulations was amended to require each state to "Assure systematic quality control and quality assurance procedures are used to maintain a high degree of accuracy and consistency in the inspection program. The QA program includes periodic field review of inspection teams, periodic bridge inspection refresher training for Program Managers and Team Leaders, and independent review of inspection reports and computations." The Structure and Bridge Division meets these NBIS requirements with its quality control and quality assurance programs.

Table J.2 – Number of Inspections in 2016 Fiscal Year

District	Number of Inspections						
	Bridges		Large Culverts		Ancillary		Total No. Structures
	No.	Percent	No.	Percent	No.	Percent	
Bristol	1,403	19%	334	11%	714	14%	2,451
Salem	1,129	15%	334	11%	233	4%	1,696
Lynchburg	606	8%	391	13%	32	1%	1,029
Richmond	1,026	14%	426	14%	206	4%	1,658
Hampton Roads	653	9%	233	8%	20	0%	906
Fredericksburg	232	3%	147	5%	402	8%	781
Culpeper	588	8%	259	9%	63	0%	910
Staunton	1,178	16%	499	17%	208	4%	1,885
NOVA	544	7%	339	11%	3,314	64%	4,197
Total	**7,359**	**100%**	**2,962**	**100%**	**5,192**	**98%**	**15,513**

In 2008, VDOT S&B developed Information and Instruction Memorandum (IIM) IIM-S&B-78, describing the bridge safety inspection QC/QA program which requires the following: In accordance with the NBIS, Program Managers and Team Leaders must successfully complete a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course; within VDOT, all bridge safety inspection personnel will successfully complete the National Highway Institute (NHI) course 'Safety Inspection of In-Service Bridges' (FHWA-NHI-130055) within the first five years of employment in bridge inspection; VDOT S&B also requires inspection personnel successfully complete the NHI course 'Bridge Inspection Refresher Training' every three (3) years; underwater inspectors are required to fulfill the training requirements as set forth in the NBIS and the VDOT 'Dive Safety Manual'.

Both the Central Office and the Districts have a responsibility to review and validate inspection reports and inventory data. Discrepancies found during the field and office reviews performed by the both District and Central Office personnel are documented in a written report and shared with all parties involved. The Central Office conducted an annual QA review of six (6) district bridge inspection programs. Review of load ratings for a sample of bridges was a key component of the QA reviews. In addition, underwater inspection QA/QC field reviews are scheduled by the Central Office Underwater Inspection Engineer. Underwater inspection QA/QC was performed on 10 structures.

The Federal Highway Administration (FHWA) conducted an annual NBIS Compliance Review from April 1, 2015 to March 30, 2016 with a draft report provided on December 31, 2015. The Department had 45 days to address any deficiencies that were identified. The review consisted of a review of the statewide inventory/database/organization/procedures for structure (bridge and large culvert) safety inspections and a QA review of a sample of structure records and structure field reviews of the Lynchburg and Northern Virginia Districts. The review found VDOT to be in compliance with 21 of the 23 NBIS metrics, substantial compliance for 1 metric and conditional compliance for 1 metric. The Department is establishing a QA/QC program for

ancillary structures similar to the one currently in place for structure (bridge and large culvert) inspections.

In August 2015, Federal Highway Administration (FHWA) issued the National Tunnel Inspection Standards (NTIS). VDOT S&B created a tunnel inspection program to implement the NTIS in Virginia. Policies and procedures for tunnel inspection, including specific inspection manuals for each tunnel, are being developed. VDOT staff and consultants have successfully completed a Federal Highway Administration (FHWA) approved comprehensive tunnel inspection training course. Preliminary inventory information was gathered and submitted to FHWA for 13 existing highway tunnels. Initial inspections have been performed for two of the 13 tunnels, and an initial inventory inspection has been performed for the new Midtown Tunnel. Two existing consultant contracts for tunnel engineering have been used to implement the program within the timeframes established by FHWA.

APPENDIX K – ANCILLARY STRUCTURES CONDITION RATINGS

General Condition Ratings are assigned by the structure inspection team after each ancillary structure inspection. These ratings are included in each inspection report and are used to describe the current physical state of the structure. Evaluation is based on the physical condition of the structure at the time of inspection. Separate GCR values are assigned to the foundation, bridge parapet mounting and superstructure components of the ancillary structure. The GCRs are assigned based on a numerical grading system that ranges from 0 (failed condition) to 9 (excellent condition). The table below provides a description of the general condition ratings for ancillary structures. The tables in the following pages provide illustrative examples of some of these ratings.

0	1	2	3	4	5	6	7	8	9
Failed	Imminent Failure	Critical	Serious	Poor	Fair	Satisfactory	Good	Very Good	Excellent

Ancillary Structure Condition Rating Table

Code	Description
9	**EXCELLENT CONDITION**
8	**VERY GOOD CONDITION** No problems noted.
7	**GOOD CONDITION** Some minor problems.
6	**SATISFACTORY CONDITION** Structural components show some minor deterioration.
5	**FAIR CONDITION** All primary structural elements are sound but may have some minor section loss, cracking, spalling.
4	**POOR CONDITION** Advanced section loss, deterioration, spalling.
3	**SERIOUS CONDITION** Loss of section, deterioration, spalling have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel may be present.
2	**CRITICAL CONDITION** Advanced deterioration of primary structural elements. Fatigue cracks in steel may be present. Unless closely monitored it may be necessary to remove the structure.
1	**"IMMINENT" FAILURE CONDITION** Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. The structure should be removed.
0	**FAILED CONDITION** Out of service - beyond corrective action.

Examples of Foundations that are in Fair to Poor Condition

Rusted anchor bolts and missing nut

Leveling nut is loose and gap is too high

Loose anchor bolt with 1” gap between nut and base plate

Deteriorated and cracked grout

Deteriorated grout pad and cracked pedestal

Severely corroded anchor bolts exposed when grout has fallen away

Examples of Foundations that are in Fair to Poor Condition

Corrosion with 1/8" deep pitting on breakaway couplers

Loose anchor bolt nut at luminaire base

Examples of Bridge Parapet Mountings that are in Fair to Poor Condition

Failed mounting bolt (circled)

Twisted anchor clamp over the parapet

Failed bolt (circled) at parapet mount.

Two failed bolts (circled) at parapet mount

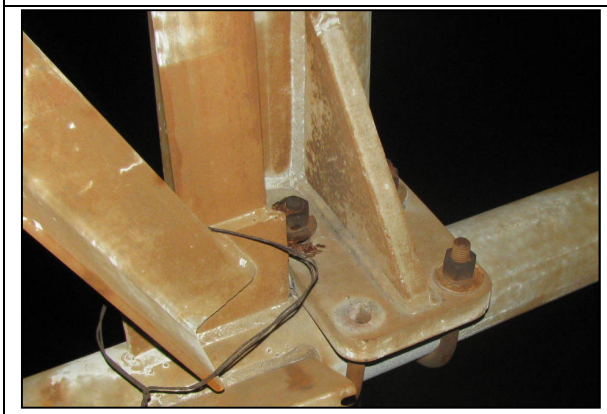
Examples of Superstructure Elements that are in Fair to Poor Condition

Loose Bolt at splice plate.

Poor vertical hanger connection with the Z-bar

Damaged & bent flange of vertical hanger

Column torn and bent 3" at point of impact



U-bolt sheared at left front pole to bottom chord Connection

1-1/4" long vertical crack in pole along toe of weld at the bottom chord

Examples of Superstructure Elements that are in Fair to Poor Condition

Section loss to the bottom of the pole.

4" vertical crack at the slip joint

1 1/2" gap between upper chord and connection strap

Missing bolt at wind beam to vertical hanger connection

6" crack in lower chord of luminaire

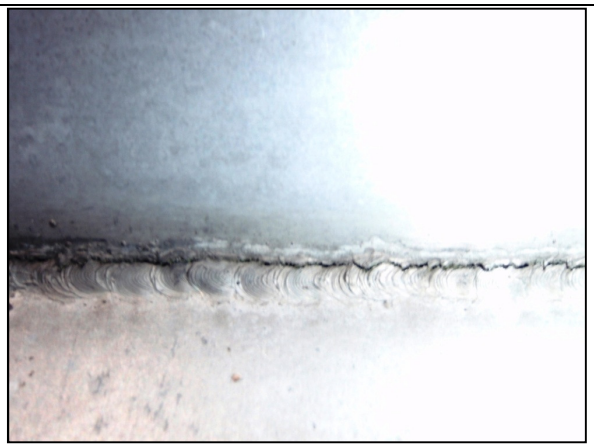
Two of four bolts loose in top chord connection to luminaire pole

Examples of Superstructure Elements that are in Fair to Poor Condition

Lower arm of luminaire chord has a 3.5" fatigue crack in weld at connection to pole

Weld around upper chord to mounting plate connection 50% complete

Fracture in weld of lower arm tube to luminaire pole connection



Crack in luminaire bracket saddle to connection plate weld

Crack in orbital bracket of 2nd signal from right pole

Nut on strap bolt for signal from pole lacks 50% thread contact

Tables K.1a through K.3d give a summary of the current condition of the ancillary structures by structure type and the primary components or areas of the structure with average GCR.

