JOINT LEGISLATIVE AUDIT AND REVIEW COMMISSION
OF THE VIRGINIA GENERAL ASSEMBLY

Adequacy and Management of VDOT's Highway Maintenance Program

A Report in a Series on Transportation Issues in Virginia

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Preface

The Virginia Department of Transportation (VDOT) is responsible for maintaining more than 56,500 miles of interstate, primary, and secondary roads, more than 18,000 bridges and culverts, six tunnels, and other assets such as ferries and toll roads. In addition, VDOT funds maintenance activities provided on the more than 12,000 miles of urban and secondary roads and streets in the cities, towns, and counties that are not part of the State-maintained system. In November 2001, the Joint Legislative Audit and Review Commission (JLARC) directed staff to conduct a study of VDOT's highway maintenance program. This report presents findings from that review.

This study found that pavements on the interstate and primary systems generally appear to be in good condition based on measurements performed by VDOT. However, 40 percent of the bridges maintained by the department are in need of repair or rehabilitation based on VDOT's general condition ratings. Costs to address these pavement and bridge maintenance needs may be more than $1.6 billion, which does not include activities for the pavements on the secondary system. Furthermore, there is currently no statewide systematic approach for measuring the conditions of the pavements on the secondary roads, although about 70 percent of Virginia's lane mileage is on this system.

In addition, financial assistance provided to the cities, towns, and counties for maintenance of road assets not included in the State system may be inadequate for effectively maintaining those assets. However, no statewide, systematic evaluation of the conditions of those assets or inventory of maintenance activities provided by these localities is currently performed.

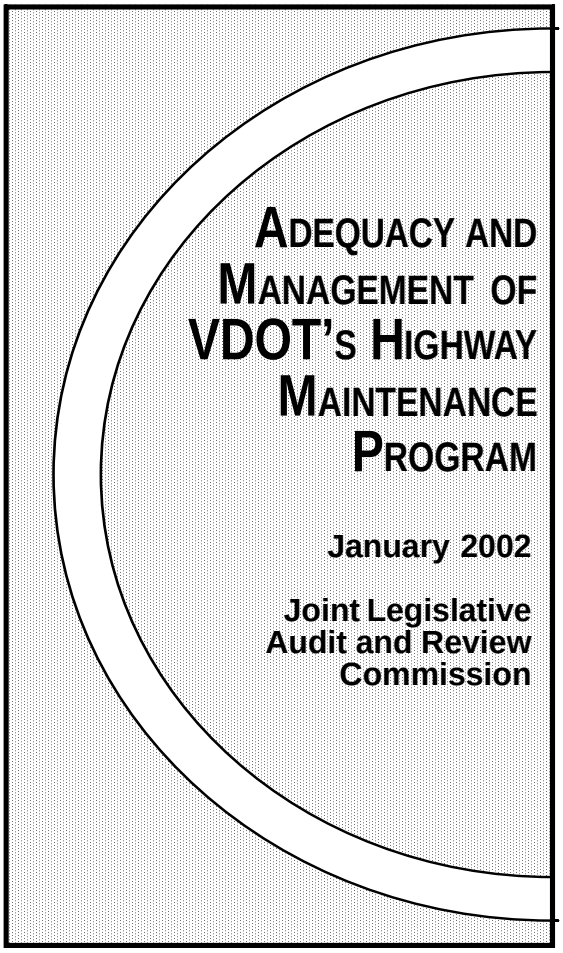
The study also found that VDOT's attempt to implement an asset management approach to highway maintenance on a statewide basis has been delayed several times and does not appear to be a priority of the department. The development of automated systems has been described as critical to the implementation of asset management, yet several substantial delays related to these systems have occurred, apparently due to cash flow problems and implementation of other department-wide technology systems.

On behalf, of the Commission staff, I wish to express our appreciation for the assistance and cooperation provided by the Virginia Department of Transportation staff, as well as transportation staff of the cities, towns, and counties of Arlington and Henrico.

Philip A. Leone
Director

January 18, 2002

JLARC Report Summary



Every year there are more roads added to Virginia's highway system, and every year the roads grow older. Thus, maintenance needs and associated costs will inexorably increase. The *Code of Virginia* requires the Virginia Department of Transportation (VDOT) to maintain the State's 56,700 miles major highways and local streets, 18,500 structures and bridges, and other assets such as tunnels, ferries, and rest areas. The *Code of Virginia* also requires the Commonwealth Transportation Board (CTB) to give priority to the funding needs related to the maintenance of the State's existing highway systems. In order to accomplish this mission, VDOT administers the maintenance program through staff in district offices, residency offices, and area headquarters around the State. VDOT currently employs a reactive maintenance approach to addressing problems as they arise, although it is trying to develop and implement a preventive approach, known as asset management.

In November 2000, the Joint Legislative Audit and Review Commission (JLARC) directed staff to undertake a review of the adequacy and efficiency of the highway maintenance program provided by VDOT. Concerns were raised by the Commission regarding the organization, management, and operations of VDOT's highway maintenance program. Specifically, those concerns focused on the department's prioritization of funding for the maintenance program, management of the program, and VDOT's development of an asset management strategy for highway maintenance.

This report presents the results of the JLARC staff assessment of VDOT's highway maintenance program. To complete the assessment, staff examined the management of the funding and other resources provided to VDOT for highway maintenance, performed site visits to all VDOT districts and several residencies and area headquarters within those districts, attended all seven monthly meetings of the Maintenance Program Leadership Group between February and August 2001, and conducted surveys of all residency maintenance operations managers and the cities and towns that receive payments from the State to maintain the streets in those localities.

The JLARC staff assessment has resulted in four major findings. First, Virginia's interstate and primary highway pavements are in generally good condition. Second, despite the generally good condition of in-

terstate and primary system pavements, there are significant deficiencies on some of Virginia's highway assets. Approximately 20 percent of the pavements on the interstate and primary systems are considered deficient as determined by VDOT. About 40 percent of Virginia's bridges may be in need of repair or rehabilitation based on VDOT-calculated general bridge condition ratings. In addition, there is no statewide systematic approach for measuring the conditions of the pavements on the secondary roads, although about 70 percent of Virginia's lane mileage is on this system.

Third, costs associated with bringing the deficient pavements and bridges needing maintenance attention to an acceptable level are substantial. JLARC staff analysis indicates that addressing only the asphalt overlay needs of the deficient interstate and primary roads in Virginia would require more than $100 million. In addition, bridge repair or replacement costs may be as much as $1.52 billion, although some of that cost would likely be funded from the construction program. These estimated costs do not reflect repairs to the pavements on the secondary road system. Representatives of the cities, certain towns, and counties that receive payments from the State for the maintenance of the streets and roads in those jurisdictions indicated that there is also a substantial unmet funding need for maintenance of local roads, but this remains unclear because no standardized statewide assessments of the maintenance needs in these localities is performed by VDOT.

Given time, personnel, and funding constraints, it is not possible for the department to fully fund these needs in a single year. Therefore, the primary purpose of this analysis is not to establish specific funding recommendations to the General Assembly, but rather to assess the adequacy of current funding for meeting identified maintenance program needs over the long term.

Finally, VDOT's implementation of an asset management approach on a statewide basis has been delayed several times and does not appear to be a current priority of the department. Because VDOT discontinued use of its prior system for measuring maintenance productivity in anticipation of the new approach, it is now left with no way to systematically assess the statewide needs or accomplishments of the overall maintenance program. Two automated systems for pavements and bridges do allow VDOT to perform some assessment of the conditions of these assets.

Several VDOT staff indicated that until the maintenance program can accurately address the conditions of the highway assets and assess what maintenance activities provide the greatest return on investment for the entire highway system, the maintenance managers will not be able to determine the true funding needs of the program. Although there is uncertainty surrounding when asset management will be implemented, there are additional management improvements the department could take now to improve the efficiency of the maintenance program.

This report provides a number of recommendations to address the issues that have been identified and highlights some of VDOT's accomplishments concerning highway maintenance.

Conditions of Virginia's Interstate and Primary Pavements Are Generally Good

Based on a condition assessment of data collected in 2000 by VDOT for a sample of the interstate and primary asphalt pavements, it appears these surface conditions are maintained to a sufficient level. The data sample consisted of 82 percent of all directional miles of interstate and primary pavements in Virginia, according to VDOT pavement management staff. As the table at the top of page III shows, only 20 percent of the pavements on the interstate and primary systems were rated as deficient based on criteria established by the department.

Total Deficient Miles of Asphalt Pavements by System in Directional Miles 2000

System	Total Sample Miles	Total Deficient Mileage
Interstate	1,834	364
Primary	9,328	1,842
Total	11,162	2,206

However, VDOT does not have a process in place to measure the pavement conditions on the secondary road system. During the summer of 2001, two districts began rating the conditions of the secondary road pavements for which they are responsible. However, a standardized approach was not established between the districts.

Recommendation. *The Virginia Department of Transportation needs to conduct a more thorough review of the pavement conditions of all the highway systems in Virginia. For example, the department should rate the conditions of the total directional mileage for the interstate and primary pavements. In addition, VDOT should rate the pavement conditions of at least a representative sample of the secondary roads using the same rating scale as is used on the interstate and primary pavements. Finally, the overlay schedules should be developed using these ratings as a method for prioritizing repair activities.*

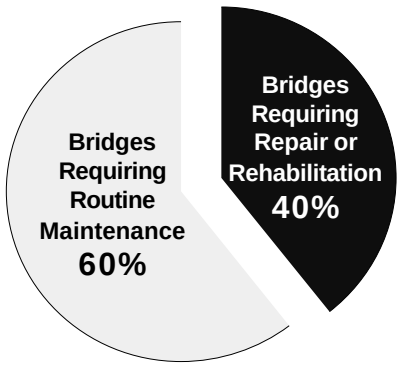
Forty Percent of Bridges Are in Need of Repair or Rehabilitation Based on General Condition Ratings

While interstate and primary asphalt pavements appear to be in relatively good condition, the State's bridges appear to have greater maintenance needs. Based on a JLARC staff analysis of general bridge condition ratings determined by VDOT, 40 percent of the State's more than 11,775 bridges are considered to be in need of some maintenance activity (see figure at right). Of the bridges rated in need of repair or rehabilitation, 64 percent are located on the secondary roads system, 25 percent are on the primary system, and eleven percent are on the interstate system.

The majority of Virginia's bridges are required by the Federal Highway Administration to be inspected at least once every two years. Bridges with identified critical issues are required to be inspected every year. According to FHWA definitions, more than 4,500 Virginia bridges were rated as potential candidates for either minor or major rehabilitation.

In addition, more than 47 percent of Virginia's bridges were built prior to 1961, according to data supplied by VDOT. FHWA has recently recommended that bridges be built to a 75-year functional life, and VDOT

Statewide Bridges in Need of Repair or Rehabilitation Based on General Condition Ratings, 2001



n = 11,775

structure and bridge staff have stated that age is a significant component in identifying potential needs because bridge performance declines as concrete and steel elements approach the end of their useful structural life spans.

Costs to Address Current Maintenance Needs Could Be $1.6 Billion

Further analysis of the pavement and bridge condition data indicates that projected costs associated with raising the condition ratings of these assets to a level identified as acceptable by VDOT and FHWA could reach more than $1.6 billion. JLARC staff analysis identified the amount of funding needed to increase the condition of all deficient interstate and primary pavements to be about $100 million. Projected bridge rehabilitation or replacement activities on the 40 percent of bridges identified as needing maintenance attention would cost more than $1.5 billion. It should be noted that the estimated amount for bridges includes bridges already scheduled for replacement and those that would qualify for replacement, and bridge replacement is funded from construction allocations. However, these estimated costs are in addition to the costs of maintaining those pavements and bridges that are currently at an acceptable condition, and also do not include cost estimates for repairs on the more than 47,000 miles of secondary roads. In addition, 92 percent of the VDOT operations managers surveyed by JLARC staff said that maintenance funding is inadequate.

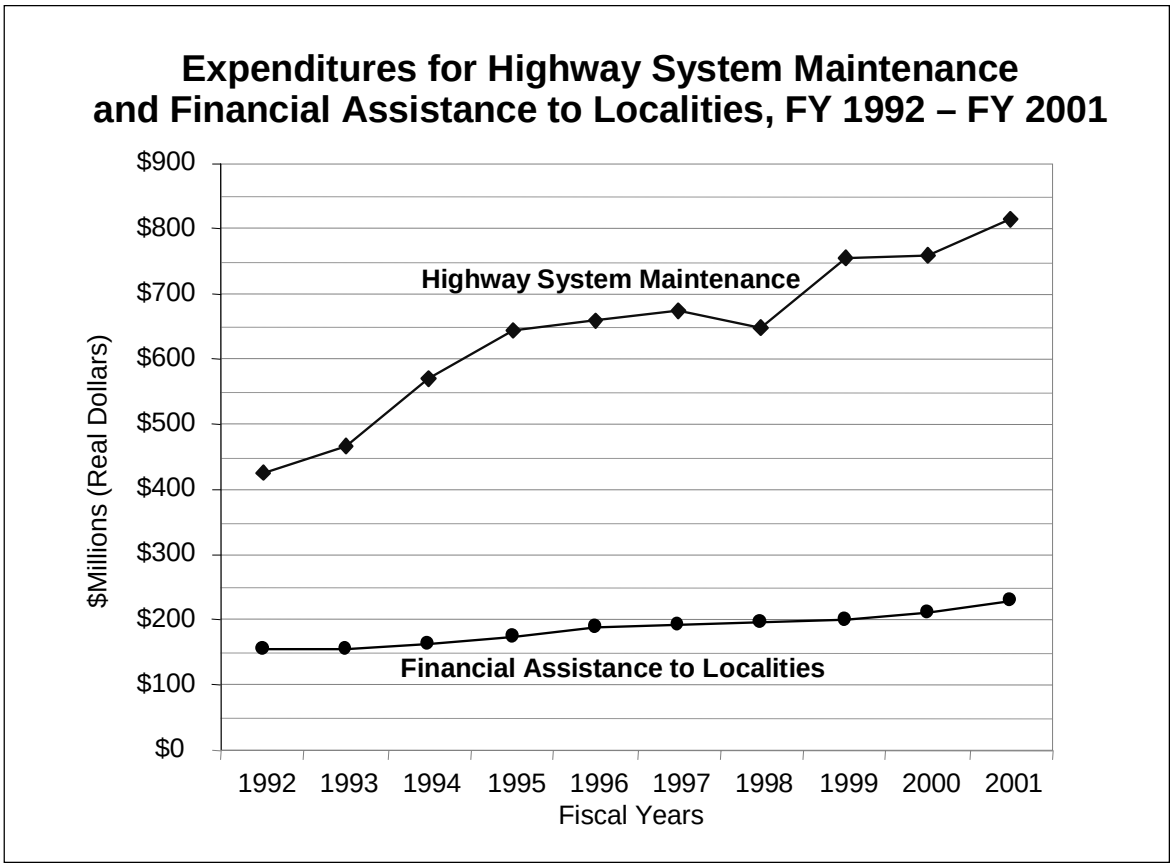
Current Maintenance Funding Appears Constrained, and Projected Funding May Be Low

Despite these identified deficiencies, funding to address these needs has not been provided to the maintenance program for a variety of reasons. While the *Code of Virginia* requires funding for maintenance of the State's existing highway systems be the first funding priority of all funds made available for highway purposes, it also leaves the determination of what is a "reasonable and necessary" amount for these functions to the Commonwealth Transportation Board. In the past several years, it appears that VDOT has constrained the level of funding available to the maintenance program for reasons that include cash flow difficulties, potential revenue shortfalls for the Highway Maintenance Operating Fund, and the desire to provide additional funding for the highway construction program.

The six-year allocation projections for the highway maintenance program appear to understate the funding that will eventually be required by approximately $670 million, based on past VDOT expenditures (see figure on next page). These projections indicate that after receiving $872 million in FY 2002 and $855 million in FY 2003, maintenance will be allocated approximately $861 million beginning in FY 2004 and continuing through FY 2007. Because the total amount of funding available for construction projects depends on the amount of funding left over after the funds are allocated for maintenance and other functions, projecting a level amount of funding for the maintenance program appears to provide extra funding for the construction program during those years.

However, not accounting for likely future increases in maintenance costs, such as those related to annual increases in fixed costs including labor, materials, and fuel, raises substantial questions regarding VDOT's commitment to maintaining the State's highway system as required by law. Moreover, this is not consistent with the history of maintenance expenditures in the previous six fiscal years.

Recommendation. *The Commonwealth Transportation Board should review the current maintenance needs on Virginia's highways and bridges and use the information obtained from these condition assess-*



ments in determining a reasonable and necessary amount of funding for maintenance of the State's existing highway systems.

VDOT's Oversight of Street and Road Maintenance Payments to the Localities Needs Improvement

Since 1997, Virginia has provided approximately $1 billion to the cities, certain towns, and the counties of Arlington and Henrico for the purpose of maintaining streets and roads. While VDOT does not directly maintain the almost 10,000 center line miles of roadways in the urban system, it is responsible for distributing the State's payments to these localities as well as overseeing the quality of the maintenance being provided. Additionally, the State makes payments to the counties of Arlington and Henrico for maintenance of certain secondary roads. VDOT has no oversight responsibility for these roads, however.

Although the State has provided substantial funding for maintenance of the streets and roads in the urban system and the two counties, 76 percent of the recipients feel these payments were insufficient to meet locality identified maintenance needs. JLARC staff analysis of VDOT urban division accounting and expenditure annual reports indicates that from FY 1997 to FY 2000, cities and towns spent $207 million more for maintenance than was received through State payments (see table on next page).

In 1996, §33.1-41.1 of the *Code of Virginia* was amended to allow cities and towns to use these payments for construction or reconstruction, as well as maintenance purposes. However, four of the six cities and

City and Town Expenditures for Maintenance Exceeded State Payments FY 1997 – FY 2000

Function	FY1997	FY1998	FY1999	FY2000
Local Expenditures	$214,127,191	$225,666,006	$239,753,255	$ 231,407,520
VDOT Payments	$167,679,709	$171,401,895	$180,990,141	$ 183,467,137
Locality Difference	$ 46,447,482	$ 54,264,111	$ 58,763,114	$ 47,940,383

towns contacted by JLARC staff indicated these payments were not used for activities that might otherwise be funded through the construction program. For example, street maintenance payments were used for construction of curb and gutter, turn lanes, and repair and replacement of sidewalks, as well as other ordinary maintenance activities such as mowing and ditching.

In addition, the *Code of Virginia* gives VDOT a very limited role in the amount of oversight it provides for maintenance of the streets in the cities and towns, and no responsibility for oversight of the maintenance of the secondary roads in the counties. If additional funding were to be provided to the localities for maintenance of their streets and roads, increased oversight and adequate reporting methods should be required.

Recommendation. *The Virginia Department of Transportation should establish a systematic and regular review of pavement and bridge conditions in the localities as a way of identifying the maintenance functions and needs on the urban system and in the counties that have chosen to withdraw from the State-maintained system. This information should be reported to the General Assembly on a regular basis.*

VDOT Has Not Implemented Asset Management

Implementation of asset management would provide VDOT with a much more accurate picture of highway maintenance needs and would greatly assist the CTB in determining a level of funding that is reasonable and necessary as required by the *Code of Virginia*. While VDOT was the first state department of transportation to award a long-term, performance-based contract for highway maintenance and has also proposed an asset management approach for highway maintenance using State forces, it has been unable to implement asset management on a statewide level.

To implement its asset management strategy, the department is developing several automated systems to collect, analyze, and forecast asset condition information and maintenance activities. Since beginning development of an asset management approach in 1996, VDOT has twice delayed the development of the Integrated Maintenance Management System (IMMS) that would be used to coordinate these functions

and the associated automated systems. To date, the department has spent about $39 million on these systems since 1996. Several VDOT staff have indicated that IMMS is critical to achieving an outcome-based approach to maintenance, and providing the department with a statewide inventory and comprehensive condition analysis of its highway assets. Likewise, other automated systems have not been finalized and their full functionality remains unrealized.

Currently, the implementation of the IMMS requirements are being delayed as VDOT attempts to develop and award a contract for a department-wide system that would integrate all of VDOT's information systems. This new system initiative is supposed to include the same business requirements developed by the maintenance program for IMMS, but it is unclear what priority the maintenance program's needs related to asset management will have. Despite the importance of this system to the maintenance program, this initiative appears to be progressing without a clear plan or specific project estimates for costs of development and implementation.