Table K.1a – Sign Structures by General Condition Rating*

Location on Structure	Structure Type	# of Elements with General Condition Rating Indicated										Average General Condition Rating
		Good				Fair	Poor					
		9	8	7	6	5	4	3	2	1	0	
Foundation	Cantilever	56	112	551	263	361	109	60	35	1	3	6.01
	Overhead	44	126	514	213	397	184	94	42	0	2	5.80
	Butterfly	8	36	182	6	29	8	1	2	0	0	6.82
	Total	**108**	**274**	**1,247**	**482**	**787**	**301**	**155**	**79**	**1**	**5**	**5.97**
Parapet	Parapet Mount	0	10	114	101	65	17	9	0	0	0	6.03
	Total	**0**	**10**	**114**	**101**	**65**	**17**	**9**	**0**	**0**	**0**	**6.03**
Superstructure	Cantilever	60	134	709	282	293	47	14	3	9	0	6.43
	Overhead	57	135	683	272	312	101	44	3	9	0	6.26
	Butterfly	9	32	197	12	18	3	0	1	0	0	6.96
	Total	**126**	**301**	**1,589**	**566**	**623**	**151**	**58**	**7**	**18**	**0**	**6.39**

*A parapet mount structure has only one primary component rating at the parapet, while other types of sign structures have component ratings at foundation and superstructure. Signal structures have component ratings either at parapet or foundation and superstructure. High mast light and camera poles have both foundation and superstructure component ratings.

Table K.1b – Luminaire Structures by General Condition Rating

Location on Structure	# of Elements with General Condition Rating Indicated										Average General Condition Rating
	Good				Fair	Poor					
	9	8	7	6	5	4	3	2	1	0	
Foundation	323	3,296	4,173	856	4,825	737	2,154	1,035	2	120	5.66
Parapet	9	187	332	287	628	48	597	12	0	7	5.11
Superstructure	352	3,479	7,233	1,069	3,332	477	1,015	394	5	165	6.30

Table K.1c – Signal Structures by General Condition Rating

Location on Structure	Structure Type	# of Elements with General Condition Rating Indicated										Average General Condition Rating
		Good				Fair	Poor					
		9	8	7	6	5	4	3	2	1	0	
Foundation	Cantilever	893	992	1,515	942	2,571	437	381	223	0	14	6.08
	Span Wire	22	66	86	221	937	128	75	89	0	17	5.03
	Overhead	0	0	2	0	1	0	0	0	0	0	6.33
	Total	**915**	**1,058**	**1,603**	**1,163**	**3,509**	**565**	**456**	**312**	**0**	**31**	**5.90**
Parapet	Parapet Mount	0	0	0	0	0	1	0	0	0	0	4.00
	Total	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**4.00**
Superstructure	Cantilever	916	1,321	2,771	931	862	254	399	498	0	15	6.44
	Span Wire	24	84	474	266	296	196	107	190	0	4	5.34
	Parapet Mount	0	0	0	0	0	0	0	0	0	1	0.00
	Overhead	0	0	2	0	0	0	1	0	0	0	5.67
	Total	**940**	**1,405**	**3,247**	**1,197**	**1,158**	**450**	**507**	**688**	**0**	**20**	**6.25**

Table K.1d – High Mast Light and Camera Pole by General Condition Rating

Location on Structure	Structure Type	# of Elements with General Condition Rating Indicated										Average General Condition Rating
		Good				Fair	Poor					
		9	8	7	6	5	4	3	2	1	0	
Foundation	High Mast	1	56	308	155	78	59	10	17	0	0	6.19
	Camera Pole	0	15	581	55	43	16	0	2	0	2	6.72
	Total	**1**	**71**	**889**	**210**	**121**	**75**	**10**	**19**	**0**	**2**	**6.46**
Parapet	High Mast	0	68	469	26	117	3	1	0	0	0	6.70
	Camera Pole	2	14	605	47	26	1	0	0	0	19	6.70
	Total	**2**	**82**	**1,074**	**73**	**143**	**4**	**1**	**0**	**0**	**19**	**6.70**

Summaries of this analysis for the four general type structures are provided in Tables K.2a through K.2e and Charts K.1a through K.1g. Charts K.1a through K.1d present the minimum general condition rating by structure type and GCR percentages. In order to present meaningful graphs with appropriate vertical scales, Charts K.1e through K.1g provide separate displays for Districts with large inventories and those with smaller inventories.

Table K.2a – Sign Structures by General Condition Category

Location on Structure	Structure Type	# of Elements with General Condition Rating Indicated			Total	% General Condition Rating Indicated		
		Good	Fair	Poor		Good	Fair	Poor
Foundation	Cantilever	982	361	208	1,551	63.3%	23.3%	13.4%
	Overhead	897	397	322	1,616	55.5%	24.6%	19.9%
	Butterfly	232	29	11	272	85.3%	10.7%	4.0%
	Total	**2,111**	**787**	**541**	**3,439**	**61.4%**	**22.9%**	**15.7%**
Parapet	Parapet Mount	225	65	26	316	71.2%	20.6%	8.2%
	Total	**225**	**65**	**26**	**316**	**71.2%**	**20.6%**	**8.2%**
Superstructure	Cantilever	1,185	293	73	1,551	76.4%	18.9%	4.7%
	Overhead	1,147	312	157	1,616	71.0%	19.3%	9.7%
	Butterfly	250	18	4	272	91.9%	6.6%	1.5%
	Total	**2,582**	**623**	**234**	**3,439**	**75.1%**	**18.1%**	**6.8%**

Table K.2b – Luminaire Structures by General Condition Category

Location on Structure	# of Elements with General Condition Rating Indicated			Total	% of Elements with General Condition Rating Indicated		
	Good	Fair	Poor		Good	Fair	Poor
Foundation	8,648	4,825	4,048	17,521	49.4%	27.5%	23.1%
Parapet	815	628	664	2,107	38.7%	29.8%	31.5%
Superstructure	12,133	3,332	2,056	17,521	69.2%	19.0%	11.7%

Table K.2c – Signal Structures by General Condition Category

Location on Structure	Structure Type	# of Elements with General Condition Rating Indicated			Total	# of Elements with General Condition Rating Indicated		
		Good	Fair	Poor		Good	Fair	Poor
Foundation	Cantilever	4,342	2,571	1,055	7,968	54.5%	32.3%	13.2%
	Span Wire	395	937	309	1,641	24.1%	57.1%	18.8%
	Over Head	2	1	0	3	66.7%	33.3%	0.0%
	Total	**4,739**	**3,509**	**1,364**	**9,612**	**49.3%**	**36.5%**	**14.2%**
Parapet	Parapet Mount	0	0	1	1	0.0%	0.0%	100.0%
	Total	**0**	**0**	**1**	**1**	**0.0%**	**0.0%**	**100.0%**
Superstructure	Cantilever	5,939	862	1,166	7,967	74.5%	10.8%	14.6%
	Span Wire	848	296	497	1,641	51.7%	18.0%	30.3%
	Parapet Mount	0	0	1	1	0.0%	0.0%	100.0%
	Over Head	2	0	1	3	66.7%	0.0%	33.3%
	Total	**6,789**	**1,158**	**1,665**	**9,612**	**70.6%**	**12.0%**	**17.3%**

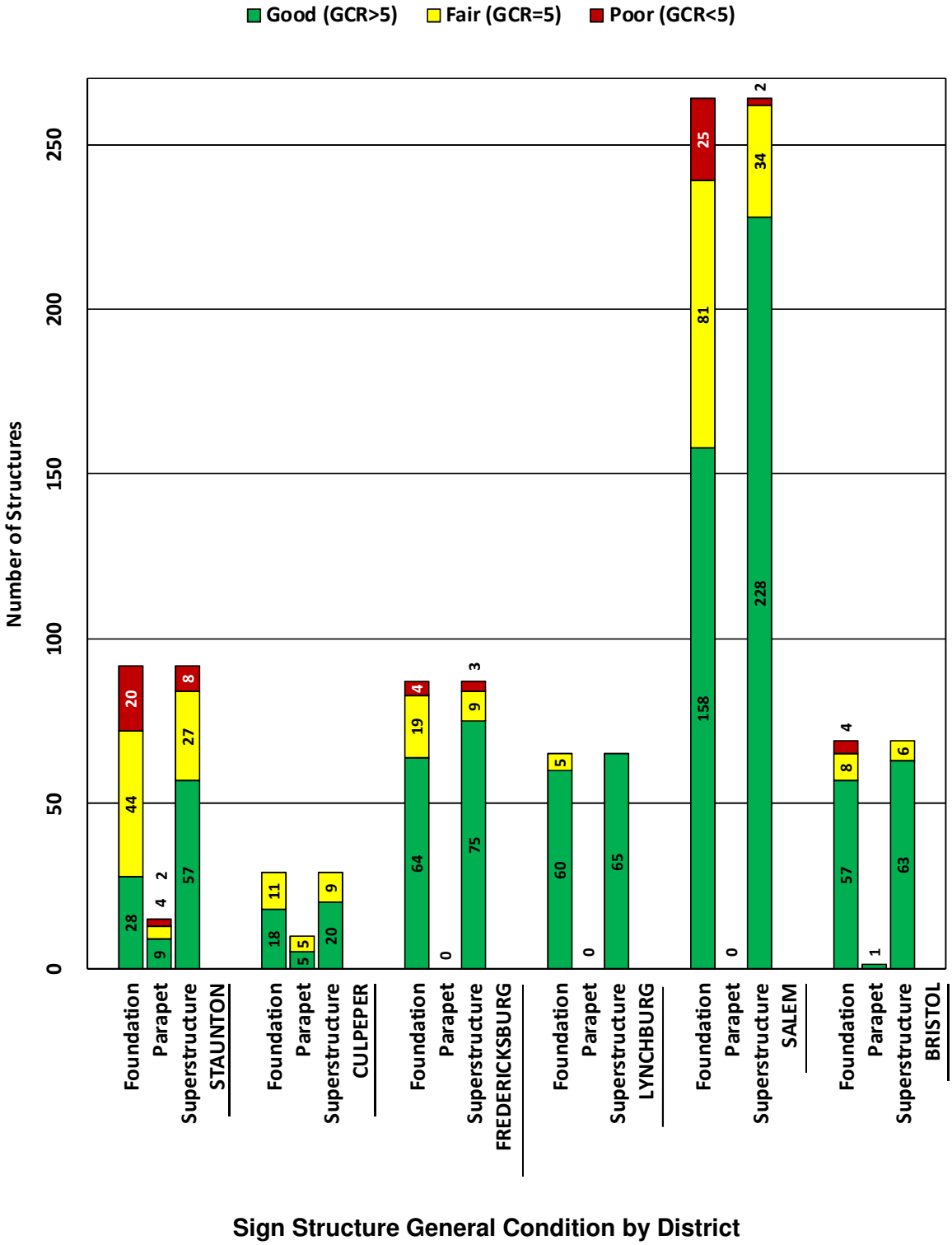
Table K.2d – High Mast Light & Camera Pole Structures by General Condition Category

Location on Structure	Structure Type	# of Elements with General Condition Rating Indicated			Total	# of Elements with General Condition Rating Indicated		
		Good	Fair	Poor		Good	Fair	Poor
Foundation	High Mast	520	78	86	684	76.0%	11.4%	12.6%
	Camera Pole	651	43	20	714	91.2%	6.0%	2.8%
	Total	**1,171**	**121**	**106**	**1,398**	**83.8%**	**8.7%**	**7.6%**
Superstructure	High Mast	563	117	4	684	82.3%	17.1%	0.6%
	Camera Pole	668	26	20	714	93.6%	3.6%	2.8%
	Total	**1,231**	**143**	**24**	**1,398**	**88.1%**	**10.2%**	**1.7%**

Table K.2e – Minimum General Condition by Structure Type

Structure Type	Condition Categories (No. of Structures)			Minimum General Condition Rating (Percentage)		
	Good	Fair	Poor	Good	Fair	Poor
Signs	2,105	956	686	56.2%	25.5%	18.3%
Signals	3,921	3,038	2,654	40.8%	31.6%	27.6%
High Mast Lights and Camera Poles	1,072	200	105	77.9%	14.5%	7.6%
Luminaires	7,541	6,101	5,986	38.4%	31.1%	30.5%
Total	**14,639**	**10,295**	**9,431**	**42.6%**	**30.0%**	**27.4%**