Recommendation. *The Virginia Department of Transportation needs to place a higher priority on the development and implementation of an asset management approach and the automated systems required. In addition, the department should continue to use the information being obtained through the Inventory and Condition Assessment System, and determine the minimum level of inventory collection and condition assessment needed to provide useful information for essential maintenance functions.*

Resources for Highway Maintenance Functions Could Be Managed More Efficiently and Effectively

In light of the fact that the implementation of an asset management approach may not occur in the immediate future, it appears VDOT could improve its use of resources by addressing certain short-term management issues. Prior to the initial development of IMMP, the maintenance program evaluated the productivity of its staffing and the use of materials and equipment as components of its activity scheduling and funding needs. However, VDOT no longer performs that function, in part because maintenance managers expected IMMP to be fully implemented by now.

Moreover, the department would benefit from a strategy that addresses the availability of unused allocations from one fiscal year to the next. According to many of the maintenance engineers interviewed for this review, the inconsistency of carry-forward funds affects their ability to adequately plan and prioritize activities into the future.

Although VDOT produces a quarterly report listing underutilized rental equipment, it does not appear that maintenance managers in the field use this information to achieve better management of the use of rental equipment. Several maintenance managers indicated they did not use these reports. VDOT has tried to develop methods for reducing existing equipment stocks. During the past summer, the department contracted with John Deere, Inc. for a pilot project leasing tractors as a means of reducing costs and unused equipment. VDOT should continue to develop strategies for reducing the amount of underused equipment in the field. For example, the department could better use the quarterly equipment utilization reports as a management tool for more efficiently providing pieces of equipment where they are needed.

Interviews with maintenance managers also identified a need for greater technical assistance in providing maintenance functions. As part of the development of a new maintenance policy manual in 1994, the maintenance program indicated that a best practices manual would also be developed. The development and implementation of a

best practices manual would provide staff in the field with additional guidance and could lead to the introduction of innovative and more efficient approaches to highway maintenance activities. However, this manual was never completed.

Recommendation. *The Virginia Department of Transportation should develop best practices for the major highway maintenance functions as soon as possible and provide adequate access and training as appropriate.*

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I. Introduction

In November 2000, the Joint Legislative Audit and Review Commission (JLARC) directed staff to undertake a review of the adequacy and efficiency of the highway maintenance program provided by the Virginia Department of Transportation (VDOT). Concerns were raised by the Commission regarding the organization, management, and operations of VDOT's highway maintenance program. Specifically, those concerns focused on the department's prioritization of funding for the maintenance program, management of the program, and VDOT's development of an asset management strategy for highway maintenance.

Following the completion of the 2000 JLARC review of the adequacy of the Virginia Department of Transportation's construction program, the Commission raised several additional concerns related to the adequacy of the State's approach to highway maintenance. Prior to the start of the 2001 General Assembly session, JLARC staff were directed to undertake a review of the effectiveness and efficiency of maintenance activities for Virginia's roads, highways, bridges, tunnels, and other facilities, including the maintenance of city streets. JLARC staff were also directed to look at the use of new and emerging technologies by VDOT to improve its maintenance programs, as well as the overall adequacy of funding for maintenance activities. Finally, staff were directed to study whether the current mix of state force and contracted maintenance activities is appropriate, and to determine whether the use of asset management could be expanded to all road systems.

This report focuses on the conditions of the State's pavements and bridges, as well as the management of the highway maintenance program. The remainder of this chapter provides an overview of VDOT, examines the organizational structure for the maintenance program, describes funding and staffing patterns of the maintenance program, presents the methods used to assess statewide maintenance needs, and outlines the approach used to conduct this study.

OVERVIEW OF VDOT'S HIGHWAY MAINTENANCE PROGRAM

Every year there are more roads added to Virginia's highway system, and every year the roads grow older. Thus, maintenance needs and associated costs will inexorably increase. As part of the highway maintenance program, VDOT is responsible for approximately 66,600 miles of major highways and local streets. Major highways include the interstate system (1,118 miles) and the primary system (8,012 miles). Local streets include the secondary system in the counties (47,247 miles) and the urban system in the cities and towns (10,224 miles). The State is directly responsible for the maintenance of all roads on the interstate, primary, and secondary systems, except secondary roads in the counties of Arlington and Henrico. While the State does not directly maintain local streets in the urban system, it does provide annual payments to localities for the maintenance of these roads.

The department also maintains several other highway related structures. These include four underwater crossings in Hampton Roads and two mountain tunnels in southwest Virginia. In addition, as of October 2000, there were more than 11,700 bridges, including one toll bridge (George P. Coleman), for which the department provides maintenance. The department also maintains two toll roads, four ferry crossings, 41 rest areas, and more than 100 commuter parking lots.

Prior to 1932, maintenance work on the highways and streets in Virginia was performed by a combination of State forces, and county or city governments. In an effort to eliminate the different levels of quality among the counties and to produce a more uniform system for the construction and maintenance of highways across the State, the 1932 General Assembly enacted the Byrd Road Act, which allowed counties to transfer their roads to the State for future maintenance. Passage of the Byrd Road Act consolidated the roads not then maintained by the State into the secondary road system. All but four counties (Arlington, Henrico, Nottoway, and Warwick) opted to turn their roads over to the State. Additionally, the Byrd Act established the urban highway system consisting of the streets in cities and towns with populations of more than 3,500. However, the State chose not to provide the actual maintenance of those streets; rather, it provided an annual payment to the cities and towns to do the same work themselves.

With passage of the Byrd Road Act, the highway system maintained by the State prior to the creation of the secondary system became known as the primary system. When Virginia's interstate highway system was constructed beginning in the 1950's, the State was required to assume responsibility for its maintenance as well. Over the years, the State has also become responsible for the maintenance and operation of the tunnels, toll operations, and other facilities, including rest areas, as previously mentioned.

After providing most highway maintenance through State forces, beginning in the 1970s, the State began to rely on private contractors to provide more and more of its maintenance functions. As Virginia's highway infrastructure increased, as well as the number of privately contracted maintenance activities, the paradigm for the maintenance program began to shift. For most of the past 70 years, the State's role in maintaining the highways and other roads, aside from routine activities, has mostly been reactive to maintenance needs. In general, that has meant waiting until an asset fails (a pothole appears or a pipe begins to leak) before providing maintenance. However, the department is currently attempting to implement an "asset management" approach to its maintenance activities that would allow the department to proactively maintain the roadway assets through preventive maintenance.

In developing asset management as VDOT's future maintenance system, the traditional definitions of maintenance activities, replacement maintenance and ordinary maintenance, have evolved into new functional classifications of maintenance activities. According to the State maintenance engineer, the department is migrating to a new environment that is based on three types of maintenance: preventive, restorative, and rehabilitative. Preventive maintenance refers to activities designed to extend the life of newly constructed assets. Restorative maintenance

tries to return an asset to its original condition through replacement of certain components. Finally, rehabilitative maintenance covers the larger activities previously referred to as maintenance replacement and focuses on more expensive activities. However, no formal policies or procedures currently exist regarding this new approach.

REQUIREMENTS FOR HIGHWAY MAINTENANCE

The provision of maintenance activities is guided by several sources including the *Code of Virginia*, federal law, and departmental policies and procedures. Although the *Code of Virginia* provides few specifics related to highway maintenance, and the department no longer has a single document that specifically directs the level of service for maintenance activities, the 1991 *Maintenance Guidance Manual* and the 1994 *Maintenance Policy Manual* have been cited among maintenance managers as the primary sources for assistance in performing activities. In addition, the Transportation Equity Act for the 21st Century (TEA-21) and other federal legislation established recommendations and requirements related to highway projects receiving federal funds.

The *Code of Virginia* sets forth the guidelines for identifying required highway maintenance activities and distributing funds for those activities. The 1977 General Assembly enacted §33.1-23.1.A of the *Code of Virginia* requiring that:

> The Commonwealth Transportation Board shall allocate each year from all funds made available for highway purposes such amount as it deems reasonable and necessary for the maintenance of roads within the interstate system of highways, the primary system of state highways, the secondary system of state highways and for city and town street maintenance payments made pursuant to §33.1-41.1 and payments made to counties which have withdrawn or elect to withdraw from the secondary system of highways pursuant to § 33.1-23.5:1.

Subsequent sections then provide for remaining funds to be allocated for administration of the department and for the construction program. While this language prioritizes the maintenance of the existing State highway infrastructure over other activities, including construction, it does not set forth any specific guidelines relating to the condition of the State highway system or any funding target beyond that which is deemed "reasonable and necessary" by the CTB.

The *Code of Virginia* also establishes criteria for funding the maintenance activities performed on the urban road system in the cities, as well as the secondary roads in the counties that have opted out of the State system (Arlington and Henrico). Moreover, the *Code of Virginia* categorizes maintenance as either ordinary or replacement, without defining either category more specifically.

Federal highway maintenance requirements set forth within Title 23 of the *United States Code*, TEA-21, and the United States *Code of Federal Regulations*, establish the responsibilities and general guidelines for the maintenance of federal-aid highway projects. As established by the Federal Highway Administration (FHWA), federal regulations regarding highway maintenance generally apply to three key areas: (1) interstate, primary and secondary roadways on the federal-aid highway system, (2) all bridges both on and off the federal-aid highway system, and (3) automated management systems for pavements and bridges. Under Title 23, the responsibility for providing maintenance services on any project constructed using federal-aid highway funds is expressly placed on the State. However, the State's obligation to provide maintenance services on any project ceases when the roadway no longer constitutes a part of the federal-aid system.

Within the maintenance division, the most current document providing maintenance staff with policy and procedural information is the 1994 *Maintenance Policy Manual*, which outlines general VDOT policies governing highway maintenance operations. Exhibit 1 provides examples of the guidelines for roadway surfaces, drainage, and snow removal activities.

Exhibit 1

VDOT Maintenance Policy Guidelines

Functional Area	**Maintenance Policy**
Roadway Surfaces	*The Department shall maintain roadway surfaces as near as practical to the originally constructed, reconstructed, or improved condition. Maintenance performed on roadway surfaces should provide a reasonably smooth and safe traveling surface.*
Drainage	*The Department shall maintain drainage facilities to: 1) provide safety and protection to the traveling motorist, 2) provide reasonably adequate drainage of the roadway surfaces, shoulders, and incidental drainage items, and 3) preserve the structural integrity of the roadway. The Department is required to perform only those work activities needed to keep the drainage systems functioning as designed, and requires that field managers perform periodic inspections of the drainage system to identify repair needs.*
Snow and Ice Control	*The Department is required to provide snow and ice control services when required and commensurate with the needs of all segments of the traveling public and the highway system. Each District is responsible for establishing the priority of bare pavement routes for removal of snow and ice based upon safety and service to the traveling public. The Code requires that the Districts coordinate to achieve the same reasonable level of service on inter-district roadways. The Code requires that access to all priority roadways be provided within 24 hours after the end of a storm and across all routes within 48 hours.*

Source: 1994 VDOT *Maintenance Policy Manual.*

ORGANIZATIONAL STRUCTURE FOR THE VDOT MAINTENANCE PROGRAM

The organization of the department's maintenance program is decentralized around four primary tiers: (1) the central office in Richmond, (2) nine districts, (3) 45 residencies, and (4) 244 area headquarters. Figure 1 shows the organizational structure of the maintenance program. The assistant commissioner for operations is charged with the responsibility and oversight of the maintenance program. Staff in the central office, district offices, and residencies mainly provide policy, budget, and resource direction to the areas, while staff in the area headquarters perform the actual maintenance functions.

Central Office

Organizationally, the maintenance program in the central office is comprised of four divisions that report to the assistant commissioner for operations, who is responsible for the supervision of VDOT's maintenance functions and programs. The assistant commissioner for operations is also responsible for all district and residency operations. These functional divisions include: maintenance, traffic engineering, equipment, and intelligent transportation systems (ITS).

The maintenance division, headed by the State maintenance engineer, is responsible for: oversight of the statewide maintenance program, establishment of policies and procedures, monitoring and evaluation of highway maintenance activities, and support of maintenance staffing, field activities, and special facility operations. In addition, the maintenance division is responsible for the Integrated Maintenance Management Program (IMMP), the department's initiative to implement an asset management system.

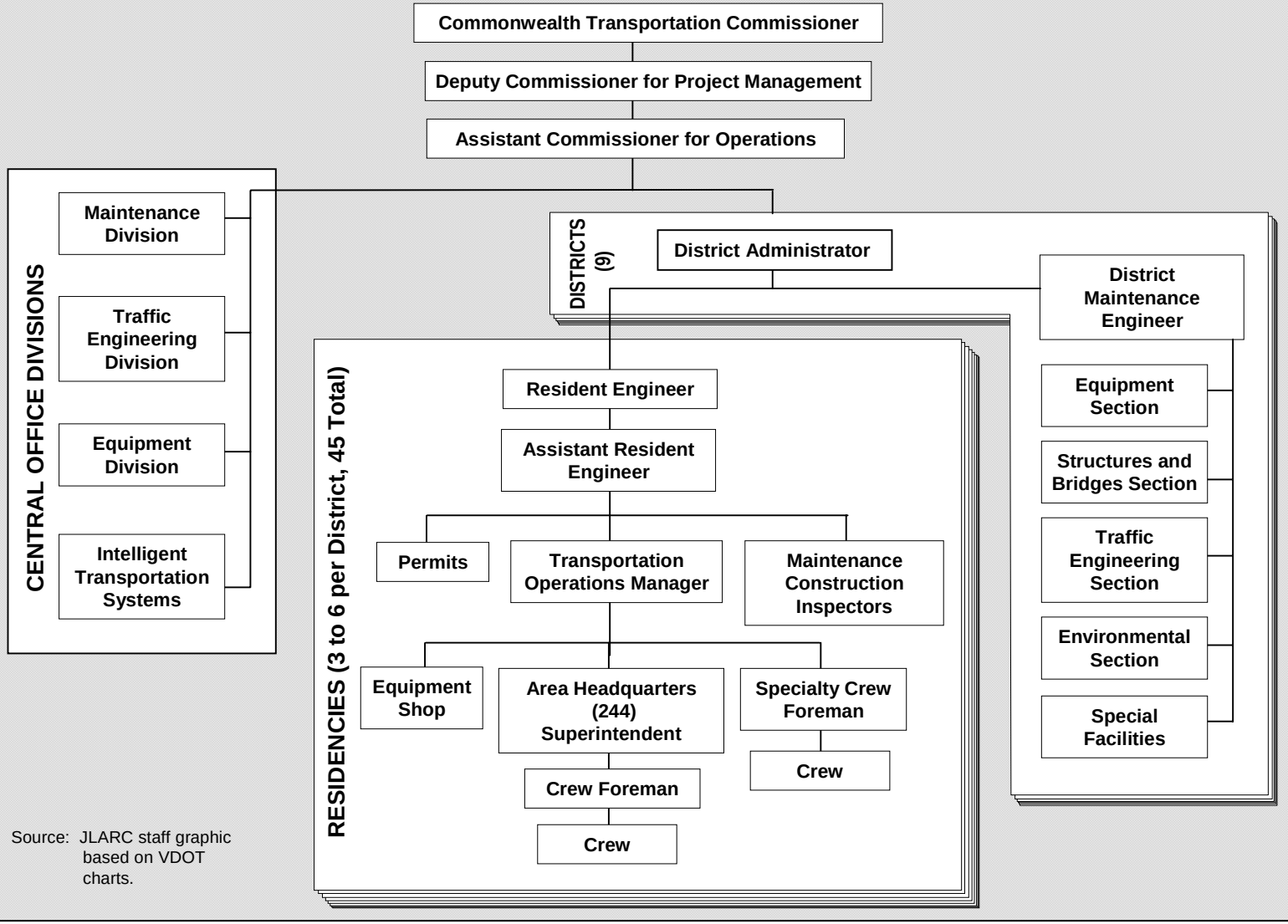
The traffic engineering division is the focal point for the department's highway safety activities and develops the transportation and congestion management programs. The central office equipment division coordinates the assignment, use, and management of vehicles and equipment in conjunction with the district equipment sections. Finally, the ITS division manages, develops, and implements advanced transportation technologies such as the Smart Travel Program.

District Offices

There are nine district offices located throughout the State (Figure 2). Each district is led by a district administrator, who is responsible for construction and maintenance activities within the district and reports to the assistant commissioner for operations. In general, maintenance oversight is shared by the district maintenance engineers and the resident engineers. The district maintenance engineer reports to the district administrator, acts as a liaison between the central office and the district, and is the principal maintenance position at the district. However, the resident engineers do not report to this position. District maintenance engineers are also responsible for several sections within each district, including: environmen-

Figure 1

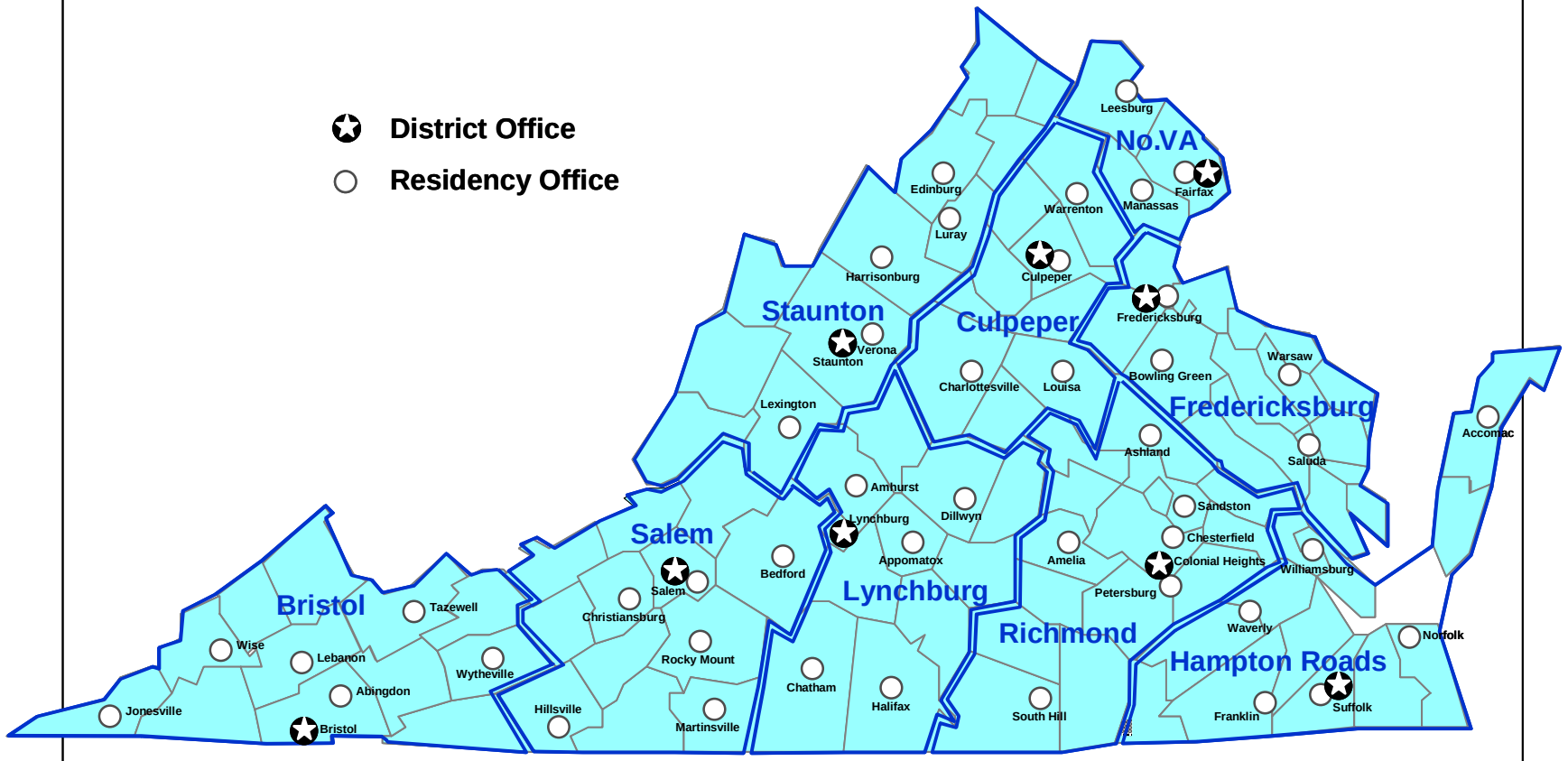
Organization of VDOT's Maintenance and Operations Functions



Source: JLARC staff graphic based on VDOT charts.

Figure 2

VDOT Districts, District Offices, and Residency Offices



Source: VDOT district map, 1997.

tal, equipment and facilities, structures and bridges, special facilities, and traffic engineering. In conjunction with the section administrators, the district maintenance engineers set long-range policy for the maintenance activities in the districts and are responsible for budget and allocation decisions.

The section heads, like the district maintenance engineers, have dual reporting responsibilities. The district section administrators report to the district maintenance engineer and not to the division administrator in the central office. However, section heads serve as conduits for policy and procedural information from their respective divisions in the central office to the maintenance staff within each district, while also providing day-to-day support related to those functions. Therefore, they have extensive contact with the central office division staff, as well as each other.

As a result of their experience with district-wide budgeting, the district maintenance engineers play a critical role in the statewide budgeting for maintenance activities. Since 1995, determination of budget priorities and allocations for the entire maintenance program have been governed by the Maintenance Program Leadership Group (MPLG), which originally consisted of all nine district maintenance engineers, but was expanded to include the State maintenance engineer during 2001. This group meets monthly to provide strategic direction, leadership, and coordination for the maintenance budget and statewide programs. The MPLG has been described as a board of directors for the highway maintenance program.

Residencies

There are currently 45 residency offices, which are responsible for maintenance in one or more counties. A resident engineer heads each residency. There is also an assistant resident engineer, who oversees the permits manager, the maintenance/construction inspector, and the transportation operations managers. In turn, the operations managers have responsibility for the area headquarters, the equipment shop, and any specialty crews.

Within each district there is a District Maintenance Program Leadership Group (DMPLG) that performs many of the same functions as the MPLG, only at a district level. These groups are composed of operations managers from each residency and the heads of the division sections mentioned previously. How the DMPLG is used and how regularly it meets are determined by the district maintenance engineer; however, most DMPLGs meet at least quarterly. DMPLGs make decisions on funding allocations to the residencies based on consensus, and the district maintenance engineer is the final authority on all decisions made by the group.

Area Headquarters

Each residency is subdivided into several “area headquarters.” There are currently 244 area headquarters statewide. A superintendent, who reports to the residency operations manager and oversees a fiscal assistant and a crew supervisor,

staffs each area headquarters. The supervisor is in charge of the road crews that provide most of the actual road maintenance done by State forces, such as routine bridge maintenance, snow removal, filling potholes, mowing, and ditch cleaning. Staff at the districts and residencies provide oversight and support to the areas, including management of the budgeting, planning, and resource allocation processes. Exhibit 2 provides an overview of position functions.

Exhibit 2

VDOT Maintenance Field Positions and General Descriptions

Position	Description
State Maintenance Engineer	Responsible for the maintenance division within the central office and the maintenance and operations activities performed in the field.
District Maintenance Engineer	Works with the residencies to prioritize needs, allocate resources, and evaluate program effectiveness.
Residency Transportation Operations Manager	Responsible for directing all maintenance and State force construction within the residency in conjunction with the maintenance area superintendents.
Area Headquarters Superintendent	Responsible for actual roadway maintenance, development and implementation of operational plans, and evaluation of results.
Crew Member	Provides actual maintenance function such as repairing shoulders, bridge repair, or snow removal.

Note: Positions reflect most recent titles.

Source: 1994 VDOT *Maintenance Policy Manual*.

VDOT'S FUNDING AND STAFFING LEVELS

Appropriations for maintenance of the State's interstate, primary, secondary, and urban roads have increased substantially over the last decade, and will amount to more than $1 billion in FY 2002. Expenditures for highway maintenance have also increased since FY 1991, although at a less consistent rate than appropriations.

VDOT provides maintenance either directly or through the use of contracts for almost all of Virginia's roads except for urban streets and the secondary roads in Arlington and Henrico counties. For the roads in the urban system and the two counties, VDOT makes payments to cover maintenance costs based on lane mileage. In order to carry out its maintenance functions on the interstate,

primary, and secondary roads, VDOT currently has approximately 6,100 filled maintenance positions in its central office and nine districts. Overall, the number of filled maintenance positions has increased by seven percent since the beginning of FY 1998. Between FY 1992 and FY 2001, contracts accounted for approximately 45 percent of VDOT's maintenance expenditures.

Funding for Highway Maintenance

Funding for VDOT's major areas of maintenance is provided through the Highway Maintenance and Operating Fund (HMOF). The great majority of this funding is made for direct highway maintenance and financial assistance to localities. Since FY 1992, there have been significant increases in both appropriations and expenditures for maintenance activities, including an increase of more than 14 percent between FY 1998 and FY 1999. Despite past increases in expenditures, the department currently projects that there will be no increase in the allocations to the highway maintenance program between FY 2004 and FY 2007.

Maintenance Activities Are Funded Through the Highway Maintenance and Operating Fund. In 1977, the General Assembly passed §33.1-23.1 of the *Code of Virginia*, providing that funding for the maintenance of the State's highways and roads would be the department's first priority. At the time, funding was provided for both maintenance and construction from the Highway Maintenance and Construction Fund. During the 1986 Special Session, the two functions were separated when the General Assembly created the Transportation Trust Fund (TTF) for construction by establishing new revenue sources, primarily from increases in existing taxes and fees.

Revenues that had been available prior to the creation of the TTF now fund the renamed HMOF for maintenance activities. These funds are comprised of several portions of revenue sources, including: fuel taxes, motor vehicle sales and use taxes, and taxes on motor vehicle licenses. The HMOF funds the eight functional areas shown in Exhibit 3. For FY 2002, revenues from the HMOF available

Exhibit 3

Functional Areas Receiving Funding from the Highway Maintenance and Operating Fund, FY 2002

- Highway System Maintenance
- Financial Assistance to Localities for Ground Transportation
- Ground Transportation System Safety
- Land Management
- Administrative and Support Services
- Ground Transportation System Planning and Research
- Ground Transportation Regulation
- Support to Other State Agencies

Source: VDOT FY 2002 Annual Budget.

for allocation to these areas were projected to be about $1.3 billion. Highway system maintenance and assistance to localities have traditionally received a significant portion of the HMOF, about 86 percent in FY 2002, for example.

Appropriations Fund Direct Highway Maintenance and Financial Assistance to Localities. Within the general appropriations for highway system maintenance and financial assistance to localities for ground transportation are appropriations designated for interstate, primary, and secondary maintenance, in addition to financial assistance to cities and counties. As Table 1 reflects, since FY 1993, appropriations for these two functions have accounted for approximately 40 percent of all VDOT appropriations. Between the two, highway systems maintenance has received a much larger share.

Payments to the cities and counties of Arlington and Henrico for local street maintenance are codified under §33.1-44.1 and §33.1-23.5.1 of the *Code of Virginia*, respectively. The State makes these payments based on moving lane miles for principal / minor arterials and collector / local roads within the cities and incorporated towns with more than 3,500 inhabitants, and lane miles of secondary roads within Arlington and Henrico. For FY 2002, the rate for arterials was $12,958 per mile and $7,608 per mile for local roads. Funding for maintenance of secondary roads within Arlington and Henrico amounted to $11,982 and $6,017 per lane mile, respectively, in FY 2002. These payments are annually adjusted by the department using a maintenance cost index. VDOT's role with respect to the funding for localities is limited primarily to administration and oversight of those funds.

Table 1

Maintenance Funding as a Percentage of Overall Department of Transportation Funding

Fiscal Year	Total Appropriations for VDOT	Appropriations for Highway System Maintenance	Percentage of Total Appropriations	Appropriations for Financial Assistance to Localities	Percentage of Total Appropriations
1993	$ 1,758,962,689	$ 515,437,700	29.3 %	$ 155,906,800	8.8 %
1994	$ 1,861,317,362	$ 536,473,700	28.8	$ 168,509,800	9.0
1995	$ 1,907,551,926	$ 583,720,600	30.6	$ 179,197,700	9.4
1996	$ 1,877,339,596	$ 606,790,225	32.3	$ 199,158,600	10.6
1997	$ 1,895,631,765	$ 634,972,755	33.5	$ 192,856,200	10.2
1998	$ 2,048,342,422	$ 641,381,055	31.3	$ 201,371,300	9.8
1999	$ 2,480,446,268	$ 754,738,300	30.4	$ 202,675,900	8.2
2000	$ 2,400,872,347	$ 768,626,200	32.0	$ 207,496,800	8.6
2001	$ 2,840,679,100	$ 821,362,500	28.9	$ 215,604,500	7.6
2002	$ 2,669,949,200	$ 847,939,000	31.8	$ 222,097,500	7.8

Note: Figures in table presented in real dollars.

Source: Appropriations Acts.

Funding and Spending for Maintenance Has Increased Significantly. The General Assembly appropriated more than $1.03 billion and $1.07 billion for VDOT highway system maintenance and financial assistance to localities for FY 2001 and FY2002, respectively. As Table 1 indicates, appropriations for highway systems maintenance and financial assistance to localities have increased by approximately 59 percent since FY 1993. In general, these appropriations grew at a steady rate of more than five percent compounded annually during the ten-year period. However, an increase of 14 percent occurred between FY 1998 and FY 1999, driven almost entirely by additional funding for the highway maintenance system.

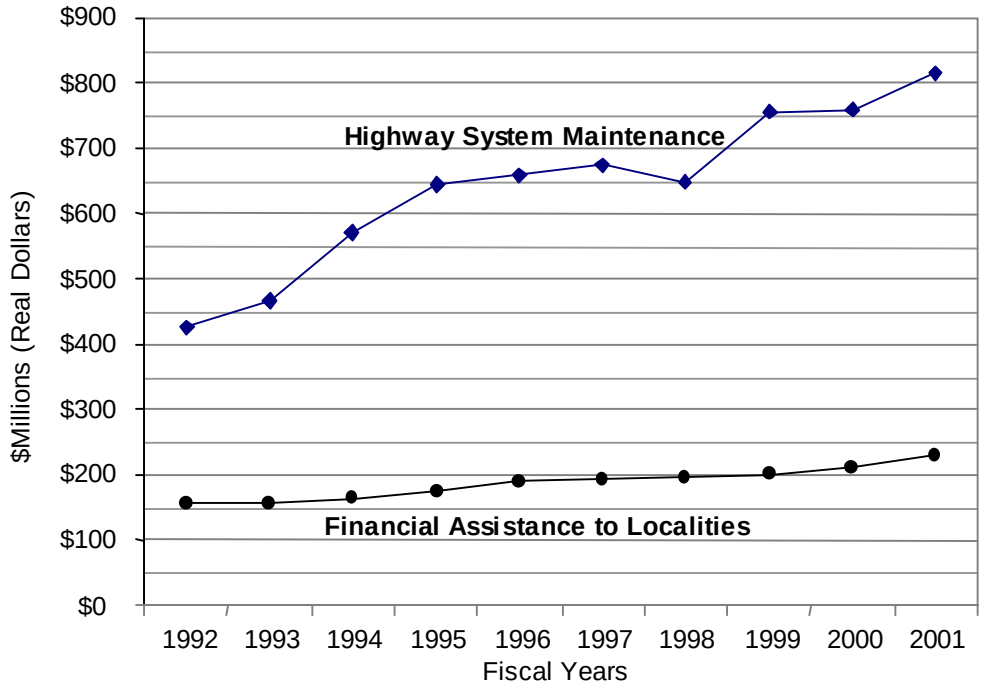
Appropriations for maintenance of the interstate, primary, and secondary systems have increased by more than $320 million, or 65 percent, since FY 1993. Financial assistance to cities and counties increased by almost 42 percent during that time. This assistance to cities and counties amounted to more than $220 million for FY 2002.

Expenditures for Highway Maintenance

Between FY 1992 and FY 2001, expenditures for highway systems maintenance and financial assistance to localities have increased by 92 percent and 48 percent, respectively. As Figure 3 shows, expenditures on highway maintenance

Figure 3

Expenditures for Highway System Maintenance and Financial Assistance to Localities, FY 1992 – FY 2001



Source: VDOT.

have increased by more than $390 million since FY 1992. Over the ten-year period, spending grew at roughly six percent, per year. However, the period was marked by large fluctuations in annual expenditures. For example, between FY 1997 and FY 1998 there was a decrease of about four percent, followed by a 14 percent increase in spending between FY 1998 and FY 1999.

Since 1991, the amount of mileage in the urban system has increased by approximately seven percent. At the same time, maintenance payments made to cities and towns increased by almost four percent compounded annually. Similarly, the total road mileage maintained by both Arlington and Henrico increased by approximately seven percent, while payments for maintenance also increased by seven percent, compounded annually, between FY 1992 and FY 2001.

Projected Maintenance Allocation Indicates No Increase in Funding. Projected annual highway systems maintenance allocations by VDOT reflect no increase in maintenance funding for FY 2004 through FY 2007. The plan indicates that maintenance costs will actually decrease by 1.9 percent from FY 2002 to FY 2003, increase by about one percent in FY 2004 and then remain at the FY 2004 level of $861 million for the next three years. The Secretary of Transportation has stated in the past that projecting maintenance allocations beyond two years is not realistic. It should be noted, however, that prior to FY 2001 the department did estimate future expenses and these estimates were generally accurate. The effect of not estimating future maintenance costs is that the amount available for construction is unrealistically inflated.

In addition, the Secretary has also said the department plans on building "new maintenance numbers" that would likely reflect an asset management approach to maintenance. However, it is not clear how this new approach will impact maintenance funding needs.

Staffing of VDOT Maintenance and Operations

As of July 2001, VDOT had more than 6,000 maintenance and operations positions distributed among the central office, nine district offices, 45 residencies, and 244 area headquarters. This represents an increase of almost seven percent since July 1997. Although the number of filled positions has been growing, the department continues to contract a significant portion of its maintenance work.

Most Maintenance and Operations Positions Are Distributed in Districts. As mentioned previously, there were 6,113 filled positions in the maintenance program as of July 2001, of which the vast majority were located in the field. In fact, slightly more than 97 percent of all maintenance program positions were distributed throughout the districts. These positions include, among others: district maintenance engineers, transportation operations managers at the residencies, area headquarters superintendents, and crew members. Additionally, staff for the equipment, structures and bridge, traffic engineering, and environmental sections are located in each district.

There were 231 authorized positions (of which 209 were filled) for the maintenance program in the central office as of July 2001, including the State maintenance engineer, who is responsible for all facets of the program. Approximately 30 percent of those positions were in the maintenance division. The traffic engineering division had the majority of unfilled positions (16 percent) compared with the maintenance division (five percent) and the equipment division (two percent).

Filled Positions for Maintenance Have Increased by Seven Percent. As Table 2 indicates, since July 1997, the overall number of filled positions related to maintenance for interstate, primary, and secondary roads has increased by almost 16 percent. Also shown in Table 2, between July 1997 and July 2001, the fill rate for these positions has been almost 97 percent. Increases in the number of filled field positions account for the majority of the increase. In early fiscal year 2001, the truck weighing function was transferred to the Department of Motor Vehicles resulting in the reduction of approximately 125 positions from the maintenance division.

Table 2

VDOT Maximum Employment Levels and Filled Positions for Maintenance, FY 1997 – FY 2001

	Central Office Totals		District Totals		Overall Totals	
	MEL	Filled	MEL	Filled	MEL	Filled
July 1, 1997	369	338	5,238	4,939	5,607	5,277
July 1, 1998	354	336	5,160	5,002	5,514	5,338
July 1, 1999	366	340	5,252	5,021	5,618	5,361
July 1, 2000	357	329	5,900	5,712	6,257	6,041
July 1, 2001	231	209	5,911	5,904	6,142	6,113
Five-Year Average	335.4	310.4	5,492.2	5,315.6	5,827.6	5,626.0

Note: Figures as of beginning of each fiscal year. Salaried positions only.
Source: VDOT maintenance program.

Recently, VDOT has allowed the use of floating positions to address critical needs within a program. According to the State maintenance engineer, floating positions allow for one program to borrow unfilled positions from another program, after VDOT management approval, to address a critical need. Instead of each program being locked into a certain maximum employment level regardless of need, this strategy allows VDOT to use its statewide maximum employment level to address specific program needs. It appears that more than 270 floating positions have been distributed to the maintenance division and field offices for FY 2002.

VDOT Contracts for Maintenance Work Extensively. Despite a decrease in FY 2000, the department contracts for a significant amount of its maintenance work. For example, from 1994 through 1998 the department made a commitment to outsourcing a greater portion of its maintenance work. As a result, contracts accounted for almost 50 percent of maintenance expenditures between FY

1994 and FY 1997. As Table 3 reflects, based on total expenditures, the department has contracted more than 40 percent of its work annually from FY 1992 through FY 2001. The department contracts a great deal of its ordinary maintenance functions including: mowing, litter pick-up, and ditch cleaning. In addition, VDOT field staff have stated that all of the annual overlay paving work is contracted.

Table 3

VDOT Maintenance Activities Contracted as a Percentage of All Maintenance Expenditures, FY 1992 – FY 2001

Fiscal Year	Total Contract Expenditures (Real Dollars)	Contract Expenditures as a Percentage of Total Maintenance Expenditures
1992	$169,211,651	39.2
1993	$192,335,333	40.2
1994	$247,232,961	43.1
1995	$335,951,699	52.7
1996	$329,477,531	49.7
1997	$363,896,937	53.6
1998	$350,275,882	52.3
1999	$369,241,484	49.6
2000	$324,466,487	41.9
2001	$401,333,607	48.0

Note: Percentages have been rounded.
Source: VDOT maintenance program.

Overlay work accounts for approximately 25 percent of a district's total allocation and receives funding priority over all ordinary maintenance activities. However, contracting has not been used to reduce the size of the department's maintenance staff. In light of the percentages identified in Table 3, and the increases in the number of VDOT maintenance positions, the department has been using contracted work to support State forces. By contracting all maintenance activities for specific sections of Virginia's interstate system in 1995, the department stated that it would be able to reallocate those State positions to provide greater maintenance on the other road systems. Moreover, this contract was designed to provide asset management techniques on these highways.

ASSESSING STATEWIDE HIGHWAY MAINTENANCE NEEDS

As previously discussed, the *Code of Virginia* prioritizes the funding of State highway maintenance activities above all other transportation functions. However, the specific amount to be provided for maintenance is not defined. In order to determine what level of funding to provide for highway maintenance, the department must develop some measure of maintenance need. In the past, this evaluation has

been based almost exclusively on historical data and funding trends, as well as the recommendations of the field staff at the area headquarters and residencies. Much of the data used is not kept electronically, although the department uses data collected from its automated pavement and bridge management systems in developing its list of maintenance needs.

Currently, the department has in place a process through which it annually evaluates maintenance needs. This process is usually initiated by the area headquarters superintendents. Through this process, the area maintenance superintendent first performs an individual assessment of area maintenance needs based on a visual inspection of the roadway surfaces, structures, and drainage items. A review of the previous years' needs is also conducted to determine which of those needs have been met and which remain to be addressed. The area superintendent then reports to the residency a list of needs for that area. The residency operations managers then compile and prioritize all lists of needed improvements based on an analysis of automated pavement system maintained independently of the maintenance program, as well as a physical review of the assets identified by the superintendent as being deficient. Bridge needs are identified and scheduled at the district level using the automated bridge management system.

The department, however, is currently trying to replace this largely subjective assessment with the more objective and analytical system of asset management. Asset management is an approach to maintaining, upgrading, and operating physical assets through cost-effective planning and resource allocation decisions. Exhibit 4 provides two examples of asset management definitions applicable to state highway maintenance programs.

Exhibit 4

Selected Asset Management Definitions

"…a comprehensive and structured approach to the long-term management of assets as tools for the efficient and effective delivery of community benefits."

-- Strategy for Improving Asset Management Practice, AUSTROADS, 1997.