Chart K.1a – General Condition of Sign Structures – Small Inventory Districts



Sign Structure General Condition by District

Chart K.1b – General Condition of Sign Structures – Large Inventory Districts

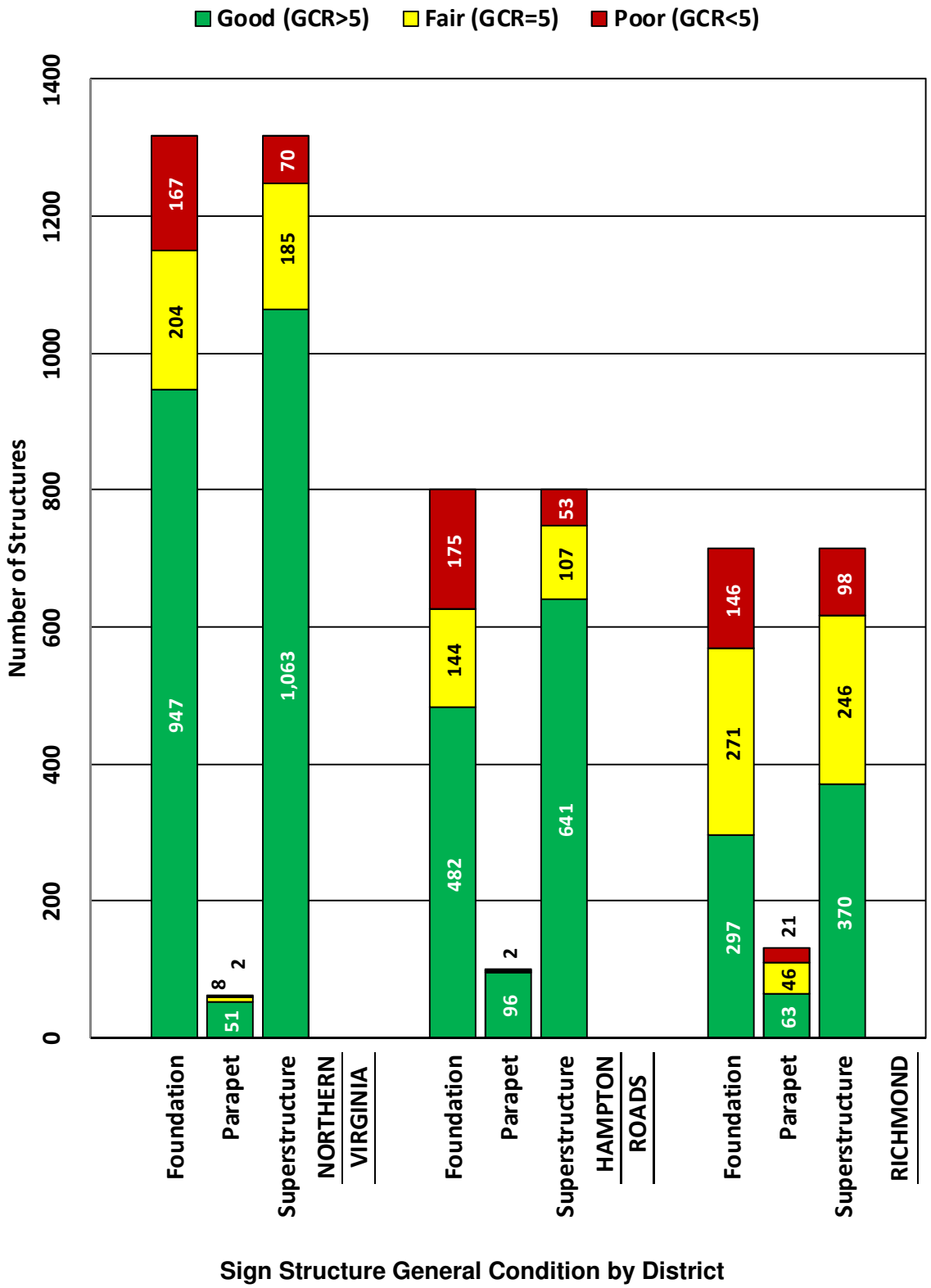