"Asset Management…goes beyond the traditional management practice of examining singular systems within the road networks, i.e., pavements, bridges, etc., and looks at the universal system of a network of roads and all of its components to allow comprehensive management of limited resources. Through proper asset management, governments can improve program and infrastructure quality, increase information accessibility and use, enhance and sharpen decision-making, make more effective investments and decrease overall costs, including the social and economic impacts of road crashes."

-- Organization for European Cooperation and Development Working Group, Asset Management Systems, Project Description, 1999.

The primary benefit of an asset management system is the prioritization of maintenance activities based on objective information about the condition and performance of highway assets. This approach to maintenance provides a groundwork for monitoring the condition of the existing transportation system, as well as optimizing the preservation, improvement, and replacement of highway assets through cost effective performance management and cost allocation. In addition, decision-makers can set performance goals and methods to achieve those goals based on various alternatives set forth by the new system of managing highway maintenance. Asset management does not, however, replace the actual manner in which maintenance work is performed.

In recent years, an increasing number of state departments of transportation have contracted highway maintenance activities based on asset management principles. VDOT has considered formalizing an asset management program since the early 1980s, when it conducted a statewide inventory of road assets. Unfortunately, the information collected could not be efficiently or effectively maintained or used over a long period of time due to limited technology and antiquated methods of recording information.

JLARC REVIEW

In November 2000, the Joint Legislative Audit and Review Commission directed its staff to examine the adequacy and efficiency of the highway maintenance program provided by VDOT. The scope and focus of the study on highway maintenance was developed by the Commission's topic selection subcommittee. The Commission directed staff to address five issues:

1. Does VDOT demonstrate that maintenance is the first priority for funding as required by §33.1-23.1 of the *Code of Virginia*?

2. Does VDOT's organizational and management structure support the highway maintenance program?

3. Are staffing, equipment, materials, and other resources adequate to properly maintain all highway assets?

4. Does VDOT have appropriate processes to measure and evaluate the quality of its maintenance work on State highways?

5. Does VDOT use an appropriate mix of State forces and private contractors for highway maintenance? Could asset management be expanded beyond the interstate system and be used effectively statewide?

To address these issues, JLARC staff also examined:

- the current conditions of the highway assets being maintained by VDOT, including analyses of bridge and pavement data,

- whether the funding needs of the State's highway maintenance program are being adequately addressed, and

- an examination of VDOT's transition to asset management along with ways in which the management of the highway maintenance program can be improved.

The study mandate required that the study be completed and submitted prior to the 2002 Session of the General Assembly.

Research Activities

Several research activities were undertaken to address the study issues. These activities included: structured interviews with VDOT, local governments, and transportation industry staff, site visits to field offices and facilities, electronic mail surveys of residency maintenance engineers and statewide local government transportation offices, document reviews, and reviews of selected other states' maintenance programs.

Structured Interviews. Structured interviews were conducted with staff from VDOT's central office; the nine district offices; selected residency and area offices; local governments and other governmental entities; and private transportation industry contractors.

JLARC staff conducted interviews with the Secretary of Transportation and VDOT central office staff, including: the assistant commissioner for operations, the State maintenance engineer, the maintenance contract manager, the director of maintenance finances, VDOT's chief information officer, the financial planning and debt management division administrator, the Pavement Management Program (PMP) director, the Integrated Maintenance Management Program (IMMP) director, the Inventory Condition and Assessment System (ICAS) director, the State structure and bridge engineer, the assistant State structure and bridge engineer, the State traffic engineer, the State equipment engineer, and the director of intelligent transportation systems. These interviews primarily focused on the larger organizational issues related to funding, development of asset management and IMMP, and organizational structure.

JLARC staff conducted interviews with staff in all nine district offices, including: nine district maintenance engineers, three district maintenance assistants, one district traffic engineer, two district equipment managers, and two tunnel engineers. These interviews examined broader themes such as funding, staffing, the quality of roads and other highway assets, asset management, and the relationships between different organizational units. In addition, JLARC staff attended all monthly MPLG meetings between February and August of 2001.

JLARC staff conducted interviews with staff from selected residency and area headquarters offices, including: four resident engineers, 12 residency maintenance operations managers, and four area superintendents. JLARC staff based the

selection of interviews on geographic location and program responsibilities. These interviews, which focused on methods of determining highway maintenance needs, the adequacy of funding and staffing provided to meet those needs, and the effectiveness of the organizational structure, were critical for assessing the quality of the statewide maintenance program at the field level.

JLARC staff also conducted interviews with transportation officials from FHWA and local governments, including: the cities of Richmond and Virginia Beach, and the counties of Arlington, Chesterfield, Fairfax, Henrico, and Prince William. Interviews with these officials focused on road quality and performance measures, the adequacy of the VDOT oversight and payments, and experiences with different types of privatization.

Finally, JLARC staff conducted interviews with private transportation industry contractors, including officials from the URS Corporation, the Virginia Road and Transportation Builders Association, and VMS, Inc. These interviews focused mainly on the sufficiency of contractor supply, the actual performance of maintenance activities, and the use of asset management.

Site Visits. JLARC staff conducted site visits to approximately 25 VDOT facilities, including facilities at the district, residency, and area levels, as well as an underwater tunnel and a mountain tunnel. JLARC staff used the site visits to examine the operations and physical conditions of the various types of facilities and equipment. In addition, the team traveled with several maintenance managers to observe road quality and deficiencies. Photographs were also taken to illustrate asset, equipment, and facility conditions.

Electronic Mail Surveys. JLARC staff administered two email surveys. The surveys were sent to: (1) all VDOT residency maintenance managers, and (2) all cities and towns receiving maintenance payments from the State.

JLARC staff conducted an email survey of all 50 VDOT residency operation managers. The overall response rate for this survey was 100 percent. The survey consisted of six sections, and asked questions regarding funding and allocations, staffing and workload measures, residency maintenance operations, program automation, organization and management, and locality maintenance oversight and payments.

JLARC staff also conducted an email survey of all cities and towns currently receiving maintenance payments from VDOT. The 79 recipients of this survey included 39 independent cities and 40 towns with a population of more than 3,500. The overall response rate for this survey was 62 percent, with 67 percent of cities responding and 56 percent of towns. The survey consisted of four parts and asked questions regarding payments received from VDOT, local expenditures, maintenance activities conducted by localities, and the highway maintenance laws and regulations.

Data Analysis. JLARC staff analyzed condition assessment data for more than 11,000 directional miles of interstate and primary roads. These condi-

tions were determined by VDOT using a windshield survey methodology for 2000. The sample of asphalt pavements chosen by VDOT represents 93 percent of all directional miles in those two systems. Concrete pavements, which constitute a small percentage of the sample, were not analyzed. Similar analyses were performed on almost 12,000 bridges using data provided by VDOT. These analyses considered general condition ratings for decks, superstructure, and substructure bridge elements. The ages of the State's bridges were also considered, but not as a measure of maintenance need.

Document Reviews. JLARC staff reviewed or analyzed a number of documents in conducting this study. Documents reviewed include reports produced for VDOT, by the MPLG, the ICAS program, the pavement and bridge sections, and the Federal Highway Administration (FHWA). In addition, the team conducted reviews of the Governor's Commission on Transportation Policy, recent VDOT capital outlay requests, and biennial budget requests for FY 1994-1996 through FY 2000-2002. Dr. David Hartgen, of the University of North Carolina at Charlotte, provided assistance in the development of a methodology for assessing pavement and bridge repair costs. Moreover, applicable JLARC reports that addressed issues evaluated in this study were reviewed. Finally, several provisions of the *Code of Virginia* were identified and reviewed.

Other States' Information. JLARC staff also conducted a telephone survey of the maintenance programs in seven other states, on management, funding, and the use of asset management. These states included: North Carolina, South Carolina, West Virginia, Florida, Texas, Maryland, and New Jersey.

Report Organization

This chapter has provided an overview of VDOT's highway maintenance program and how JLARC staff conducted this study. Chapter II considers the current conditions of highway assets in Virginia, particularly with regard to pavements and bridges. Chapter III discusses the process of allocating maintenance funds and identifying maintenance needs, along with a more detailed examination of VDOT's oversight to localities and overall adequacy of funding. Finally, Chapter IV explores the management of the highway maintenance program in terms of implementing asset management and effectively using other resources to adequately address maintenance activities.

II. The Current Condition of Virginia's Highway Assets

Overall, Virginia's interstate and primary pavements are considered to be in generally good condition, with more than 80 percent of these pavements classified in "fair" or better condition for 2000. However, JLARC staff analysis of VDOT maintained bridges indicates that more than 40 percent are in need of varying degrees of repair or rehabilitation. Several trends are evident in concentrations of deficient pavements and bridges needing repair across the State. One such trend identified for interstate and primary system pavements is that urban areas in the Richmond, Hampton Roads, and Northern Virginia districts have the highest concentration of pavements considered to be deficient. Concentrations of VDOT maintained bridges requiring some maintenance activity occur in the more rural areas of the State, such as the Bristol and Staunton districts. Of further concern, VDOT maintains very little systematic information concerning the condition of pavements on the secondary system, which comprises more than 70 percent of Virginia's highway systems.

While there are a number of automated systems designed to provide condition assessment information for both pavements and bridges, it appears that VDOT has not focused appropriate attention on the integration of a system for coordinating the data available to address maintenance needs from a statewide perspective. Furthermore, while the development of these systems has resulted in a substantial amount of pavement and bridge condition information, only the bridge management system is capable of providing information concerning the cost to repair or maintain these structures. Moreover, the attention that has been focused on pavement and bridge assets has not addressed other roadside assets such as drainage, ditches, and pipes.

MAJORITY OF VIRGINIA'S INTERSTATE AND PRIMARY PAVEMENTS ARE IN GOOD CONDITION

VDOT operates an automated pavement management system to evaluate the conditions of pavements on the interstate and primary systems. The Virginia Pavement Management Program (PMP) provides a numeric rating of pavement conditions based on an objective assessment of digitally recorded pavement condition data. JLARC staff analysis of pavement condition data for these two highway systems indicates that approximately 80 percent of the road surfaces included in the 2000 pavement condition survey are considered to be in "fair" or better condition. The remaining 20 percent of Virginia's interstate and primary pavements are considered to be deficient and would be candidates for rehabilitative maintenance activities. Although pavement conditions vary across Virginia, this analysis also indicates deficient pavements are concentrated around urban areas.

Virginia has been a leader in the development of a pavement rating system. However several conditions limit the effectiveness of the current assessment process. First, there has been no continuity in the type of pavement condition data collected, and VDOT is not currently adding digitally recorded data to the PMP. Instead, VDOT is using a more subjective windshield survey technique, which is a visual evaluation of pavement conditions conducted by a team of district pavement management engineers physically traveling the pavement surfaces. Second, VDOT does not actively collect this information for roads on the secondary system, which comprise the majority of the State-maintained system. Finally, VDOT has not sought to fully utilize the capabilities of the PMP for various reasons. For example, delays in contracted data collection have impeded VDOT's ability to use the data in a way congruent with asset management practices.

Virginia's Pavement Management Program

VDOT currently uses an automated pavement management system to standardize condition assessment ratings for pavements on the interstate and primary systems. These assessments are, in turn, used by staff in the districts to assist in the planning of pavement maintenance activities and in the development of annual pavement overlay schedules. VDOT has been in the process of developing the PMP since a visual pavement rating system was first applied to the interstate system in 1981.

In the mid-1980s, VDOT developed a pavement condition index describing pavement surface distresses detected through windshield surveys, called the Distress Maintenance Rating (DMR). VDOT pavement engineers were able to apply the DMR and windshield surveys to establish priority listings for certain overlays and to allocate funds for those overlays. Beginning in 1995, VDOT began to collect pavement distress data through the use of videotaped images. While the automated collection of pavement data has been ongoing since 1995, the current pavement condition indices used by VDOT were not developed until 1998.

The intended product of the PMP is the provision of pavement information designed to assist in the determination of overall pavement maintenance funding needs as well as in the scheduling of day-to-day pavement maintenance activities. According to the State pavement management engineer, the PMP is expected to be fully operational for all road systems in 2003.

Currently, the PMP is established within the maintenance division as part of the Integrated Maintenance Management Program (IMMP). The State pavement management engineer is responsible for the statewide collection and reporting of pavement condition data. Each of the nine district pavement management engineers is responsible for coordinating pavement maintenance activities in their district, as well as collecting district data for the PMP.

Pavement Condition Indices

VDOT has identified three major causes of pavement distress leading to most maintenance and rehabilitation decisions. These are: cracking and other surface distress related to loads on the pavement surface, cracking and other surface distress related to environmental effects on pavement surfaces, and the general roughness of the pavement surface. Load related distresses typically occur in the vehicle wheel path area of the pavement, while distresses relating to environmental factors may occur anywhere on the pavement surface. Additionally, pavement smoothness measures are generally calculated for the wheel path area of a pavement section. Furthermore, these indices can be treated as measures of pavement performance, and can be used to identify road sections in need of rehabilitative maintenance, prioritize pavement sections selected for maintenance, predict future pavement performance, or serve as a basis for measuring the cost-effectiveness of pavement repairs.

Two condition indices have been developed by VDOT to measure the presence of these conditions: load related distresses (LDR), comprised of pavement distresses considered to be primarily related to vehicle load and traffic volumes, and non-load related distresses (NDR), comprised of distresses considered to be primarily related to the effects of local climate, sub-surface materials, or initial construction deficiencies. As part of its analysis of pavement conditions, VDOT developed a third index, the critical condition index (CCI), which simply uses the lower of the two distress ratings to assess the general pavement condition. A fourth pavement condition index, the international roughness index (IRI), was developed by the Federal Highway Administration (FHWA) to describe the relative degree of driver comfort with the roadway, and VDOT is required to annually report IRI information to FHWA for all roads in the National Highway System. Exhibit 5 outlines the contributing factors and uses of each of these indices.

According to the State pavement management engineer, the LDR, NDR, and CCI indices were designed to use a 0 – 100 scale, where a value of "0" indicates a very poor pavement section, and a value of "100" indicates a pavement section in perfect condition. Pavement sections are evaluated with a base score of 100 and points are deducted based on the occurrence and frequency of specific pavement conditions, such as cracking or rutting.

Load Distress Ratings. Pavement load-related distress measures are an indication of pavement condition damage due to wheel loads applied to the pavement surface. A pavement with an LDR of 100 has no discernable load related distress. In order to calculate the LDR for a specific section of pavement, VDOT pavement engineers deduct points from the base measure for conditions such as alligator cracking, rutting, and patching. Unless a pavement is significantly under-designed for the loads it carries, the LDR will decrease very slowly for a fairly long period of time (usually 40 to 50 percent of the pavement's life), and then will begin to decline rapidly as the pavement becomes fatigued. Figure 4 (page 25) illustrates common pavement conditions related to load distresses.

Exhibit 5

Pavement Condition Indices

Index	Description	Relative Measure	Conditions	Recommended Treatments
LDR	Load-Related Distress Ratings	Related to traffic volume and traffic type.	Alligator Cracking, Longitudinal Cracking in Wheel Paths, Potholes, Delamination, Patching, Rutting.	Structural Overlay.
NDR	Non-Load Related Distress Ratings	Related to climate, materials, subsurface or construction deficiency.	Block Cracking, Patching, Longitudinal Cracking outside the Wheel Path, Transverse Cracking, Reflection Cracking.	Slurry Seal, Chip Seal, Thin Overlay.
CCI	Critical Condition Index	Overall evaluation of a pavement section.	Lower value of either LDR or NDR.	N/A
IRI	International Roughness Index	Measure of pavement smoothness.	Digital pavement measure of total inches of roughness per mile.	N/A

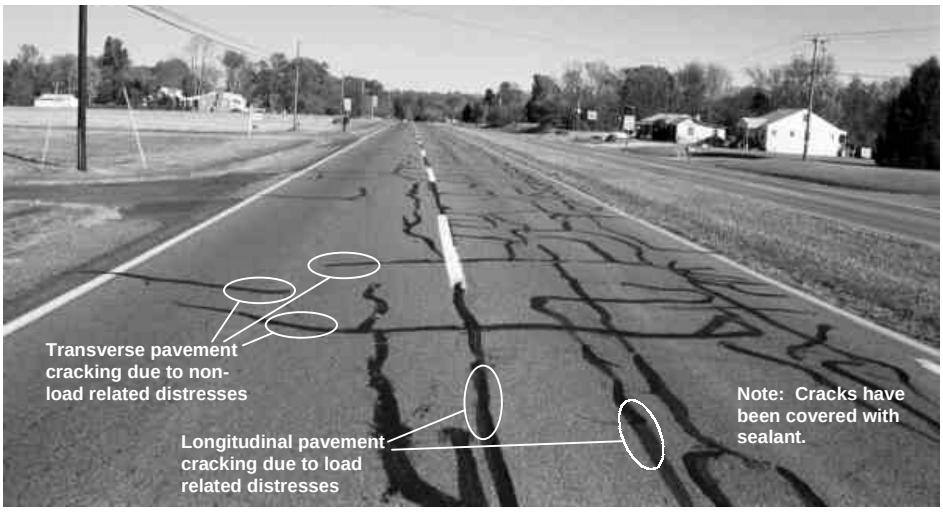
Source: JLARC review of VDOT pavement section materials.

Ideally, major maintenance, such as a structural overlay, would be applied just before the rapid decline in LDR begins. A pavement that is underdesigned or one that experiences a sudden significant increase in vehicle weights or volumes may be subject to rapid decline in LDR. In the event of a very rapid change in LDR, a thorough analysis of the pavement, such as a core sample or traffic analysis, is required to identify the root cause of the pavement distress and assess the appropriate maintenance activity.

Non-Load Distress Ratings. Non-load related distresses can occur anywhere on the pavement surface and are related to temperature and moisture changes in the pavement over time, or to other climate related issues such as oxidation of asphalt concrete. NDR values are calculated by deducting points for transverse or reflection cracks and the extent of patching. Non-load related distresses typically do not affect the whole pavement structure and are much more likely to be treatable by less drastic and expensive actions than load related distresses. Slurry seals, chip seals, and very thin overlays often will work well on non-load related distresses. Composite pavements, however, may require thick overlays, milling and replacement, or even reconstruction to overcome wide reflection cracking. Figure 4 illustrates common pavement conditions related to non-load distresses.

Figure 4

Examples of Pavement Conditions



Source: JLARC staff photos.

Critical Condition Index. VDOT applies a conversion factor to the LDR and NDR ratings using degrees of pavement distress on a 0 to 100 scale and converts these to a single critical condition index (CCI) which is used to establish a pavement condition classification ranging from excellent to very poor. The CCI is simply the lowest value of either the LDR or NDR rating. According to the State pavement management engineer, the CCI is primarily used to identify pavement sections considered to be deficient. According to a senior pavement engineer, when identifying deficient pavement sections, the standard definition of a deficient pavement section is any pavement section with a CCI rating less than 60.

A pavement with a CCI rating between 50 and 59 is considered in poor condition and would typically require repair within two to three years. A pavement with a CCI rating of 49 or less is considered to be in very poor condition and would likely be placed on the following year's paving schedule. Exhibit 6 defines the categories of distress ratings used in the 2000 pavement condition survey.

Exhibit 6

VDOT 2000 Critical Condition Index

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

Source: VDOT 2000 Windshield Data Collection Summary.

International Roughness Index. Finally, the IRI is a measure of overall pavement smoothness that VDOT is required to report to FHWA for all roads in the National Highway System. The IRI is produced using an instrumented research vehicle to measure road surface roughness in inches of vertical deviation per mile of road. Smaller IRI values represent a smoother pavement surface.

Different Standards for Reporting Mileage. When assessing the condition of the existing pavement sections, there are three distinct ways of communicating pavement mileage: centerline miles, directional miles, and lane miles. Centerline miles measure the total length of both directions of a roadway regardless of the number of lanes or the direction of travel. Directional miles measure the total lane mileage of the farthest right hand lane of each direction of travel. Lane miles, on the other hand, are measured for all travel lanes in each direction. For example,

considering a section of Interstate 95 between mile points 45.0 and 46.0 with three lanes in each Northbound and Southbound direction, there would be: one centerline mile, two directional miles (one mile Northbound and one mile Southbound), or six lane miles (three lane miles Northbound and three lane miles Southbound). Table 4 compares the total reported mileage for all State maintained systems using all three measures. Because payments to localities generated through the MCI are based on lane miles, VDOT does not track directional miles for roads located in the urban system.

Table 4

Virginia's Highway Mileage, 2000

System	Centerline Mileage	Directional Mileage	Lane Mileage[1]
Interstate	1,118	2,274	5,299
Primary	8,012	10,374	21,325
Secondary & Frontage	47,582	48,204	95,742
Total	**56,712**	**60,852**	**122,366**

Note: For undivided primary and secondary pavements, VDOT calculates directional mileage for only the primary (Northbound or Eastbound) direction.

[1] Lane mileage reported is as of December 31, 1999.

Source: VDOT pavement section, traffic engineering section, and web site.

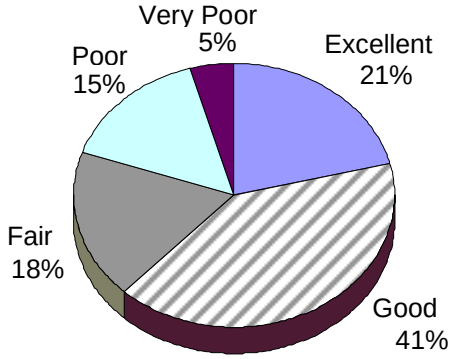
Approximately 80 Percent of Virginia's Pavements Are in Good Condition

Based on an analysis of pavement condition data collected for the interstate and primary systems, these pavements appear to be in good condition. Eighty percent of interstate and primary system pavements were rated as "fair" or better with 21 percent of these rated as "excellent." Only 20 percent of the pavement sections included in the 2000 pavement condition survey are considered deficient. Percentages of deficient pavements, however, vary across the State based on system type and location. The methodology used by JLARC staff for performing this analysis is included in Appendix A.

Statewide Interstate and Primary Pavement Conditions Are Good. As Figure 5 illustrates, 62 percent of the sample of Virginia's interstate and primary pavements are considered to be in "good" to "excellent" condition. Pavements in excellent condition will likely receive no maintenance activities, including routine preventive maintenance, for three to four years. According to VDOT staff, pavements

Figure 5

Overall Statewide Interstate and Primary Pavement Conditions, 2000



n = 11,161 Directional Miles

Source: JLARC staff analysis of VDOT 2000 pavement condition survey data.

rated as "fair" or "good" will ideally have some type of preventive work performed, such as a crack sealing treatment. Additionally, 18 percent of the pavements sampled are considered to be in "fair" condition and, while they are not in immediate need for rehabilitative maintenance, should be monitored to ensure that preventive maintenance activities are effective in sustaining the life of the pavement. Overall, 2,207 directional miles (20 percent) of the pavements sampled are considered to be in "poor" or "very poor" condition and should be recommended to the district maintenance engineers for inclusion on the next pavement overlay schedule. Maintenance of these pavements includes all routine preventive activities as well as substantial rehabilitative activities.

Further analysis of the data indicates that by system, 65 percent of Virginia's interstate pavements and 61 percent of primary pavements are in "good" or "excellent" condition. Additionally, 20 percent of both interstate and primary mileage sampled was rated "poor" or "very poor." As Table 5 illustrates, 364 directional miles of interstate system pavements and 1,842 directional miles of primary pavements are considered deficient within the State-maintained system.

Pavement Conditions Vary Across Districts. Pavement conditions vary across districts with an apparent concentration of deficient pavements in the urbanized districts of Richmond, Hampton Roads, and Northern Virginia. As compared to the statewide average, these districts have fewer directional miles of pavements considered to be in "good" or "excellent" condition, as well as a significant concentration of pavements considered to be in a deficient condition. Table 6 illustrates the total directional miles of pavement in the general conditions defined by the pavement section.

Distribution of pavement conditions across the nine maintenance districts indicates that, for the pavement sections included in the 2000 sample, the Lynch-

Table 5

Total Deficient Miles by System, 2000

System	Total Sample Miles	Total Deficient Mileage	Percent Deficient Mileage
Interstate	1,834	364	20%
Primary	9,328	1,842	20%
Total	11,161	2,207	20%

Note: All miles shown in directional miles. Total mileage reported for each system does not add to the total due to eight miles of unclassified pavements and rounding.

Source: JLARC staff analysis of VDOT 2000 pavement condition survey data.

Table 6

Cumulative Interstate and Primary Pavement Conditions by District, 2000
(Based on Miles of Pavement)

District	Excellent	Good	Fair	Poor	Very Poor	District Totals
Bristol	548	672	216	175	55	**1,666**
Salem	302	628	260	223	87	**1,500**
Lynchburg	411	590	156	125	12	**1,294**
Richmond	112	692	314	236	113	**1,467**
Hampton Roads	260	266	272	272	19	**1,090**
Fredericksburg	258	483	170	168	69	**1,149**
Culpeper	72	216	124	120	11	**543**
Staunton	320	736	317	188	66	**1,627**
Northern Virginia	73	265	226	192	76	**833**
Statewide Totals	**2,357**	**4,548**	**2,055**	**1,700**	**509**	**11,169**

Note: All miles shown in directional miles. Analysis does not include condition data gathered for five directional miles of concrete pavements. Figures may not sum to total due to rounding.

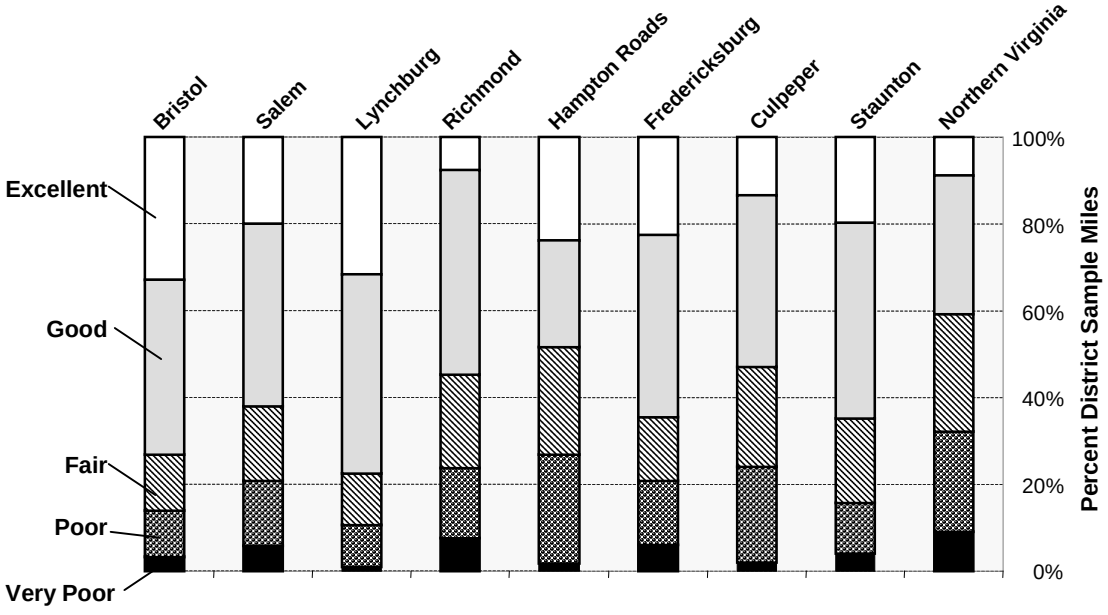
Source: JLARC staff analysis of VDOT 2000 pavement condition survey data.

burg (78 percent) and Bristol (73 percent) districts have the highest overall concentration of pavements considered to be in "good " to "excellent" condition. Figure 6 illustrates the distribution of Virginia's pavement conditions across the nine districts.

An analysis of the distribution of deficient pavements across the nine districts indicates that the Fredericksburg, Salem, and Staunton districts more closely followed the statewide average for overall pavement conditions. Deficient pavements in these districts mirrored statewide averages, with the Fredericksburg district having a slightly higher concentration of pavements considered in "good" or "excellent" condition.

Figure 6

Interstate and Primary Pavement Conditions by District, 2000



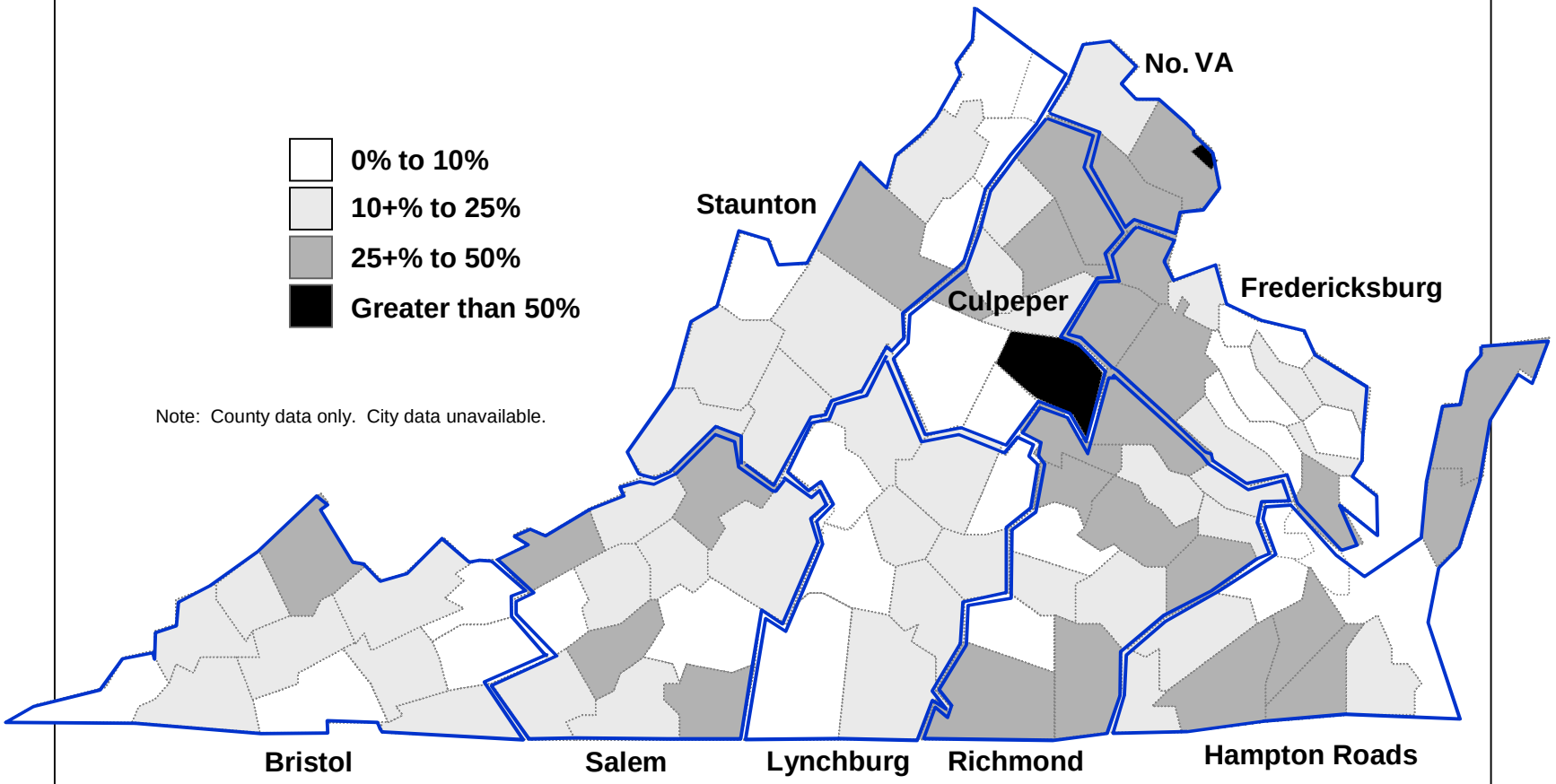
Source: JLARC staff survey of VDOT 2000 pavement condition survey data.

Conditions of Interstate and Primary Pavements Vary by County. Districts with large urbanized areas, such as Northern Virginia, Richmond, and Hampton Roads, appear to have higher rates of pavement deficiencies. While VDOT does not maintain pavement condition information for city streets in the urban system, concentrations of deficient pavements appear to occur along the I-95, I-81, and I-64 corridors. Figure 7 illustrates the overall concentrations of deficient pavements across the State. Total deficient mileage for Virginia's counties is contained in Appendix B.

Lack of Reliable Information for Secondary and Concrete Pavements. While pavement data collection for the interstate and primary systems have significantly evolved in the past 20 years, VDOT does not currently collect this in-

Figure 7

Percent Deficient Interstate and Primary Road Miles by County



Source: JLARC staff analysis of VDOT 2000 pavement condition survey data.

formation for roads on the secondary system, which comprises 71 percent of the State maintained road system. Expenditures and allocations for the secondary system also comprise a significant portion of the district maintenance budgets. The secondary system contains the bulk of the roads in each district and the majority of roads in most counties. Currently, only the Northern Virginia and Fredericksburg districts have begun to develop methods and data for some roads on the secondary system.

In addition, there are currently no measures for determining the condition of concrete pavement sections within the interstate and primary systems. According to a senior pavement engineer, Virginia has more than 620 directional miles of concrete pavements. As a result, the district maintenance engineers have the responsibility for assessing the conditions of these pavements as well as determining the appropriate maintenance activities. The Richmond and Hampton Roads districts each account for approximately 46 percent of the concrete pavements in Virginia, or a total of almost 93 percent of the statewide total. According to the Richmond district maintenance engineer, while the safety of concrete pavements is not a concern, the riding condition of these pavements is uncomfortable. Since there is no accepted measure of the condition of concrete pavements, these pavements were not included in this analysis.

VDOT Has Not Demonstrated a Commitment to the Completion of an Automated Pavement Management Program

While the pavement data collection process has experienced a significant number of changes in the types of information collected over the past 20 years, it appears that VDOT has not focused significant attention or resources towards developing, for all highway systems, a fully functional automated pavement management program capable of producing an estimate of the costs associated with necessary pavement maintenance activities. Exhibit 7 provides a brief timeline of the development of the pavement management program.

JLARC staff have identified two main concerns with the development of the pavement management program. First, concerns initially raised in the 1984 JLARC study regarding the use of a pavement management system in determining reasonable and appropriate levels of maintenance replacement work and funding on all highway systems have not been addressed. Secondly, the changing nature of VDOT pavement data requirements has resulted in inconsistent pavement data measures and recent pavement data collection contract failures have exacerbated this concern.

VDOT Has Not Addressed Concerns Raised in 1984 JLARC Study. As previously stated, VDOT's pavement management program has been in development for more than 20 years. While VDOT has made considerable advances in the development of an operational pavement management program during this time, concerns raised with this program in the 1984 JLARC study, "*Equity of the Current*

Exhibit 7

Evolution of Virginia's Pavement Management Program

Year	Condition Indices	Evaluation Criteria
mid-1980s – 1990	DMR	Visual "Windshield" Survey
1990 – 1993	PCI	Modified "Windshield" Survey
1994 – 1998	PQI / Pavetech / IRI	Automated Data Collection
1999	LDR / NDR / IRI	VDOT "Windshield" Survey
2000	LDR / NDR / CCI / IRI	VDOT Modified "Windshield" Survey

Source: VDOT Pavement Management Program.

Provisions for Allocating Highway and Transportation Funds in Virginia," have still not been addressed.

At the time of the initial study, the Appropriation Acts for FY 1983-1984 required that VDOT's maintenance replacement budget for the 1984-1986 biennium be based on an up-to-date pavement management system. The JLARC review found that VDOT was in the process of developing an automated pavement management system. However, because VDOT management had not prioritized this project, it would be several years before the system would be used in prioritizing allocations for all pavement systems.

This concern, raised in 1984, remains today. According to the State pavement management engineer, while VDOT does collect pavement condition information to aid in establishing the annual pavement overlay schedule for interstate and primary pavements, it will be at least two more years before the maintenance division will have a fully operational PMP that can be used in the allocation of maintenance funds across all systems. Therefore, the functional PMP will not directly impact overall pavement budget allocations until the FY 2004-2006 biennium at the earliest.

Current Data Collection Efforts Have Failed. As part of its automated pavement data collection process, VDOT contracted with a private firm for the collection of pavement condition data on the interstate and primary systems beginning in 1995. As part of the 1998 data collection process, a *Pavement Distress Rating Manual* was established in an effort to create detailed standards and specifications for the collection of pavement data. These standards were developed in an effort to provide more consistency across pavement data collection cycles and changing specifications. The requirements of the new manual were used as a specification for the data collection contract issued in 1998. The development of new condition indices in 1998 resulted in the collection of pavement condition data that was not

consistent with previous data, and thus, changes in pavement conditions could not be compared for the two time periods.

Moreover, as a result of delays and other issues with the pavement data collection, VDOT has not been able to add digital pavement condition data for the pavement condition dataset since 1998. For the current data collection effort, under way since 1998, one contractor defaulted and another was unable to provide the required data within the contract time frame. Because of the inability of the contractors to meet the contract requirements, VDOT has had to use two additional contractors in addition to State forces to meet federal Highway Performance Monitoring System reporting requirements. While VDOT did not miss the federal requirements, according to the IMMP Director, the failure of these contracts resulted in an additional $350,000 in expenditures for the 2000 pavement condition survey. The State pavement management engineer indicated that, as a result of the failure of these contracts and VDOT's subsequent steps to collect the required data, VDOT was not able to evaluate the conditions of pavements that received overlays during the 2001 paving season.

Recommendation (1). **The Virginia Department of Transportation should place a higher priority on the electronic collection and analysis of pavement condition information for 100 percent of Virginia's interstate and primary roads.**

Recommendation (2). **The Virginia Department of Transportation should continue to develop an appropriate methodology for the collection of pavement condition information for the secondary road system, and implement this system as soon as possible. The department should report on the status of this project to both the House and Senate Transportation Committees.**

Recommendation (3). **The Virginia Department of Transportation should base its maintenance schedules and expenditures for maintaining pavements on the analysis of accurate pavement condition data from all State maintained highway systems as soon as a system is in place for the secondary system.**

FORTY PERCENT OF VDOT MAINTAINED BRIDGES MAY NEED MAINTENANCE ATTENTION

VDOT is responsible for the upkeep and maintenance of more than 18,950 bridges and other structures across the State. As part of this review of the VDOT maintenance program, JLARC staff performed an analysis of the overall condition of the 11,775 bridges for which VDOT has the primary maintenance responsibility. This analysis excluded any assessment of the condition of culverts or other structures and bridges for which localities or other entities have the primary mainte-

nance responsibility. The maintenance, inspection, and rehabilitation of the assets that were paid for by federal funds when they were constructed, are regulated by FHWA. Bridge condition and safety inspections are performed by a combination of contractors and State forces depending on the complexity of the structure. However, there are no federal inspection requirements for the State's five tunnels.

Virginia maintains and operates three separate automated bridge rating systems. Based on information from these systems, it appears that 40 percent of Virginia's bridges for which VDOT has the primary maintenance responsibility may need repair or rehabilitation maintenance activities.

Virginia's Structure and Bridge Inspection Program

VDOT is responsible for the routine maintenance and inspection of 18,985 bridges, culverts, and other structures across the State. VDOT is required by FHWA to perform a federal bridge safety inspection for more than 10,000 bridges and 2,500 culverts every two years for bridges and structures included on the National Bridge Inventory (NBI). Bridge condition and safety inspections are performed by either contractors or State inspectors depending on the complexity of the structure. However, there are no federal inspection requirements for the State's six tunnels.

As defined within the FHWA National Bridge Inspection Standards (NBIS), a structure is considered a bridge if it is constructed for the purpose of carrying traffic over an obstruction, such as water, a highway, or a railway. As such, any bridge within the State system with a travel surface greater than 20 feet in length is required by FHWA to be inspected biennially as part of the NBI. Similarly, a culvert is defined as a smaller structure designed to hydraulically carry a water channel under a traveling surface. Culverts, as distinguished from bridges, are usually covered with an embankment and are composed of structural material around the entire perimeter.

Federal Requirements for Bridge Inspections. Federal regulations establishing the requirements for bridge inspection procedures, frequency, qualification, and reporting are promulgated within the NBIS. Through the NBIS, VDOT is required to perform a bridge safety inspection for more than 10,000 bridges and 2,500 culverts in Virginia at least every two years. As the condition of a bridge deteriorates, or if there is a sudden drop in the overall condition rating, VDOT is required to perform the safety inspection on an annual or semi-annual basis. Additionally, bridges with fracture-critical items, primarily dual girder bridges where the failure of one girder would result in the failure of the entire structure, are required to be inspected annually. VDOT inspects an additional 2,500 bridges every two years, and 4,500 culverts every four years, not included in the NBI because of their smaller size.