Chart K.1c – General Condition of Luminaires – Small Inventory Districts

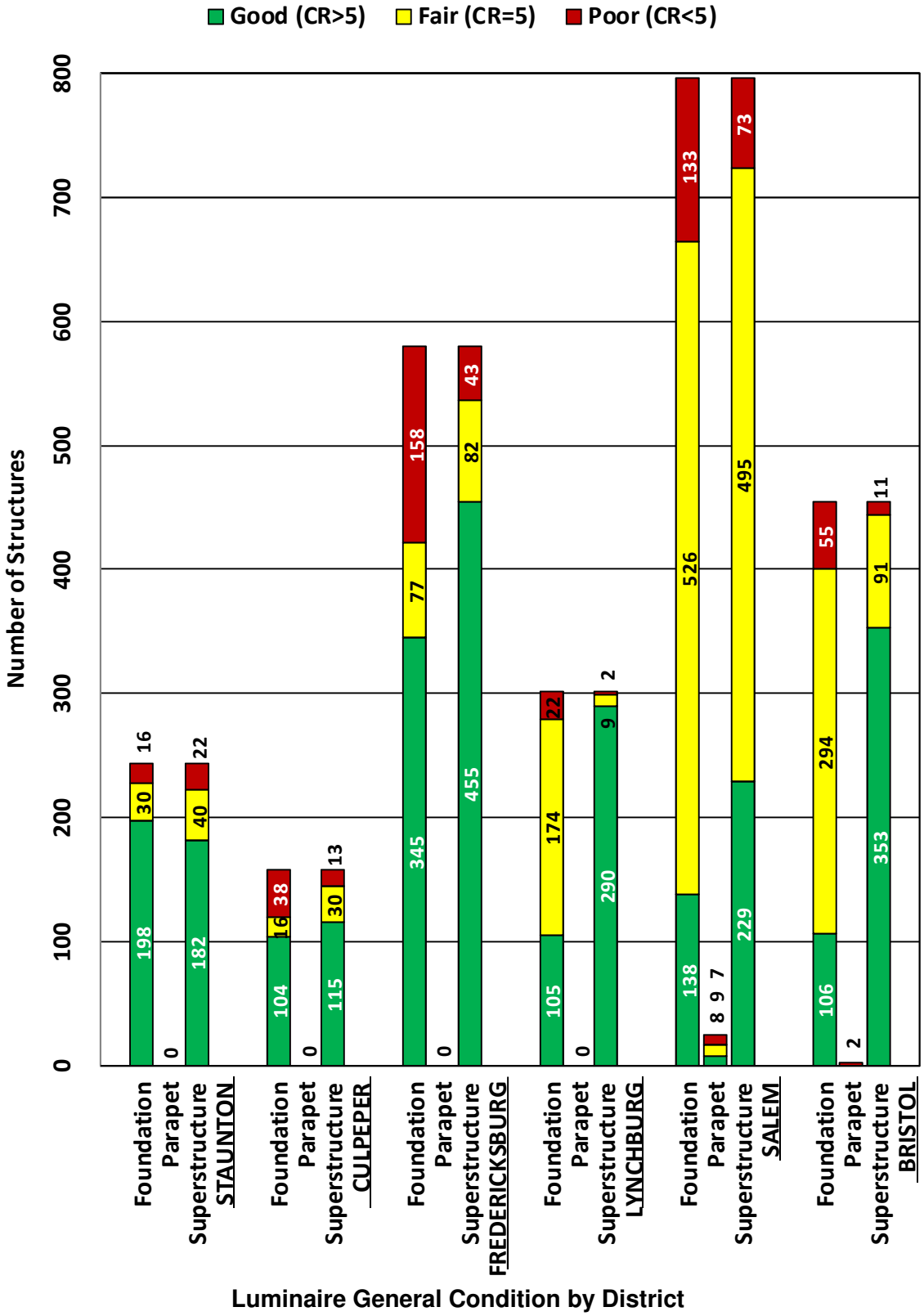


Chart K.1d – General Condition of Luminaires – Large Inventory Districts

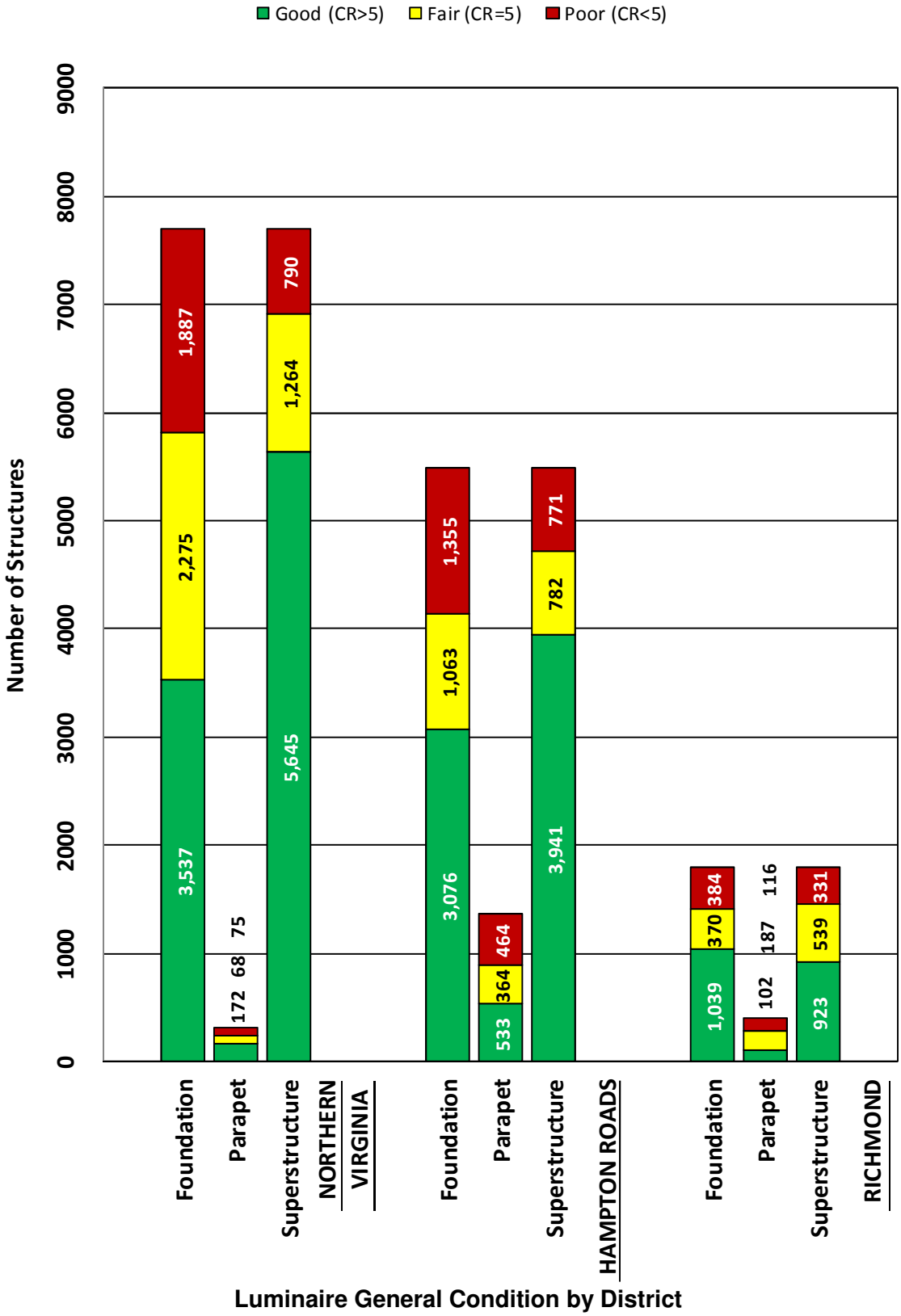
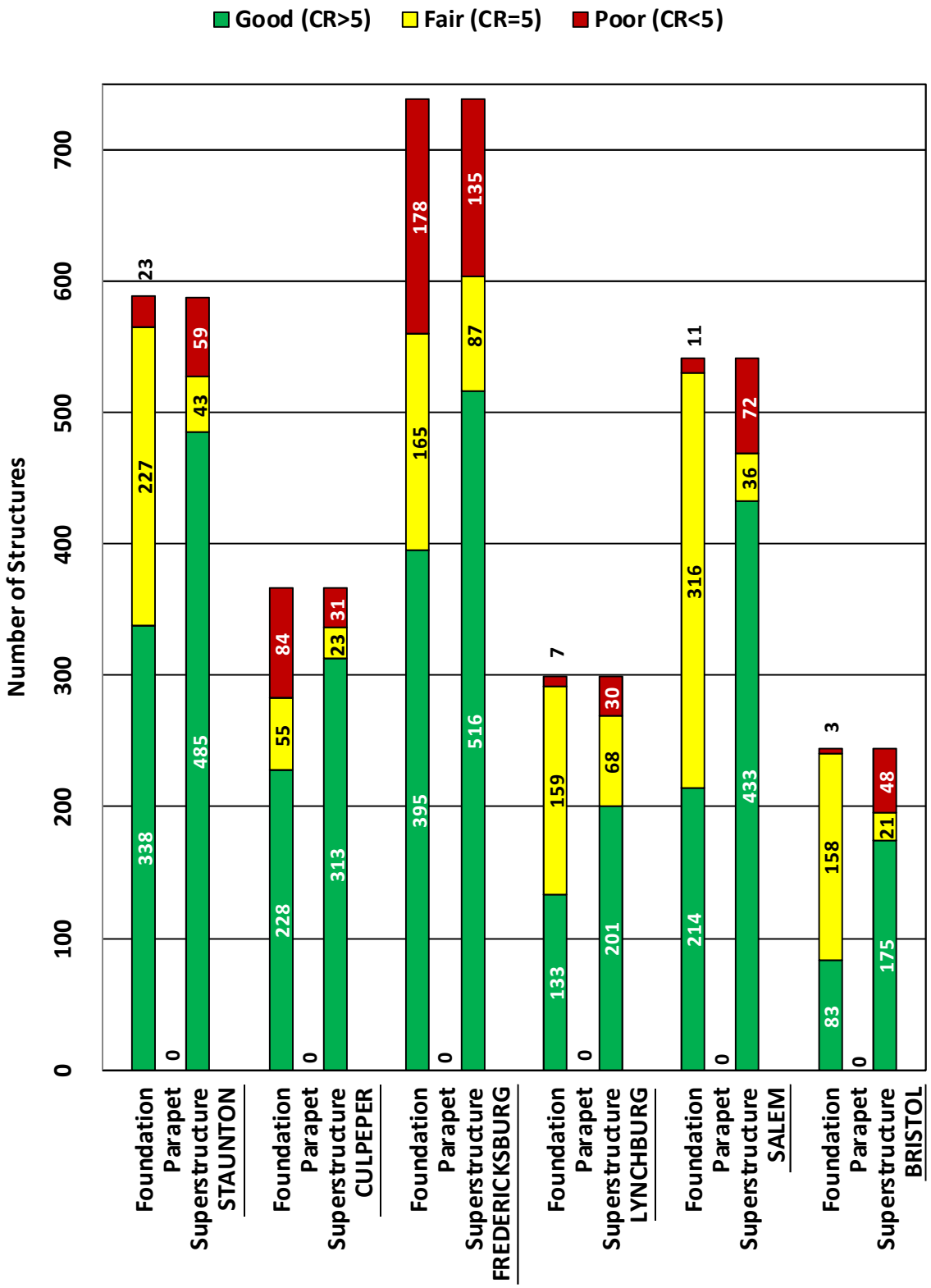
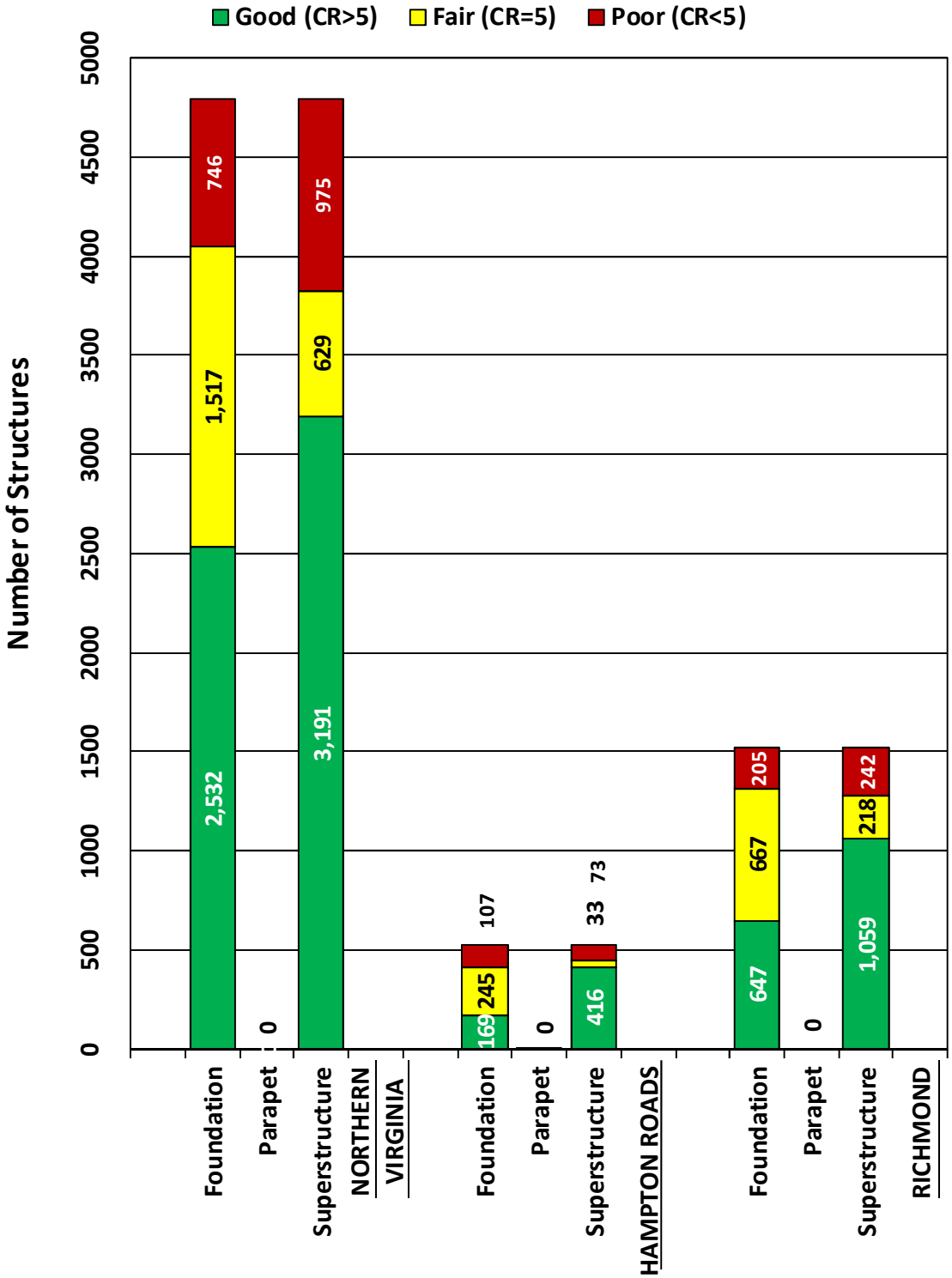