Safety inspection requirements established by FHWA include visual inspections of the condition of the bridge deck, superstructure, and substructure. Ad-

ditionally, the girders, sign structures, and underwater conditions, such as scour and wear on bridge piers, are inspected as well.

Organization of the Structure and Bridge Safety Inspection Program. Trained bridge inspection personnel gather information concerning bridge quality and assign overall condition ratings based on FHWA training and guidelines as well as personal observation. The State has approximately 90 bridge inspectors trained to FHWA standards, and inspection teams are located in each of the nine districts. The district structure and bridge engineer is responsible for the scheduling of the regular bridge safety inspections performed by district inspectors. Staff from the central office structure and bridge division conduct approximately 100 underwater safety inspections each year. Additionally, there are approximately 50 bridges with underwater structures that the structure and bridge section does not have the capacity to inspect and must contract for those services.

No Inspection Requirements for Tunnels. While bridge safety inspections are required by FHWA regulations, there are no federal requirements for tunnel inspections on either the underwater or mountain tunnels located in the Hampton Roads and Bristol districts, respectively. In the cases of tunnel inspections, both districts have on-site tunnel maintenance staff, with the district structure and bridge engineers responsible for the planning and scheduling of tunnel maintenance activities, and the central office providing support through the provision of on-call tunnel contractors.

In 1993, VDOT decided to discontinue its practice of contracting for inspection services of the State's six tunnels, and instead opted to utilize State forces to conduct these activities. A tunnel and moveable bridge inspection group was established that year and headquartered in the Hampton Roads district to be administered by the district structure and bridge engineer. According to the Hampton Roads district structure and bridge engineer, the goal of the group, which consists of a structural engineer, a mechanical engineer, and an electrical engineer, is to perform inspections of the tunnels on a five-year cycle. In 1997 and 1998, the group inspected the two mountain tunnels. Currently, they are inspecting the Monitor-Merrimac facility and hope to begin and complete a formal review of the Hampton Roads Bridge-Tunnel complex by mid-2002, according to the district bridge engineer.

The Hampton Roads district structure and bridge engineer indicated that the current VDOT approach to tunnel inspection provides a much more thorough and detailed examination than was provided by the consultants. The lead engineer for the Hampton Roads Bridge-Tunnel facility told JLARC staff that although the tunnel and moveable bridge team have not yet inspected the tunnel facility to date, inspections do occur on a non-scheduled basis. In July 2001, the U. S. Department of Transportation announced that it would be developing a Tunnel Management System that would, among other activities, "lay out procedures for proper inspection and record-keeping, and provide guidance for proper maintenance and rehabilitation techniques" for maintaining safe and efficient tunnels.

Virginia's Automated Bridge Management System

Under State and federal reporting requirements, VDOT is responsible for maintaining a significant amount of information regarding the overall condition of each of the State's bridges and culverts on the NBI. While the development of a formal automated bridge management system was initially required under the 1991 Intermodal Surface Transportation Efficiency Act, this requirement was removed under the 1998 Transportation Equity Act for the 21st Century. Currently an automated bridge management system is recommended by FHWA, but not mandated.

There are three existing automated bridge condition and safety inspection databases used by the structure and bridge section for maintaining information on the State's bridges and culverts: the Highway Traffic Records Information System (HTRIS), the Highway Performance Monitoring System (HPMS), and the *PONTIS* System. Additionally, according to the assistant State structure and bridge engineer, as part of the development of the Integrated Maintenance Management Program, VDOT has been working towards the establishment of a unified Bridge Management System (BMS) to combine the information available in each of the existing databases. Regardless of what system is used, a VDOT engineer ultimately decides the course of action actually taken in order to allow for intangible factors to be considered in the maintenance decision, according to the assistant State structure and bridge engineer. Exhibit 8 describes the bridge condition reporting systems used by the VDOT structure and bridge section.

Exhibit 8

Virginia's Automated Bridge Management Systems

System	Function
HPMS	Federally required reporting system. Contains information regarding the condition of all bridges and structures on the National Bridge Inventory.
PONTIS	Used for recording the condition of the components of each structure. This information is not reported to the FHWA and is only used by the maintenance program's bridge management system. This information is not in the bridge database available through HTRIS
HTRIS	Used for the storage and retrieval of data on each bridge. The data in the bridge database of HTRIS does not include the data recorded in *PONTIS*.
BMS	The maintenance program is working toward using a bridge management system for determining and documenting allocations for bridge maintenance and repair as part of the Integrated Maintenance Management Program.

Source: VDOT structure and bridge section.

Highway Traffic Record Information System. According to the assistant State structure and bridge engineer, the primary system used for the retrieval of bridge condition information is the HTRIS database developed by the VDOT traffic engineering section. However, bridge condition data is only a very small portion of the total HTRIS data storage and retrieval system. The HTRIS database contains detailed information regarding the condition of the individual components of each bridge, bridge location, alignments, and average daily traffic volumes. HTRIS data is used by the VDOT structure and bridge section in the assessment of bridge and structure conditions, as well as for estimating the costs for rehabilitative maintenance activities based on the total square footage of the structure. However, according to the assistant State structure and bridge engineer, the district bridge engineers prepare the repair cost estimates included in HTRIS and there are no formal standards for the calculation of these costs.

Highway Performance Monitoring System. The HPMS is a federally required database of condition information describing the components of the nation's public road mileage. The data included in the HPMS are driven by the condition rating information, as well as average daily traffic information, contained within the HTRIS. The HPMS data are annually updated by VDOT and submitted to FHWA for national analysis and reporting. For federal reporting, the structure and bridge section, with the aid of VDOT's information technology division, prepares a database of the specific items requested by the FHWA. The data collected as part of the HPMS reporting process are used primarily by FHWA for assessing statewide conditions and for the allocation of federal transportation funds. According to the assistant State structure and bridge engineer, VDOT does not use HPMS data alone for assessing the condition of Virginia's structures and bridges or in the scheduling of bridge maintenance activities.

PONTIS. For internal management of the structure and bridge condition data, VDOT uses element condition ratings included in the commercially available software *PONTIS*. The *PONTIS* system utilizes the condition data collected as part of the HPMS reporting process, as well as additional condition and traffic information, for a more complex analysis of the overall condition calculated by the approximate square footage of damage. The *PONTIS* software compares the functional characteristics of a structure to standard parameters for the same class of highway or volume of traffic.

In addition to estimating the extent of bridge damage, *PONTIS* can be used to provide information on various corrective actions by comparing the effects of repairing or replacing the bridge deck or taking no action at all. Using this information, *PONTIS* can be used to evaluate feasible maintenance or replacement actions against budget scenarios in order to produce the optimal maintenance recommendations. It can also compare the maintenance needs to the functional needs in order to determine which is most beneficial over the life of the structure.

Virginia's Bridge Condition Rating System

As previously discussed, VDOT is required by FHWA to perform at least a biennial inspection of the condition of all structures and bridges included in the NBI. Guidelines for these inspections, set forth within the NBIS, establish the procedures and standards for performing bridge inspections. In addition, VDOT also inspects the bridges and structures not on the NBI on a regular schedule.

The three primary components considered as part of a bridge safety inspection are the age, structural condition, and functional capacity of the structure. FHWA has developed several methods to assist states in the evaluation of the structural condition and functional characteristics of structures and bridges. For example, VDOT requires bridge inspectors to receive training from FHWA every three years, a level of consistency has been developed with regards to bridge condition ratings. Furthermore, the condition and appraisal ratings specified in the NBIS are used nationwide and provide a good evaluation of the structural and functional characteristics of a structure.

Condition Rating Process. According to the State structure and bridge engineer, the condition of bridges and structures can best be gauged using the age, present structural condition, and functional characteristics of the structure. The age of a structure is a significant component in identifying potential maintenance needs because bridge performance declines as concrete and steel elements approach the end of their useful structural and functional life spans. According to the State structure and bridge engineer, FHWA recently recommended bridges be built to a 75-year functional life-cycle.

Structural conditions can be measured by comparing the present structural capacity to the original structural capacity at the time of construction. Functional characteristics are measured by comparing the structural capacity, roadway widths, underclearances, and waterway openings to the desirable characteristics for the particular location and class of road. The assistant State structure and bridge engineer further stated that, while the functional rating is important for determining the type of maintenance or replacement activity that is going to be used for a particular structure, the best indicators of the condition of a structure are the age and the structural component condition rating.

The three primary condition evaluation tools used by VDOT's structure and bridge section are: general condition ratings, appraisal ratings, and overall bridge sufficiency ratings. Information is gathered concerning bridge integrity and quality through general condition ratings and appraisal ratings as defined by FHWA. Additionally, these measures are combined to create the overall bridge sufficiency rating that is reported to FHWA.

General Condition Ratings and Uses. General condition ratings are assigned by the district bridge inspection personnel or contractor to the bridge deck (roadway surface), superstructure (main longitudinal load carrying members), and substructure (the supports for the superstructure). Figure 8 illustrates examples of conditions in likely need of repair for each of these components. In the case of a cul-

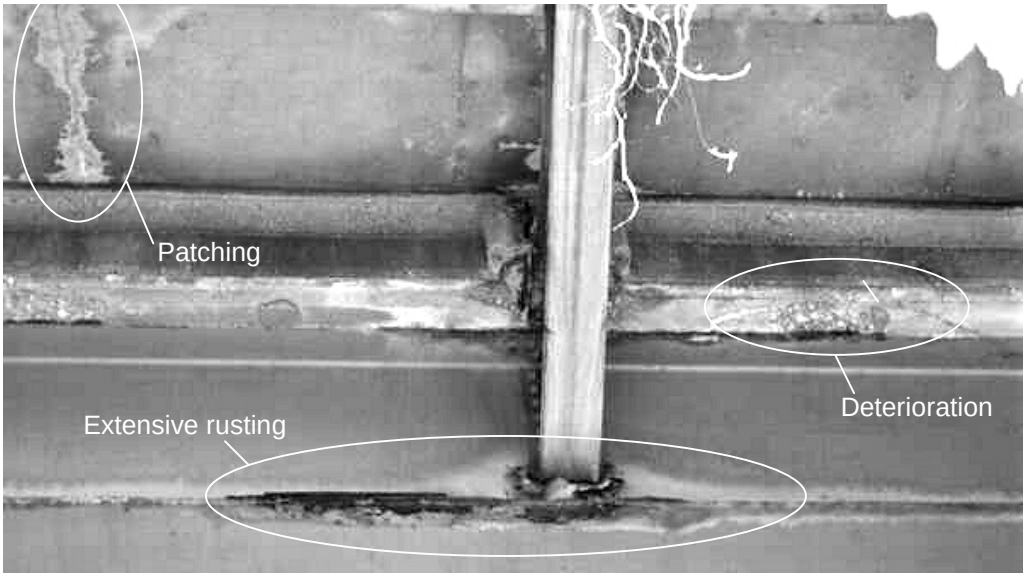
Figure 8

Examples of Bridge Deck, Superstructure and Substructure Conditions

Below: Heavily patched deck

Right: Deteriorating substructure unit

Note: Photo below shows superstructure beneath bridge, looking up from ground.



Source: JLARC staff photos.

vert, one condition rating is assigned, which best describes the aggregate condition of the culvert. The general condition ratings represent the current structural condition of the bridge or culvert when compared to the condition of that structure when it was initially constructed. Condition ratings vary from a value of 9 (excellent) to a value of 0 (failed condition). According to FHWA guidelines, structures with a general condition rating less than six are considered in need of maintenance, and structures with ratings of three or less require immediate attention to protect the motoring public and preserve the structure. Exhibit 9 outlines the FHWA guidelines for general condition ratings.

General condition ratings are the most accurate representation of the present structural condition of a bridge, according to the State structure and bridge engineer, because they measure the current condition of the structure against the initial condition at the time of construction. Additionally, VDOT safety inspectors are trained on how to evaluate the condition ratings every three years through the National Highway Institute. According to VDOT staff, the structure and bridge section uses general condition ratings in both the identification of immediate bridge needs as well as in the planning and scheduling of routine bridge maintenance activities.

Exhibit 9

FHWA General Condition Ratings

Numeric Code	General Condition Description
N	Not Applicable.
9	New Condition.
8	Good Condition – No repairs needed.
7	Generally Good Condition – Potential exists for minor maintenance.
6	Fair Condition – Potential exists for major maintenance.
5	Generally Fair Condition – Potential exists for minor rehabilitation.
4	Marginal Condition – Potential exists for major rehabilitation.
3	Poor Condition – Repair or rehabilitation required immediately.
2	Critical Condition – The need for repair or rehabilitation is urgent. Facility should be closed until the indicated repair is complete.
1	Critical Condition – Facility is closed. Study should determine the feasibility for repair.
0	Critical Condition – Facility is closed and is beyond repair.

Source: FHWA *Recording and Coding Guide for the Structure Inventory and the Appraisal of the Nation's Bridges*, 1995.

Appraisal Ratings and Sufficiency Ratings. Appraisal ratings are determined from information collected during the bridge safety inspection and are assigned for both a structural and functional evaluation of the bridge or culvert, based on the deck geometry, vertical and horizontal clearance beneath the bridge, adequacy of the waterway, and the approach roadway alignment. Three appraisal ratings compare the existing condition of, and the level of service provided by, a bridge to a desirable condition or level of service, and standards for appraisal ratings are defined by FHWA. While the appraisal rating is used in the calculation of the overall bridge sufficiency rating, according to VDOT staff, appraisal ratings are not frequently used as a stand-alone measure of the overall condition of a structure.

Bridge sufficiency ratings compare the actual condition of a structure to a desirable condition and are calculated using both the general condition and appraisal ratings in order to assess the overall structural and functional condition of a bridge. Bridge sufficiency ratings are calculated on a scale of 0 to 100, using a formula that accounts for structural adequacy, safety, serviceability, functionality, and the essentiality for public use. Sufficiency ratings are used by FHWA to apportion rehabilitation and replacement funds. According to the assistant State structure and bridge engineer, the sufficiency rating is useful for comparing a nationwide grouping of structures, but it is not specific enough to identify types of structural conditions associated with a specific bridge.

Condition of Virginia's Structures and Bridges

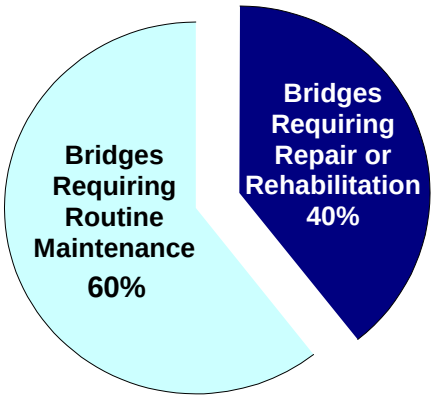
Since VDOT is required to provide an annual update on the condition of the statewide bridge inventory to FHWA, there is a substantial amount of information available regarding the general structural condition of Virginia's bridges. Based on a subset of this data, it appears that 40 percent of the bridges in Virginia, for which VDOT has the primary maintenance responsibility, are considered in need of some type of repair. Similar to the condition of Virginia's pavements, the amount of bridges in need of repair varies across the State. This analysis, however, only addresses the current structural condition of VDOT maintained bridges and does not address the adequacy of these bridges in meeting current and predicted vehicle capacities.

Forty Percent of Virginia's Bridges Maintained by VDOT Are Considered in Need of Repair or Rehabilitation. JLARC staff analysis of data for more than 11,700 bridges across the State for which VDOT has the primary maintenance responsibility indicates that, based on general condition ratings, 40 percent need maintenance attention. According to the assistant State structure and bridge engineer, a bridge would be considered in need of repair or rehabilitation if any of the three general condition ratings were less than six. Additionally, bridges identified as in need of maintenance would qualify for either federal rehabilitation or reconstruction funds. Figure 9 illustrates the overall percentage of VDOT maintained bridge conditions based on general condition ratings.

JLARC staff analyzed the general condition ratings and age of VDOT maintained bridges throughout each district and across each highway system based

Figure 9

Statewide Bridges in Need of Repair or Rehabilitation Based on General Condition Ratings, 2001



n = 11,775

Source: JLARC staff analysis of VDOT structure and bridge section data.

on the bridge condition data provided by the structure and bridge section, and the standard FHWA definitions for general condition ratings. Analysis of the age of VDOT maintained bridges indicates that 32 percent of these bridges were constructed prior to 1941, while 36 percent of these bridges were constructed from 1961 to 1980. According to the State structure and bridge engineer, any bridge that is more than 75 years old may also be considered a candidate for rehabilitative maintenance or complete reconstruction.

Further analysis of the age of VDOT maintained bridges indicates that there are 342 bridges which were constructed before 1926. While the age of a bridge alone is not the sole factor in a determination of whether a bridge needs repair or rehabilitation, analysis of the bridges constructed prior to 1926 indicates that 69 percent of these bridges would be considered to need some level of maintenance beyond routine maintenance based on general condition ratings. Approximately 48 percent of the bridges constructed between 1926 and 1940 are also considered in need of repair or rehabilitation. On the other hand, of the bridges constructed since 1980, only six percent are considered in need of repair or rehabilitation. Table 7 illustrates the overall age of bridges for which VDOT has the primary maintenance responsibility.

Majority of VDOT Maintained Bridges In Need of Repair or Rehabilitation Are Located on the Secondary System. A systems-based analysis of bridge and structure conditions indicates that 63 percent of bridges identified as needing maintenance attention are located on the secondary system. Of the bridges considered in need of repair or rehabilitation, 25 percent are contained within the primary system, and 11 percent are located within the interstate system. Further analysis of the distribution of condition ratings analyzed by JLARC staff illustrates that the trend in bridges needing some type of maintenance activity greater than

Table 7

VDOT Maintained Bridges in Need of Repair or Rehabilitation by Age, 2001

	Year Bridge Built				
	Before 1926	**1926 – 1940**	**1941 – 1960**	**1961 – 1980**	**1981 – present**
Total Bridges	342	3,450	1,760	4,180	2,043
Bridges Needing Repair or Rehabilitation	235	1,658	920	1,716	129
Percent Needing Repair or Rehabilitation	69%	48%	52%	41%	6%

Source: JLARC staff analysis of VDOT structure and bridge section data.

routine maintenance is proportionate to the distribution of bridges across all three systems. Table 8 illustrates both the total distribution of Virginia's bridges as well as the distribution of bridges in need of repair or rehabilitation across all systems.

Table 8

VDOT Maintained Bridges in Need of Repair or Rehabilitation by Highway System, 2001

System	Total Number of Bridges	Percent of Total Statewide Bridges	Total Number of Bridges Needing Repair or Rehabilitation	Bridges Needing Repair or Rehabilitation as a Percent of All Bridges Needing these Activities
Interstate	1,425	12	533	11 %
Primary	2,872	24	1,187	25
Secondary	7,458	63	2,935	63
Urban	20	<1	3	15
Statewide Total	**11,775**	**100**	**4,658**	**40**

Source: JLARC staff analysis of VDOT structure and bridge section data.

Bridge Conditions Vary Across Districts. Evaluation of the distribution of VDOT maintained bridges across the State indicates that the Bristol (19 percent) and Staunton (19 percent) districts have the highest number of bridges, comprising more than 37 percent of total statewide bridges. Comparatively, the three urban districts: Richmond (11 percent), Hampton Roads (8 percent), and Northern Virginia (7 percent), contain only slightly more than one-quarter of total statewide bridges. The Fredericksburg district has the lowest total number of bridges, containing only three percent of the statewide total. Table 9 outlines the statewide distribution of VDOT maintained bridges by district as well as the distribution of the bridges needing maintenance attention for which VDOT has the primary maintenance responsibility.

As Figure 10 illustrates, 53 percent of the bridges in the Bristol district and 47 percent of the bridges in the Fredericksburg district are considered in need of

Table 9

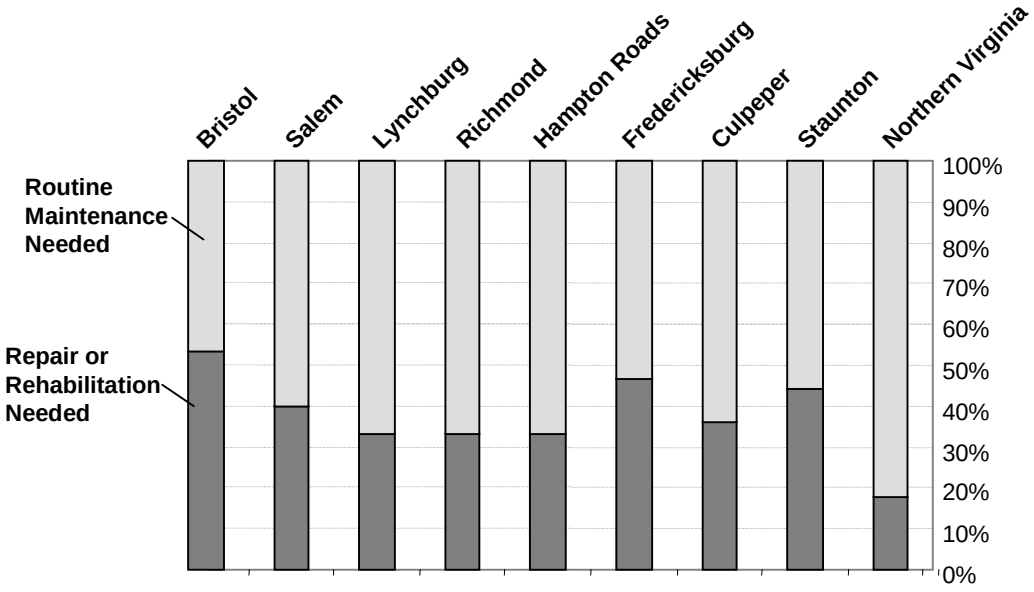
Statewide Distribution of VDOT Maintained Bridges In Need of Repair or Rehabilitation by District

District	Total Number of Bridges	Percent of State Total	Total Number of Bridges Needing Repair or Rehabilitation	Bridges Needing Repair or Rehabilitation as a Percentage of District Totals
Bristol	2,218	19 %	1,178	53 %
Salem	1,874	16	747	40
Lynchburg	1,074	9	357	33
Richmond	1,332	11	441	33
Hampton Roads	897	8	297	33
Fredericksburg	353	3	165	47
Culpeper	982	8	355	36
Staunton	2,179	19	965	44
Northern Virginia	866	7	153	18
Total	**11,775**	**100**	**4,658**	**40**

Source: JLARC staff analysis of VDOT structure and bridge section data.

Figure 10

Percent Bridges Maintained by VDOT in Need of Repair or Rehabilitation Shown by District, 2001



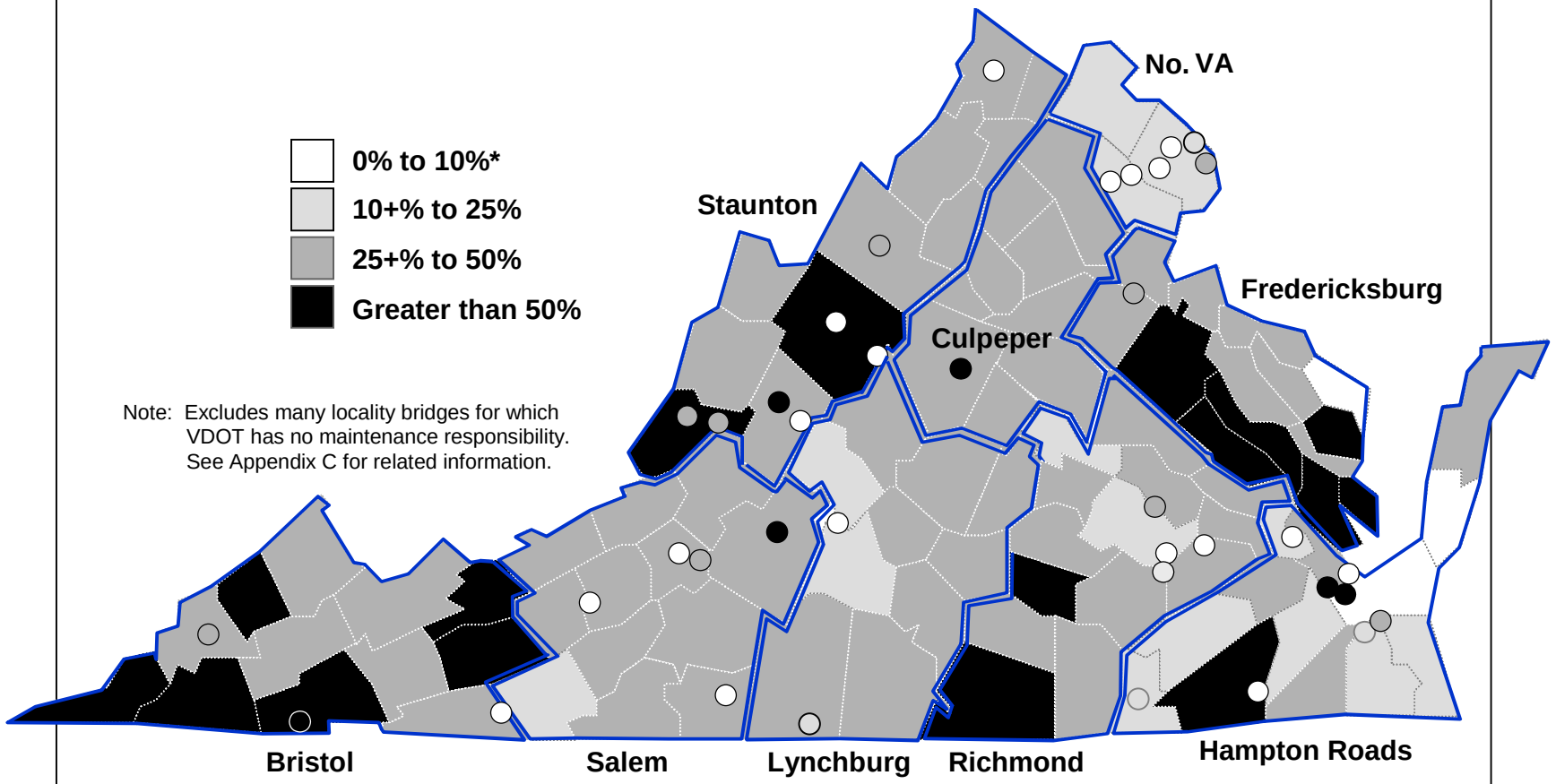
Source: JLARC staff analysis of VDOT data.

repair or rehabilitation. However, analysis of the distribution of these bridges in both the Richmond and Hampton Roads districts indicates that one-third of each of the districts total bridges are considered to be in need or repair or rehabilitation. The Northern Virginia district has the lowest concentration of bridges needing some type of maintenance activity greater than routine maintenance, with only 18 percent of the bridges in the district considered to be candidates for substantial maintenance.

Conditions of Virginia's Bridges Vary by County. Similar to the trends identified for each district, the distribution of VDOT maintained bridges needing repair or rehabilitation across the State indicates that rural counties within the Bristol and Fredericksburg districts have the highest concentration of bridges in need of repair. Districts with more urbanized areas, such as the Northern Virginia district; appear to have a lower concentration of bridges in need of repair or rehabilitation. Since VDOT does not have primary maintenance responsibility for the majority of bridges in the urban system, this analysis does not address the percentage of bridges needing repair or rehabilitation within the cities. Figure 11 illustrates the overall concentrations of bridges needing more than routine maintenance across the State for which VDOT has the primary maintenance responsibility. A list of the total bridges needing repair or rehabilitation for Virginia's counties are contained in Appendix C.

Figure 11

Percent Bridges Maintained by VDOT in Need of Repair or Rehabilitation, by County



Note: Excludes many locality bridges for which VDOT has no maintenance responsibility. See Appendix C for related information.

Source: JLARC staff analysis of VDOT structure and bridge section data.

An analysis of the distribution of Virginia's oldest bridges, illustrated in Table 10, indicates that the total number of bridges for which VDOT has primary maintenance responsibility built prior to 1926 is approximately three percent, and no more than five percent of any district's bridges were constructed prior to 1926. The Bristol and Staunton districts, however, have the highest total number of bridges greater than 75 years old. The Hampton Roads and Fredericksburg districts have the fewest number of bridges that are 75 years or older. Furthermore, an analysis of the distribution of bridges that are between 60 and 75 years old indicates that both the Salem and Staunton districts have the highest percentage of bridges constructed during this period.

Table 10

Age of VDOT Maintained Bridges by District, 2001

District	Total Number of Bridges	Year Bridge Built				
		Before 1926	1926 – 1940	1941 – 1960	1961 – 1980	1981 – present
Bristol	2,218	54	690	260	778	436
Salem	1,874	53	717	215	654	235
Lynchburg	1,074	11	365	160	393	145
Richmond	1,332	44	125	311	600	252
Hampton Roads	897	6	101	145	366	279
Fredericksburg	353	7	69	69	142	66
Culpeper	982	47	340	201	296	98
Staunton	2,179	98	933	308	630	210
Northern Virginia	866	22	110	91	321	322
Total	**11,775**	**342**	**3,450**	**1,760**	**4,180**	**2,043**

Source: JLARC staff analysis of VDOT structure and bridge section data.

Table 11 shows the distribution of the ages for the 4,658 bridges identified as in need of repair or rehabilitation. As illustrated by the table, 235 of the bridges constructed prior to 1926 are considered in need of maintenance work greater than routine maintenance which represents 69 percent of all bridges constructed during that time. Furthermore, 1,658 bridges (48 percent) constructed between 1926 and 1940 are considered needing repair or rehabilitation.

Further analysis of this data indicates that for bridges considered in need of repair or rehabilitation in the Staunton, Salem and Culpeper districts, the majority of these bridges are between 60 and 75 years old.

Table 11

Age of VDOT Maintained Bridges In Need of Repair or Rehabilitation, by District, 2001

District	Total Number of Deficient Bridges	Year Bridge Built				
		Before 1926	1926 – 1940	1941 - 1960	1961 – 1980	1981 – present
Bristol	1,178	38	423	167	491	59
Salem	747	42	291	127	278	9
Lynchburg	357	8	131	73	142	3
Richmond	441	27	68	142	201	3
Hampton Roads	297	5	51	72	135	34
Fredericksburg	165	4	45	49	64	3
Culpeper	355	27	152	89	83	4
Staunton	965	77	465	175	239	9
Northern Virginia	153	7	32	26	83	5
Statewide Total	**4,658**	**235**	**1,658**	**920**	**1,716**	**129**

Source: JLARC staff analysis of VDOT structure and bridge section data.

CONDITION OF NON-PAVEMENT ASSETS NEEDS ATTENTION

According to VDOT, the maintenance program spent more than $160 million on maintaining non-pavement, non-bridge assets during FY 2000, including drain pipes, ditches, traffic signals, and guardrail. VDOT does not systematically measure the condition of non-roadway assets or secondary road pavements as it does the interstate and primary pavements and bridges. As a result, no uniform condition data exist reflecting an evaluation of these assets. In addressing the condition of these assets, JLARC staff relied on statements from the VDOT central office and field staff responsible for assessing these conditions and determining needs. Additionally, JLARC staff employed the department's most recent study of roadway users to evaluate the condition of other highway assets.

According to several maintenance managers in the field, activities related to VDOT's other assets have been delayed or put off altogether in recent years as a result of funding and staffing issues. According to several district maintenance engineers, activities that have been most impacted include ditching (which is consid-

ered to have a direct impact on pavement conditions), pipes, and brush cutting. For example, one district maintenance engineer stated that the district is letting preventive work on cut slopes and fill slopes damaged by washouts go undone and is also not cleaning and maintaining enough pipes. Another district maintenance engineer said that brush-cutting and ditch work were falling behind. Some maintenance managers said that these are functions that can be labor intensive and, as a result, are difficult to contract. Respondents to the JLARC staff survey of transportation operations managers indicated that funding concerns had impacted their ability to perform work on pipes and culverts, unpaved ditches, and brush-cutting the most.

As part of this review, JLARC staff traveled substantial amounts of roadway in each district. Based on these observations and on comments by maintenance field managers, it appears that assets on the secondary system, including pipes, shoulders, and vegetation control, are in need of additional attention. For example, a transportation operations manager stated that although the residency is able to provide good maintenance on the interstate and primary roads, this was not the case for the secondaries. The manager added that shoulders and drainage add more life to the pavement structure, but residencies need more funds for secondary roads in order to increase maintenance for these types of assets.

According to the State traffic engineer, the overall condition of traffic engineering assets has improved in recent years. For example, previously traffic engineering assets were tested using VDOT standards, but are now being tested with nationally recognized performance-based specifications. Virginia's traffic engineering assets primarily consist of road signs, pavement marking materials, video detection devices, and approximately 2000 statewide signals, most of which are operated and maintained in the Northern Virginia district. Inspections of these assets are performed by a combination of State forces and contractors. However, traffic engineering does not have a division-wide database to store specific asset information. In fact, according to Arlington county transportation officials, VDOT currently pays them to inventory and maintain the traffic signals in the county.

As a way to define areas needing improvement, during February and March 2001 VDOT contracted with the University of Virginia's Center for Survey Research to conduct a customer satisfaction survey related to levels of satisfaction with the major highways and secondary roads. Preliminary results presented to VDOT in June 2001, indicate that 77 percent of respondents were satisfied with the conditions of the major highways. However, overall satisfaction fell to 67 percent when respondents were asked about secondary roads. More than a quarter of those surveyed indicated dissatisfaction with secondary roads. For example, more than half were dissatisfied with the width of secondary roads. In addition, almost one quarter were also dissatisfied with the drainage on these roads.

Recent changes in federal guardrail standards have affected the condition of these assets. Of the more than $107 million the MPLG identified as needed in supplemental funding for the FY 2002-2004 biennium, approximately $48 million of those needs were for mandated improvements in guardrail. Members of the MPLG stated that previous expenditures for guardrail reflected "the limited number of experienced contractor crews" in the State. Guardrail replacement needs have in-

creased as a result of a 1994 FHWA policy. VDOT chose to implement its policy for upgrading guardrail by requiring the replacement of damaged guardrail in need of repair, as well as all other existing guardrail located within construction projects and transportation improvements not in compliance with the new standards. Although much of the State's guardrail does not meet the new standard, according to the State maintenance engineer, it is still in good condition.

Recommendation (4). **The Virginia Department of Transportation should assess the need for additional maintenance beyond that currently identified on non-pavement assets pending full implementation of its asset management program. The Maintenance Program Leadership Group could make such an assessment based on requests for non-pavement maintenance from the residencies.**

III. Funding the State's Highway Maintenance Program

The *Code of Virginia* requires that priority be given to funding for the maintenance of the State's existing highway system before all other activities. Currently, this process appears to work in two ways. First, VDOT management determines the maintenance program's allocation amount as part of the allocations for the entire department; maintenance managers then distribute this amount across the districts. Second, beginning in the area headquarters, a funding request amount is identified through a series of requests and reviews at each level of the maintenance program. The statewide maintenance leadership group uses a ranking methodology to prioritize these supplemental requests before combining it with the base budget request and submitting that amount to VDOT's management team. This process has been described as a "top-down, bottom-up" approach to funding the highway maintenance program.

In order to develop its funding requests, VDOT currently assesses the pavement conditions of the State's interstate highways and primary roads. Additionally, VDOT is required by the Federal Highway Administration (FHWA) to rate the conditions of certain structures and bridges in the State. Since identified maintenance needs in the conditions of VDOT maintained pavements and bridges must compete for funding from VDOT's maintenance allocation, some of these identified needs go unmet. JLARC staff analysis indicates that to bring all interstate and primary pavements as well as the bridges identified as needing some type of repair or rehabilitation at the present time to an acceptable level would require at least $1.6 billion.

Despite the identified deficient conditions for interstate and primary pavements, as well as for bridges needing repair or rehabilitation, VDOT does not appear to place the necessary level of priority on the funding needs of the highway maintenance program. Current projections for the highway maintenance program indicate that allocations will be level funded at $861.4 million beginning in FY 2004 through FY 2007. District maintenance engineers have also been asked to identify projects worth about $45 million statewide that could be eliminated in FY 2002 if revenues to the Highway Maintenance Operating Fund (HMOF) do not meet projections. The Commonwealth Transportation Board (CTB) and VDOT should consider the maintenance program's need for additional funding as a result of these issues.

Additionally, VDOT is responsible for distribution of State maintenance payments to the cities, certain towns, and the counties of Arlington and Henrico for the maintenance of roads within their jurisdictions. Since 1997, Virginia has provided approximately $1 billion to these localities. However, JLARC staff analysis of VDOT accounting and expenditure reports indicates that from FY 1997 to FY 2000, the cities and towns have reported more than $200 million of expenditures in excess of State maintenance payments. While VDOT is not directly responsible for establishing payment rates to these localities, the department is responsible for the over-

sight of local maintenance expenditures. However, the *Code of Virginia* only provides broad guidance for the quality of the roads maintained by the cities and towns, and no formal guidelines regarding the quality of the roads maintained by the counties. Therefore, without a more comprehensive system for evaluating the conditions of the streets and roads maintained by these localities, there is no formal way of assessing the appropriateness of maintenance payments and expenditures or the adequacy of the maintenance provided.

VDOT'S CURRENT PROCESS FOR IDENTIFYING AND ALLOCATING FUNDS FOR HIGHWAY MAINTENANCE

The highway maintenance program is funded from the HMOF. For the most part, the CTB relies on the amount recommended in the department's annual budget as the allocation amount. Once VDOT's overall allocation has been established, the Maintenance Program Leadership Group (MPLG) decides on the statewide objectives and programs the funds commensurate with those goals.

Typically, this allocation consists of two parts, in which the previous year's allocation serves as the base, and a portion of identified needs supplements that amount. To determine its supplemental funding needs, VDOT employs an identification and review process. Superintendents at the area headquarters level identify potential maintenance needs in those areas, and this information is reviewed and prioritized by the transportation operations managers at the residency level. The process is then repeated at the District Maintenance Program Leadership Group (DMPLG) in each district, and then again at a statewide level through the MPLG. A district maintenance engineer described the identification and allocation process as a "top-down, bottom-up" approach to funding the State's highway maintenance program.

The Process of Allocating Funds for Highway Maintenance

The *Code of Virginia* requires that maintenance of the State's existing highway assets be VDOT's first funding priority. The CTB, based on VDOT's recommendation of what is deemed "reasonable and necessary," provides an allocation to each functional area within the department, including the maintenance program. All nine district maintenance engineers and the State maintenance engineer have been charged with allocating those funds within the maintenance program by district. Within each district, a similar body of maintenance managers programs those funds to the residencies, area headquarters, and district sections.

VDOT Recommends Amount of Maintenance Allocation to CTB. The *Code of Virginia* clearly prioritizes funding for the maintenance of existing highway assets above other transportation functions. Specifically, §33.1-23.1 authorizes the CTB to allocate each year from all funds made available for highway purposes such amount as it deems "reasonable and necessary" for the maintenance of roads within the "state system, as well as the localities and roads in the counties not in the state system." Although funding for maintenance is a VDOT priority, the

Code of Virginia does not provide guidance on the specific amount to be allocated to maintenance. Identification of the amount deemed reasonable and necessary is performed by the department. For the more than 10,000 miles of urban roads being maintained by localities, VDOT has no direct responsibility of determining maintenance payments. Instead, the maintenance program's role is to provide administrative support and oversight to reviewing local maintenance expenditures and assessing local maintenance needs.

VDOT annually presents to the CTB a budget that includes an amount to be allocated for highway maintenance. This amount is typically based on the previous fiscal year's budget, along with a portion of the department-wide supplemental maintenance needs determined by the MPLG. According to its charter, the MPLG is accountable for allocating resources in a way that best meets the needs of the maintenance program.

MPLG Allocates Funding to the Districts, Central Office, and Other Statewide Programs. The *Code of Virginia* does not specify how the annual allocation should be distributed among the various levels of the maintenance program. In recent years, the MPLG has been responsible for the distribution of funds within the program, and distributes the allocation across the maintenance program in order to accomplish administrative functions and maintenance goals through contracts and State forces. The district allocation amounts are generally based on historical trends that reflect how funds have been allocated in the past, and often consider other growth factors such as lane mileage, population, and vehicle-miles-traveled. However, the base amount is supplemented with additional funds based on identified needs not already included in the base. Table 12 shows the district-wide allocation amounts since FY 1997.