Chart K.1e – General Condition of Signal Structures – Small Inventory Districts

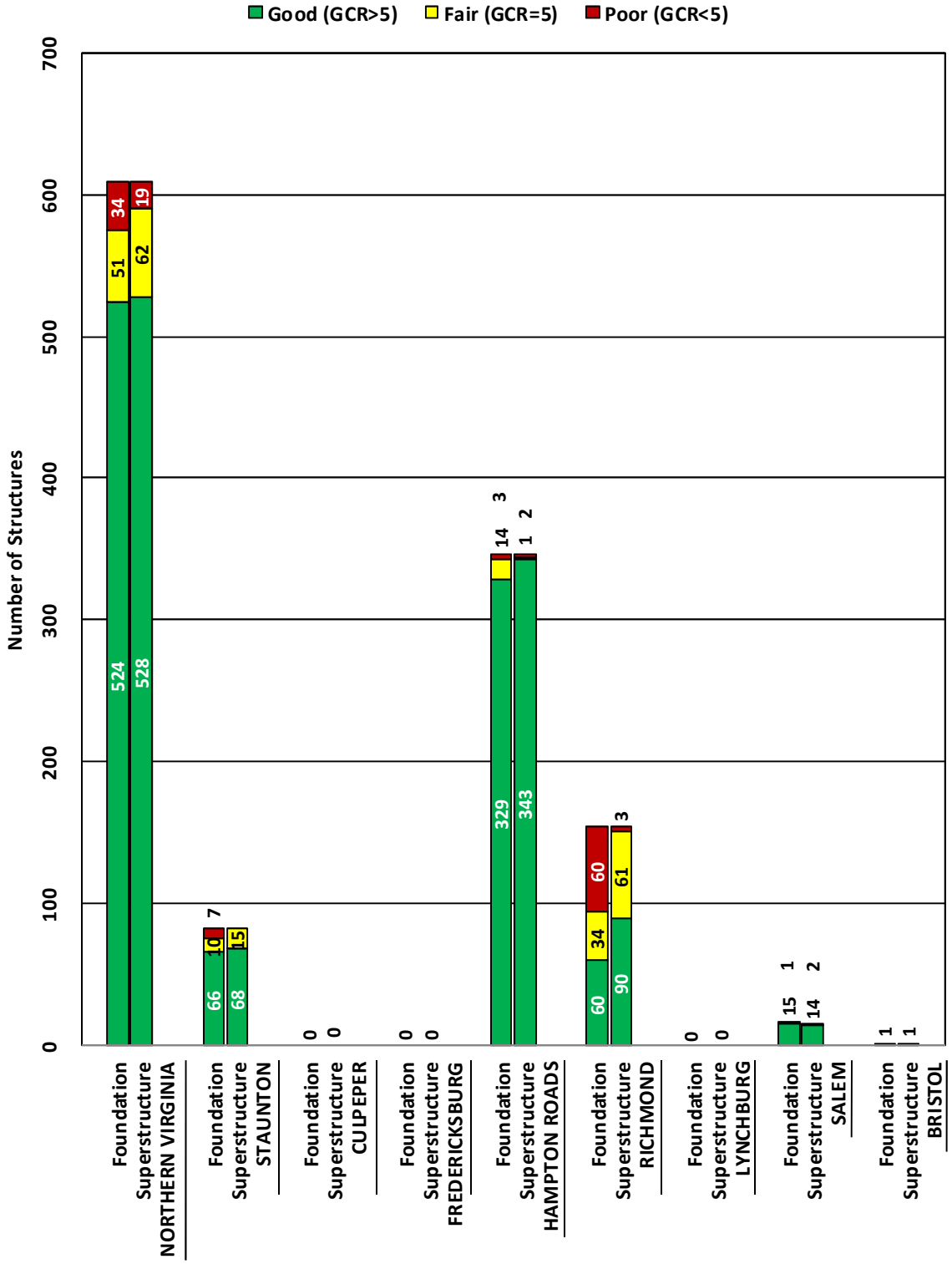


Signal Structure General Condition by District
Chart K.1f – General Condition of Signal Structures – Large Inventory Districts



Signal Structure General Condition by District

Chart K.1g –Condition of High Mast Lights and Camera Poles– All Inventory Districts



High Mast and Camera Poles Structures Condition by District

Charts K.2 through K.5, provided below, were developed in order to gain a more specific understanding of the conditions that cause structures to receive reduced GCRs.

These charts identify the number and percentage of ancillary structures with significant identified problems and summarize the specific sources of those problems. Charts K.2.a through K.2.c address sign structures by foundation, parapet mount and superstructure. Charts K.3.a through K.3.c address luminaire structures by foundation, parapet mount and superstructure. Charts K.4.a and K.4.b address the signal structures by foundation, parapet mount and superstructure. Charts K.5.a and K.5.b address high mast light and camera pole structures by foundation and superstructure.

The charts below reflect tallies of all identified problems, so a structure with multiple problem areas will be represented more than once in any particular chart. Accordingly, the total number of structures in each chart will not necessarily agree with summaries provided elsewhere in this report.

Chart K.2.a – Reasons Coded for Poor Sign Structure Foundation

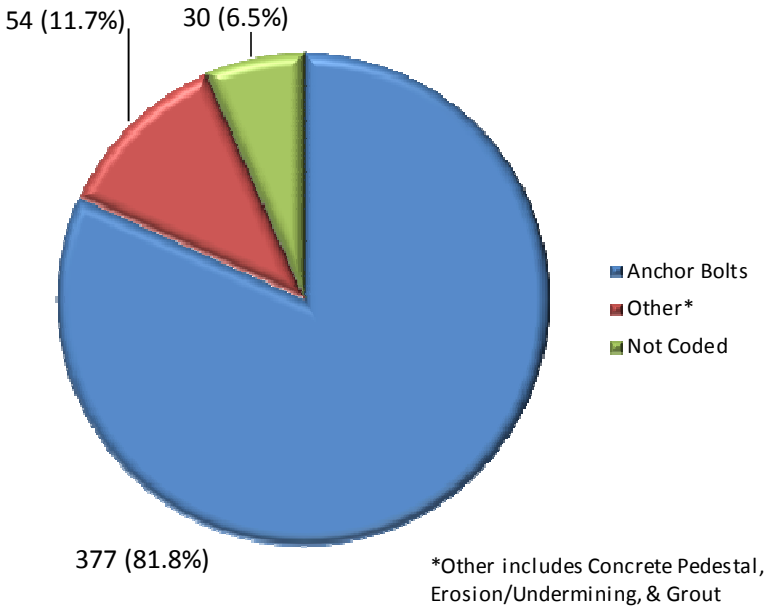


Chart K.2.b – Reasons Coded for Poor Sign Structure Parapet Mounting

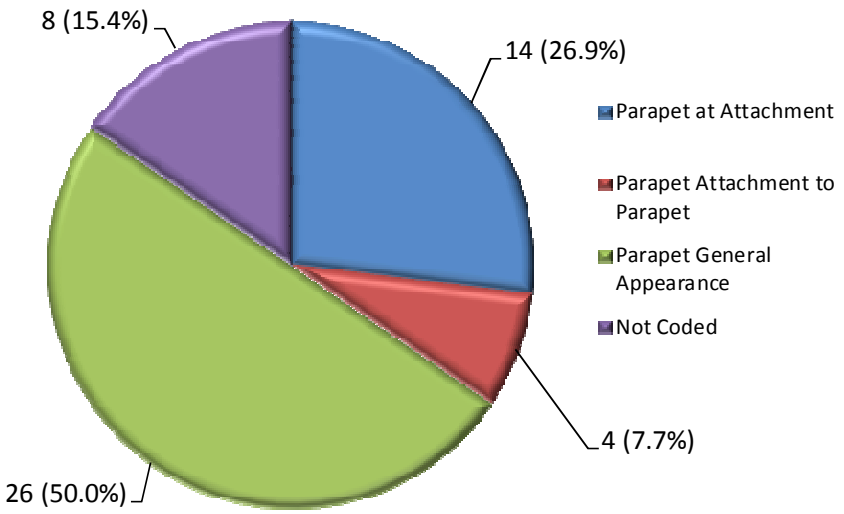


Chart K.2.c – Reasons Coded for Poor Sign Structure Superstructure

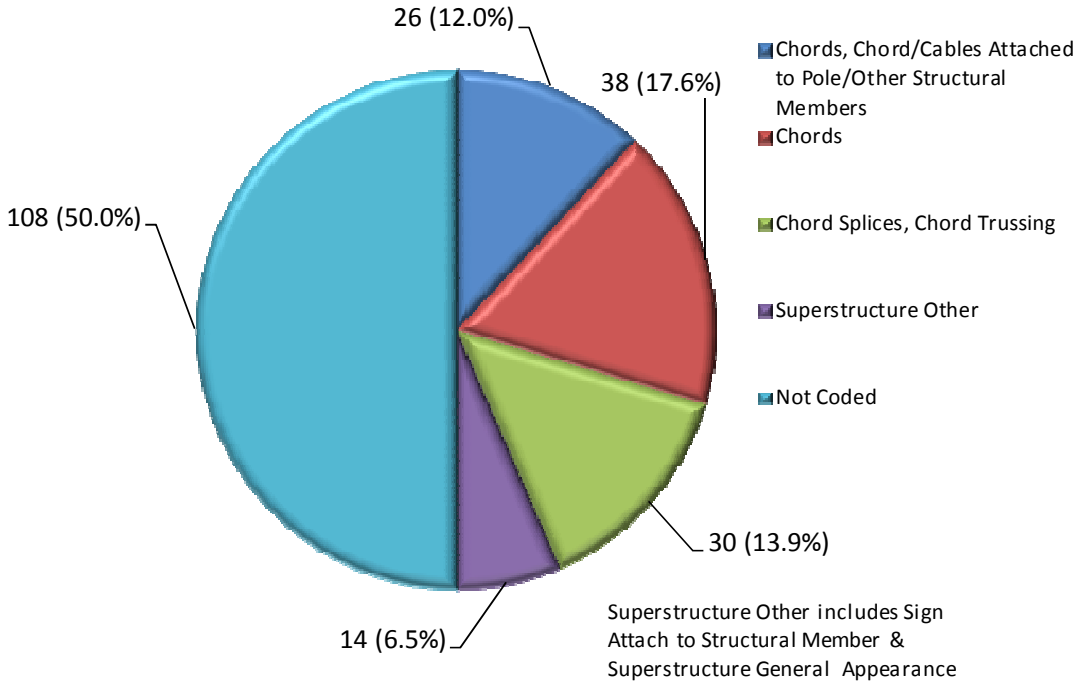


Chart K.3.a – Reasons Coded for Poor Luminaire Structure Foundation

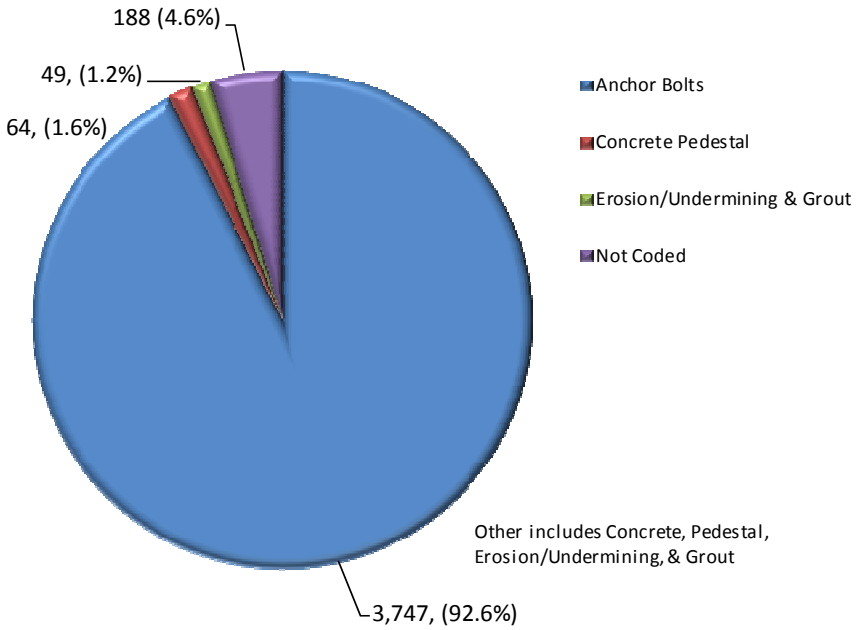


Chart K.3.b – Reasons Coded for Poor Luminaire Structure Parapet Mounting

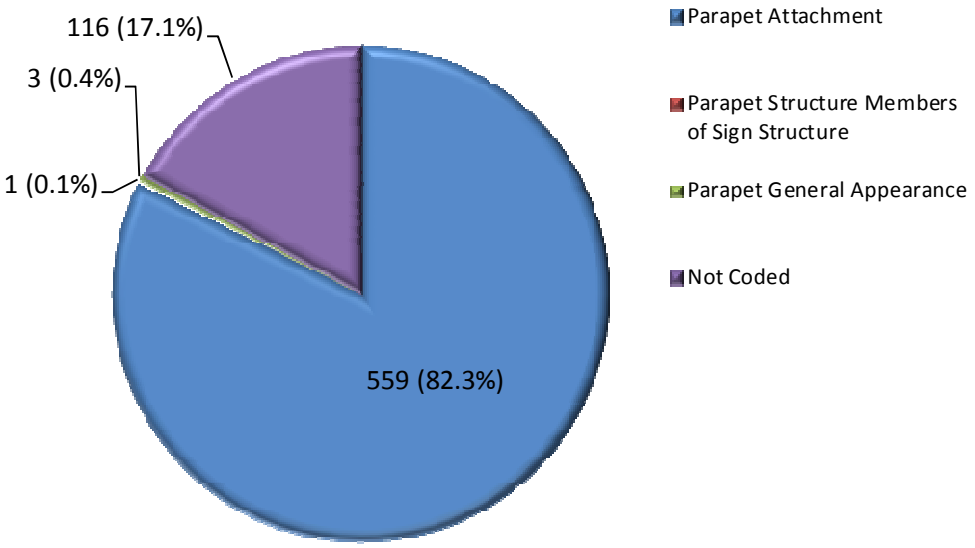


Chart K.3.c – Reasons Coded for Poor Luminaire Structure Superstructure

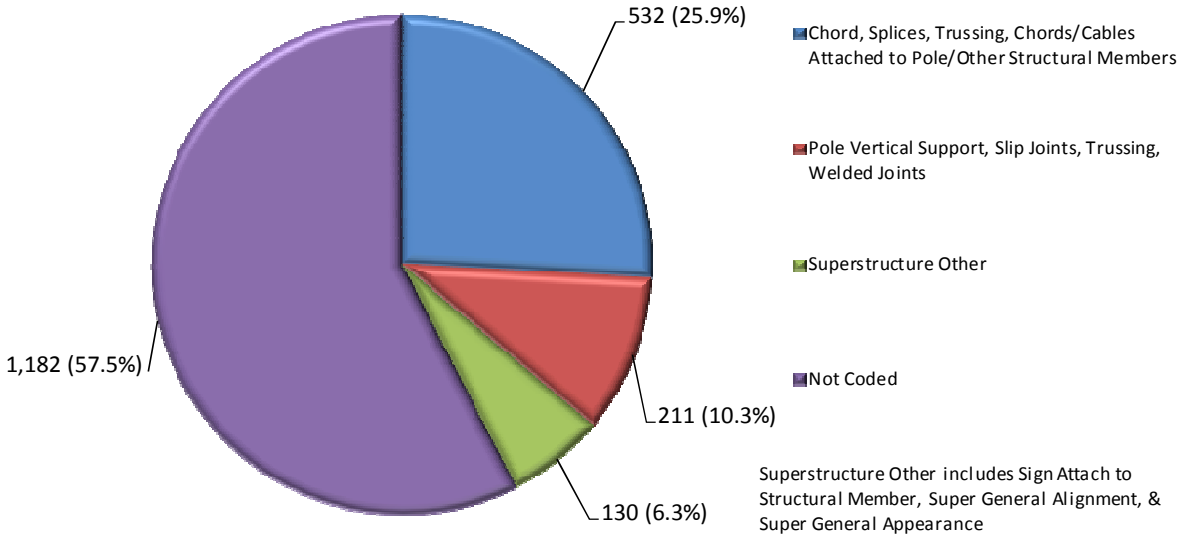


Chart K.4.a – Reasons Coded for Poor Signal Structure Foundation

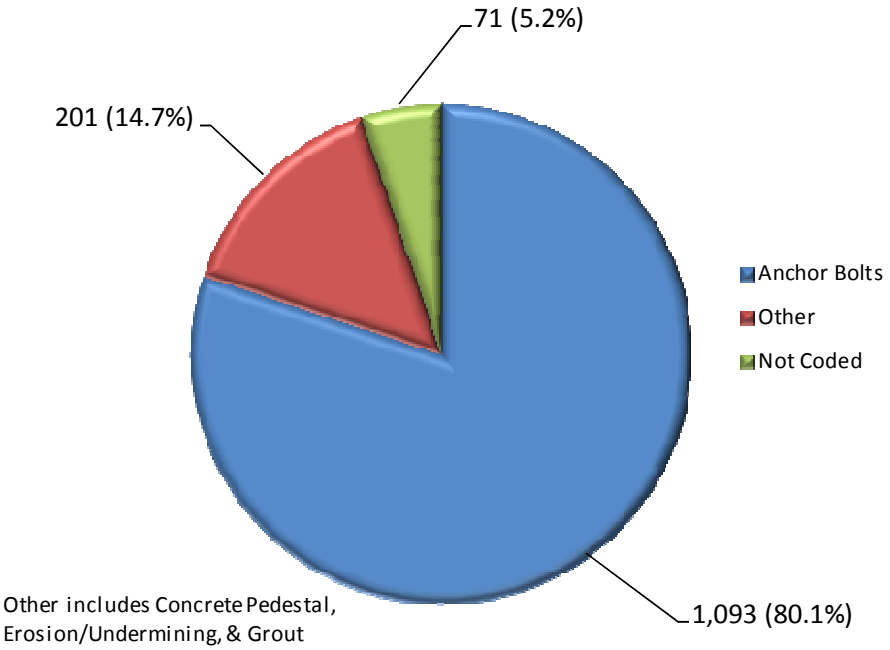


Chart K.4.b – Reasons Coded for Poor Signal Structure Superstructure

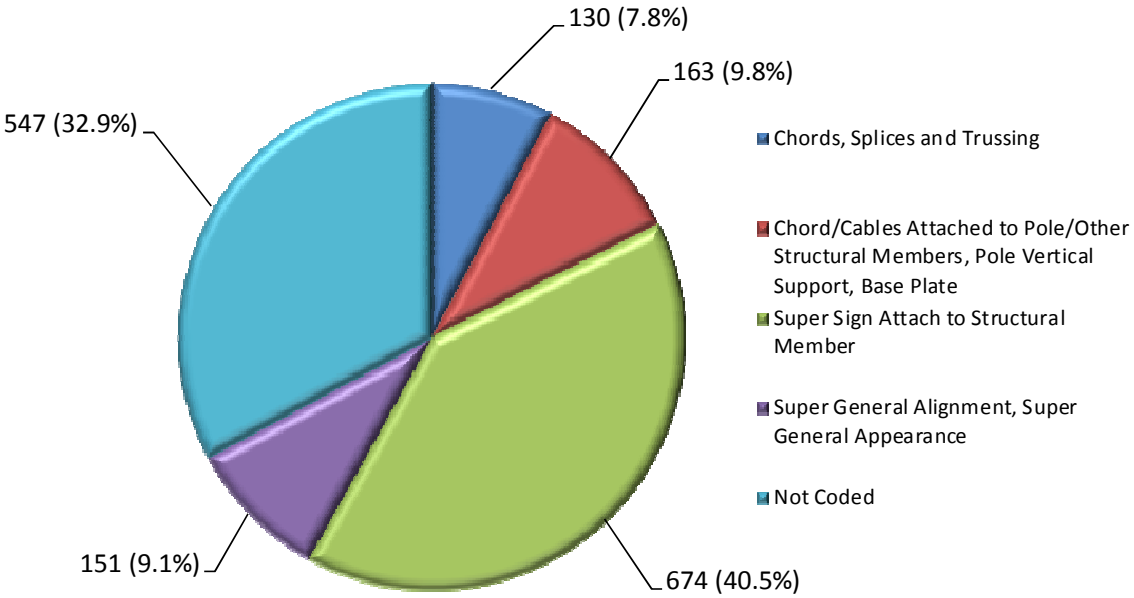


Chart K.5.a – Reasons Coded for Poor High Mast Light and Camera Poles Foundation

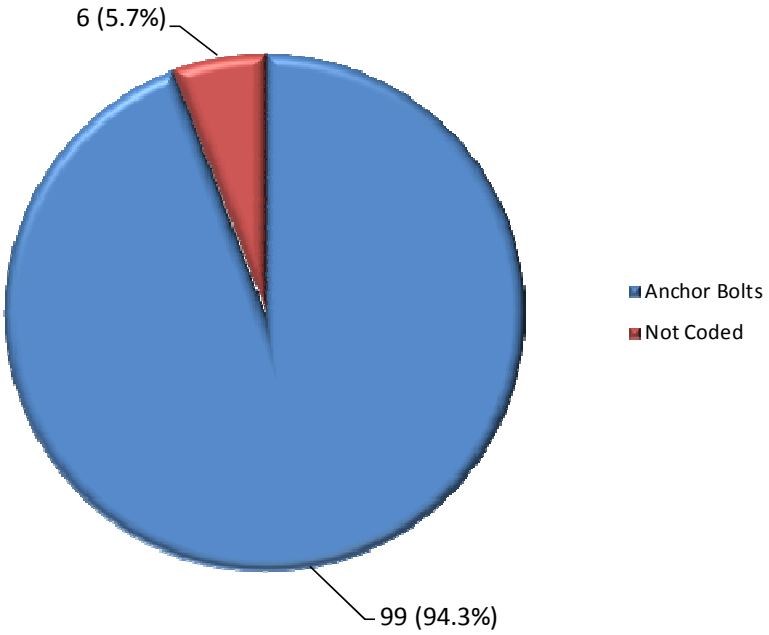
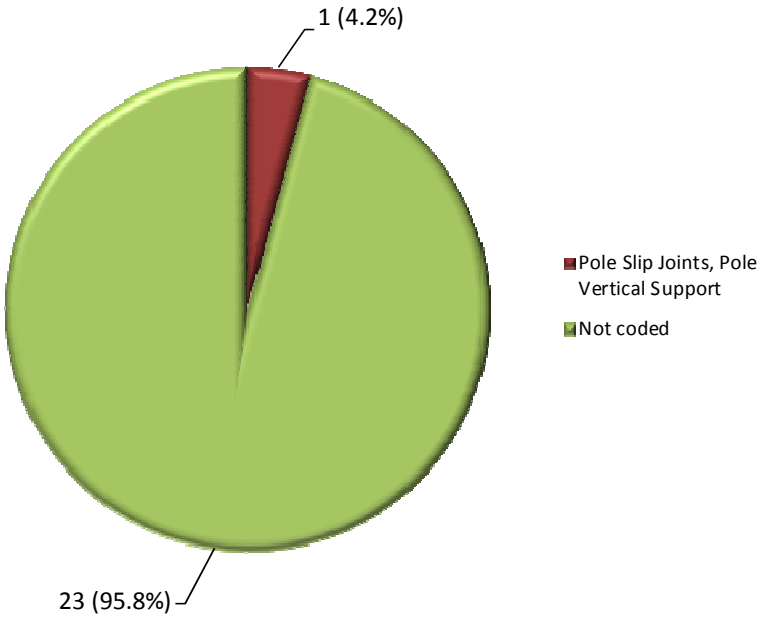


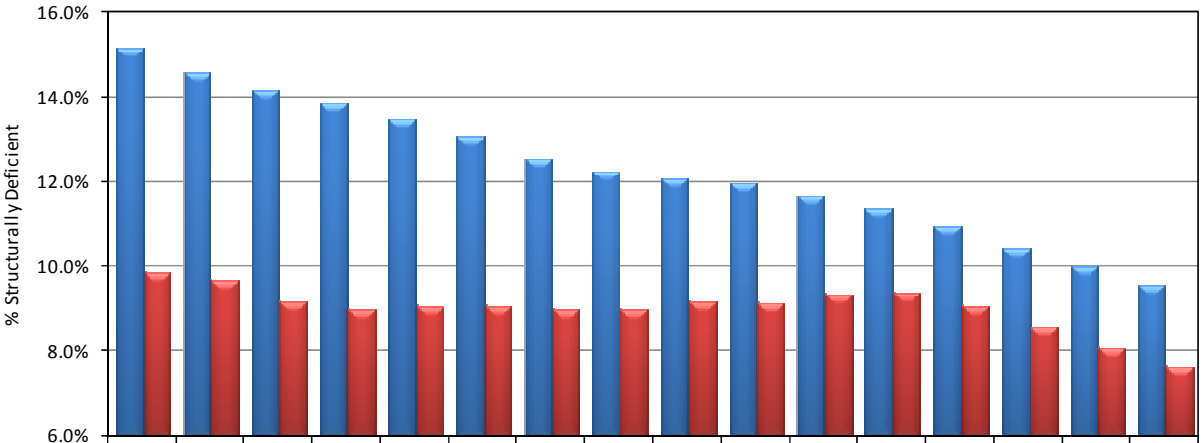
Chart K.5.b – Reasons Coded for Poor High Mast Light and Camera Poles Superstructure



APPENDIX L – NATIONAL PERFORMANCE TRENDS

Every Year FHWA collects data of NBI structures from all the states. The National Bridge Inventory reports data by calendar year and the 2016 data will not be available until after April 2017. The following charts compare Virginia's percentage of deficient structures with the national average as reported by FHWA. Percentages are based on National Bridge Inventory structures only. See previous charts for percentages of the entire Virginia inventory.

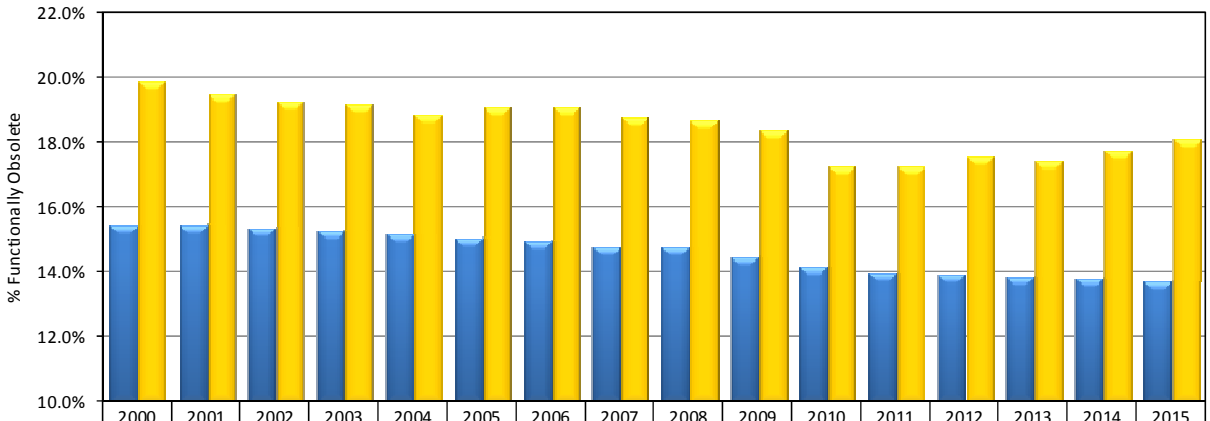
Chart L.1 – Comparing Virginia's NBI Structurally Deficient (SD) Structures to the National Average



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
National	15.2%	14.6%	14.2%	13.9%	13.5%	13.1%	12.6%	12.3%	12.1%	12.0%	11.7%	11.4%	11.0%	10.5%	10.0%	9.6%
Virginia	9.9%	9.7%	9.2%	9.0%	9.1%	9.1%	9.0%	9.0%	9.2%	9.2%	9.4%	9.4%	9.1%	8.6%	8.1%	7.7%

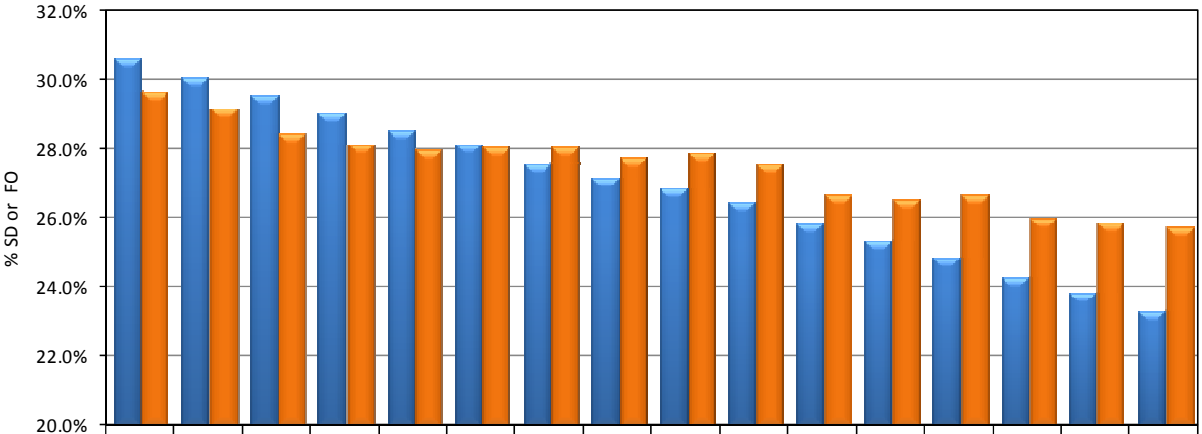
Note: Percentages are based on National Bridge Inventory structures only. See previous charts for percentages of entire Virginia inventory. Data presented are for end of calendar year.

Chart L.2 –Comparing Virginia's NBI Functionally Obsolete (FO) Structures to the National Average



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
National	15.5%	15.5%	15.4%	15.3%	15.2%	15.1%	15.0%	14.8%	14.8%	14.5%	14.2%	14.0%	14.0%	13.9%	13.8%	13.7%
Virginia	19.9%	19.5%	19.3%	19.2%	18.9%	19.1%	19.1%	18.8%	18.7%	18.4%	17.3%	17.3%	17.6%	17.5%	17.8%	18.1%

Chart L.3 –Comparing Virginia's NBI Deficient (SD & FO) Structures to the National Average



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
National	30.7%	30.1%	29.6%	29.1%	28.6%	28.2%	27.6%	27.2%	26.9%	26.5%	25.9%	25.4%	24.9%	24.3%	23.9%	23.4%
Virginia	29.7%	29.2%	28.5%	28.2%	28.0%	28.1%	28.1%	27.8%	27.9%	27.6%	26.7%	26.6%	26.7%	26.1%	25.9%	25.8%

Note: Percentages are based on National Bridge Inventory structures only. See previous charts for percentages of entire Virginia inventory. Data presented are for end of calendar year.