The MPLG allocates funds within each district to the six asset groups. These asset groups are: pavements, structures and bridges, pipes and drainage, roadside, traffic devices, and special facilities. According to the director of maintenance finances, the base budget reflects the fiscal year-end appropriation from the final year of the previous biennia, minus funding for any one time program or activity that was completed in that year. All supplemental allocations are programmed to those activities addressed through the MPLG's needs identification process and ranking methodology, which will be discussed later in this chapter. Additionally, amounts are set aside in a centralized account for snow removal and other emergency expenditures, from which districts charge to the appropriate activities as events occur.

DMPLGs Can Adjust Maintenance Funds as Needed. DMPLGs are comprised of the residency transportation operations managers, the district section managers, and the district maintenance engineers who serve as chairpersons and hold final authority. They meet on a regular basis, usually either monthly or quarterly, to discuss issues impacting the maintenance programs and budgets within their districts, including the district sections that receive maintenance funding. The DMPLGs also coordinate and program district funds based on special needs within the district and the sections. For example, in the summer of 2001 the Bristol district experienced extensive flooding in certain areas due to long periods of rain. As a re-

Table 12

Annual District Allocations FY 1997-2001

District	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Bristol	$ 50,122,222	$ 60,666,963	$ 59,372,674	$ 62,259,527	$ 66,794,194
Salem	$ 57,425,685	$ 68,031,555	$ 69,374,595	$ 72,653,801	$ 80,146,179
Lynchburg	$ 45,027,266	$ 48,364,208	$ 50,381,320	$ 53,432,073	$ 57,131,531
Richmond	$ 72,566,248	$ 69,996,071	$ 78,121,338	$ 78,855,527	$ 85,463,746
Hampton Roads	$103,923,606	$ 85,628,882	$ 87,729,690	$ 93,945,637	$105,110,233
Fredericksburg	$ 39,494,873	$ 41,066,800	$ 44,268,055	$ 46,035,136	$ 50,149,283
Culpeper	$ 44,163,180	$ 48,369,003	$ 48,320,132	$ 50,146,324	$ 53,554,393
Staunton	$ 52,669,692	$ 61,193,589	$ 71,970,221	$ 77,016,290	$ 81,948,105
Northern Virginia	$ 85,614,076	$ 93,117,797	$ 94,181,150	$ 99,609,049	$111,131,444
Statewide Totals	**$551,006,848**	**$576,434,868**	**$603,719,175**	**$633,953,364**	**$691,429,108**

Source: VDOT's Maintenance Program.

sult, district resources were re-allocated to accommodate special immediate needs. This disaster also warranted the assistance of FEMA.

Both currently and in the past, maintenance allocations have been distributed according to the highest priority needs, a process which managers sometimes refer to as "worst-first." Funding for the paving schedule is usually taken off the top of the district's allocation and generally amounts to about 25 percent of a district's allocation. Districts also distribute funding for major bridge rehabilitation, leaving residencies responsible for funding minor bridge maintenance. Several district maintenance engineers stated that within the districts, funding for the residencies is typically based on the number of lane miles in each residency. However, historical maintenance allocation trends at the residency level also play a role in determining these amounts.

Many maintenance managers interviewed by JLARC staff expressed confidence that the department's transition to asset management will eventually allow them to allocate more funding toward preventive maintenance activities, thereby

expanding the optimal life of existing assets. Meanwhile, nearly 90 percent of the respondents to the JLARC staff survey of transportation operations managers expressed a high level of satisfaction with the effectiveness of the DMPLGs as a decentralized process for allocating maintenance funds. Many other maintenance managers echoed this sentiment.

For ordinary maintenance activities, particularly on the secondary system, residencies base their allocation decisions on the experience and judgment of their operations managers, along with citizen requests and the identified needs submitted by the area headquarters superintendents. A somewhat more formal process exists for the rehabilitative work on interstate and primary systems, for which some automated data and formulated standards exist through various pavement and bridge systems that rate critical needs. The process for allocating maintenance funds for the secondary system, on the other hand, is driven primarily by paper records and the ability of operations managers and area superintendents to identify pavement and other maintenance needs.

Process of Identifying Maintenance Needs

Assessing the adequacy of VDOT's maintenance program in meeting statewide highway maintenance needs requires consideration of the process for identifying and planning needed maintenance activities in order to complete the "bottom-up" part of the funding cycle. This process involves several levels of deliberation and negotiation, starting at the area headquarters, and continuing up through the DMPLG and the MPLG, before being granted approval by the CTB and becoming part of the Governor's biennial budget.

Area Headquarters and Residencies Compile a List of Maintenance Needs. Area headquarters superintendents determine their maintenance needs through a combination of visual inspections of roadway assets and personal experience. Funding requests are then generated from these needs based on historical costs and increases for certain items such as labor, equipment, and materials. Maintenance needs at this level are usually impacted by new residential or commercial development in an area such as the addition of subdivisions. The need information is reviewed and prioritized by the operations managers for the whole residency, and not all requests are carried forth at this point.

Because the process of identifying maintenance needs is inevitably prioritized by the DMPLGs and the MPLG, areas sometimes have to submit requests for major improvements as many as five years in advance in order to get on the list for priority funding. Funding delays especially tend to occur for road surface requests. One superintendent stated that he feels the area headquarters are falling behind on surface work because of the age of some secondary roads and the increased public demand for more aesthetically pleasing pavement maintenance. He added that the maintenance budget is often short on funds for paving needs because of the increased use of more expensive plant-mix asphalt.

DMPLG Develops a Prioritized List of District Needs. Residency operations managers tend to be more methodical in identifying their maintenance needs given their greater access to additional district resources and oversight. Aside from the recurring fixed costs in the operating budget such as equipment and labor, operations managers often identify the maintenance needs of the entire residency according to target numbers established through the DMPLG and through automated pavement data maintained by the central office. According to responses to the JLARC staff survey of transportation operations managers, the three general areas that are considered most in identifying maintenance needs are safety, public complaints, and mandates (Table 13).

Table 13

Transportation Operations Managers Considerations in Identifying Maintenance Needs

Consideration	Frequency
Safety	49
Public Complaints	31
Mandates	22
Cost	13
Environment	11
Precedent	9
Age	8
Aesthetics	7

Note: Each of the 50 respondents selected their top three considerations.
Source: JLARC staff survey of VDOT residency transportation operations managers.

The DMPLG considers the funding requests of the residencies and sections within the district. For the most part, the DMPLG will try to include as many identified needs as possible and also address any special requests from within the district. Pavement overlay requests are initially identified on a residency-wide basis, and then prioritized on a district wide basis, where the district maintenance engineer, budget assistant, and materials administrator will visually inspect the highest priority roads to ensure the needs exist. Additionally, structure and bridge needs are identified through a similar process.

One operations manager described the process of identifying needs as primarily "maintaining the status quo." In fact, less than half of the operations managers indicated in the survey that they had requested a funding increase in FY 2000-2001, while 92 percent of respondents believe funding to be inadequate. This suggests that many residencies either identify needs according to what they have allocated in the past (assuming no increase), or that funding is, in fact, adequate to meet their identified needs. The district maintenance engineer takes what is agreed

upon by the DMPLG, and presents it to the MPLG for further deliberation and prioritization.

MPLG Establishes Priority Categories for Statewide Funding Needs. The supplemental funding request is designed to capture the identified needs in excess of the amount available from the previous fiscal year's allocation, otherwise known as the base amount. Because identified needs have typically been greater than previous funding has supplied, the MPLG has established a methodology to group and rank these requests, illustrated in Exhibit 10. The final supplemental amount identified has been described as the amount critical to the success of the maintenance program. However, since the available funds are limited, the final listing covers only a portion of the total amount identified as needed. As Exhibit 10 indicates, mandates are perceived to have the greatest importance.

Finally, VDOT's executive leadership considers the funding request for the maintenance program along with the funding needs for the rest of the department. The amount finalized by the executive committee is submitted to the Department of Planning and Budget (DPB) as part of VDOT's biennial budget submission. Final approval and adjustments are made by the General Assembly.

Exhibit 10

MPLG Maintenance Activity Prioritization Criteria and Weights

Criteria	Description	Relative Weight
Mandates	*Initiatives required by law or department policy*	0.28
Impact on Base Budget	*Cost of maintaining the value and operating the existing system*	0.21
Strategic Direction	*Alignment with VDOT purpose, mission and values. Consistency with Maintenance Strategic Plan and Strategic Outcome Areas.*	0.19
Life Cycle Costs	*Cost-benefit / Return on investment. Minimize risks to future budgets.*	0.18
Level of Service	*Achieve performance targets. Supports transition to outcome-based management*	0.14
Total		**1.00**

Source: MPLG FY 2003-2004 Biennial Budget Ranking Scales.

FUNDING NEEDS OF THE MAINTENANCE PROGRAM ARE UNMET

In order to establish annual funding distributions within each district, as well as for the entire maintenance program, the MPLG relies on needs identified for each asset group by the various program managers within the districts and central office. Identified maintenance needs based on the condition of VDOT maintained pavements and bridges often go unaddressed because identified program needs must compete for funding from VDOT's maintenance allocation. As part of its analysis of the VDOT maintenance program, JLARC staff assessed the estimated cost to repair all pavements and bridges identified as needing some maintenance attention.

As identified in Chapter II, 20 percent of Virginia's interstate and primary pavements are considered deficient. Based on an analysis of these 2,207 directional miles using VDOT's average contracted maintenance overlay costs for FY 2001, the estimated cost to provide a structural pavement overlay for all deficient pavements is at least $105.6 million. Analysis of the estimated cost to repair or rehabilitate all bridges identified as needing maintenance attention for which VDOT has primary maintenance responsibility indicates a more substantial funding need of more than $1.5 billion.

While VDOT is currently in the process of developing preventive maintenance strategies for pavements and bridges in an effort to reduce the need for later rehabilitation, these systems are not in place at this time. Additionally, estimates of pavement rehabilitation needs include some interstate pavements currently included in the VMS contract, and would not be the responsibility of the maintenance program. Similarly, the estimated bridge repair and rehabilitation needs includes bridges that would currently qualify for federal rehabilitation funds and would not necessarily have to be funded out of maintenance allocations, as well as some bridges that are currently in the Virginia Transportation Development Plan (VTDP).

Given time, personnel, and funding constraints, it is not possible for the department to fully fund these needs in a single year. Therefore, the primary purpose of this analysis is not to establish specific funding recommendations to the General Assembly, but rather to assess the adequacy of current funding for meeting identified maintenance program needs over the long term.

Estimated Costs for Pavement Repairs is $105.6 Million

The Virginia Pavement Management Program (PMP) was established to provide an assessment of the general condition of Virginia's interstate and primary pavements, and as a tool to aid in the planning and scheduling of rehabilitative and preventive maintenance activities. While the PMP is currently not able to estimate the costs of pavement maintenance needs for the purposes of determining necessary and appropriate maintenance allocations, pavement condition information available from the PMP indicates that there are 364 directional miles of interstate pavements and 1,842 directional miles of primary pavements identified as deficient. Based on an analysis of the most recently completed pavement overlay contracts, it is esti-

mated that in order to provide a structural overlay to all pavements identified as deficient, the asphalt costs alone would be at least $105.6 million. This does not include work on underlying subsurface conditions that would need to be addressed.

Development of Pavement Maintenance Cost Estimates. As stated in Chapter II, using the Critical Condition Index developed by the PMP, there were 2,207 directional miles of interstate and primary pavements identified as deficient. For pavement sections identified as deficient, the two types of rehabilitative pavement maintenance activities that can be employed to address these problems are functional and structural overlays. Functional overlays are designed to provide a new travel surface only and are less than 1½" in depth. Structural overlays, on the other hand, are overlays in excess of 1½" in depth and include work to the underlying substructure in order to correct an identified structural problem. According to VDOT staff, while the functional overlay will address the surface condition, it does not address the underlying causes of the pavement distress. Therefore, a structural overlay is the preferred rehabilitative maintenance activity and is more consistent with the principles of asset management.

According to the State pavement management engineer, the most common type of rehabilitative pavement maintenance activity is a 1½" structural overlay. However, according to VDOT contract management staff, while a 1½" milling and overlay is a good point of reference, it is logical to assume that in order to appropriately correct a specific deficiency, some pavement sections would require more tonnage of asphalt and some would require less. VDOT analysis of the 78 contracts issued for the 2001 pavement overlay schedule indicates that approximately 43 percent of these contracts included a standard 1½" structural overlay, the single largest category of structural overlays.

For the JLARC staff analysis, an estimate of the costs of providing asphalt overlay for the pavement sections identified as deficient was developed by VDOT staff based on the completed contract costs for the 2001 overlay schedule. This estimate was based solely on the total contracted cost for asphalt overlay and, therefore, does not include additional costs to address underlying subsurface conditions, or other project related costs that would be included in a complete structural overlay.

Since actual contract costs for pavement overlays are recorded at the county and route level based on total asphalt tonnage, and are not recorded as a directional mile estimate, in order to standardize to directional miles it was necessary to look at the total cost of the contract, as well as the direction, and total length. Additionally, interstate and primary overlay contracts have different average costs. Therefore, this analysis provides a directional mile estimate for deficient pavements on both the interstate and primary systems. Based on this analysis, the average cost of asphalt overlay for pavements in the interstate system is $80,441 per directional mile, and the average cost of asphalt overlay for pavements in the primary system is $41,437 per directional mile.

VDOT maintenance contract administration staff stated that these directional mile average costs are extrapolated from asphalt tonnage and total mileages

from completed contracts, and would vary with the actual quantity of asphalt used and geographic region. Additionally, VDOT staff further stated that these directional mile estimates do not represent the cost for repairing a specific pavement section. Furthermore, since the average contract cost is given for a standard directional mile and does not account for the total number of lanes in a given section, the directional mile average costs cannot be used to determine a specific contract price for a particular section.

Estimated Cost to Meet VDOT's Road Condition Rating Index Would Be Substantial. Based on this analysis, JLARC staff estimate the total cost for providing structural overlays to 2,207 directional miles of interstate and primary pavements identified as deficient at $105.6 million. Further analysis indicates that the total estimated cost for interstate pavement rehabilitation is $29.3 million, and the total estimated cost for primary pavement rehabilitation is $76.3 million. Table 14 outlines the total estimated cost for statewide pavement rehabilitation needs.

VDOT contract management staff indicated that this would be a conservative estimate of the costs for providing a complete structural overlay to all pavement sections identified as deficient, because this analysis does not include contingency, traffic control, painting, and shoulder reinforcement costs that are directly related to the maintenance activity and would be included in the final contract cost for a structural overlay. Furthermore, VDOT staff indicated the urban areas of the State, such as the Northern Virginia district, require more asphalt tonnage per overlay because of the traffic volumes.

Table 14

Estimated Costs of Pavement Rehabilitation

Road System	Total Deficient Miles	Average Asphalt Cost Per Directional Mile	Estimated Total Cost
Interstate	364	$ 80,441	$ 29,280,524
Primary	1,842	$ 41,437	$ 76,326,954
Total	**2,207**		**$ 105,607,478**

Note: Deficient mileage does not add to total due to rounding. All miles shown in directional miles.

Source: JLARC staff analysis of VDOT pavement condition data and 2001 pavement overlay contracts.

According to the State pavement management engineer, because VDOT uses only State funds for maintenance, there is no trigger for when pavement overlays or routine maintenance should occur, and the executive committee does not support the establishment of such a measure. VDOT staff further stated that the department chose not to use any federal funds in order to avoid these triggers and, therefore, avoid having to place any pavement maintenance projects on the Virginia Transportation Development Plan. Furthermore, according to the State pavement management engineer, VDOT cannot currently perform an accurate assessment of costs to meet all pavement maintenance needs and will not have the ability to estimate these costs until 2003. VDOT staff further stated that it is not possible to provide an estimate of costs associated with routine maintenance for a section of road that is not considered deficient.

Maintenance Program Is Developing Performance Targets for Pavement Condition Ratings. In an effort to balance identified pavement rehabilitation needs with realistic assumptions of annual pavement maintenance activities, the MPLG is in the process of developing performance targets to address the minimum acceptable level of deficient pavements and appropriate annual funding needs. The pavement performance targets are being established to provide a rational basis for developing the biennial maintenance budget based on the existing condition of the asset. These targets are required within the VDOT strategic plan.

The performance target for pavements requires that by 2003 no more than 10 percent of interstate pavements and 20 percent of primary pavements should be considered deficient. As previously stated, currently 20 percent of both interstate and primary pavements are considered deficient. The performance target for pavement appears to be set unnecessarily low since it is currently being met. Additionally, there are no performance targets for the condition of secondary pavements, which account for 71 percent of the miles in the State-maintained system.

Recommendation (5). **The Virginia Department of Transportation should prioritize the development of a system for the determination of pavement maintenance costs for interstate and primary pavement sections. Additionally, the department should develop a process for the identification and tracking of routine pavement maintenance costs for interstate and primary pavements.**

Recommendation (6). **The Virginia Department of Transportation should develop a clear plan for the development of a system for the identification and tracking of both rehabilitative pavement maintenance costs and routine maintenance costs for pavements on the secondary system.**

Estimated Cost for Bridge Repairs Is $1.52 Billion

Since the maintenance and inspection of the majority of Virginia's bridges is mandated by FHWA, VDOT maintains a substantial amount of information regarding existing bridge conditions as well as average repair and rehabilitation costs.

In order to assess the estimated cost of providing more than routine maintenance activities for all VDOT maintained bridges identified as in need of repair or rehabilitation, JLARC staff analyzed the average cost for this level of bridge maintenance work based on the specific condition. Statewide, the cost to address existing needs for VDOT maintained bridges with identified maintenance needs greater than routine activities, is estimated to be $1.5 billion.

This estimate includes bridges that would currently qualify for federal rehabilitation funds and would not necessarily have to be funded out of maintenance allocations, as well as bridges that are currently in the Virginia Transportation Development Plan. Based on discussions with the assistant State structure and bridge engineer, as well as a review of structure and bridge section documents, it appears that the $1.5 billion estimate is consistent with VDOT estimates from 1997.

Development of Bridge Repair and Rehabilitation Cost Estimates. As discussed in Chapter II, VDOT considers a bridge to be in need of repair or rehabilitation if any of the three component condition ratings for the bridge deck, superstructure, or substructure are five or less. Based on this analysis, JLARC staff identified 4,658 bridges for which VDOT has the primary maintenance responsibility with at least one general condition rating of five or less. Using a conservative estimate of average bridge rehabilitation costs provided by the VDOT structure and bridge section, JLARC staff estimated statewide bridge maintenance needs based on the specific condition of each bridge's deck, superstructure, and substructure with a rating of five or less.

In order to obtain the most complete picture of bridge repair and rehabilitation costs, a unit cost estimate based on the specific condition causing the bridge to be classified as in need of repair or rehabilitation was developed using average prices provided by VDOT staff. For bridges with deck conditions considered in need of maintenance attention, rehabilitation costs were determined based on an estimate of $45 per square foot for the total square foot area of the bridge deck. For bridges with superstructures considered to need repair or rehabilitation, the total square footage of the superstructures was multiplied by $60 per square foot. Finally, for bridges with substructures considered to be in need of some maintenance activity greater than routine maintenance, the total number of substructure units was multiplied by $10,000 per unit. The assistant State structure and bridge engineer stated that these are standard prices, which vary with quantity and geographic region. Additionally, VDOT staff further stated that these unit prices do not represent the cost for repairing a randomly selected bridge without further details of the specific repairs needed.

The three primary types of bridge decks within the State maintained system are concrete, timber and steel. For the purposes of this analysis, JLARC staff looked only at the costs of repairing or rehabilitating concrete or wooden deck bridges. Based on the recommendation of VDOT staff, steel deck bridges were not included in this analysis because they represent a minimal number of statewide bridges and have substantially higher repair and rehabilitation costs. Furthermore, the unit prices employed in this analysis were conservative, and according to VDOT

staff, average costs for the repair and rehabilitation of wooden decks and substructures would be considerably higher.

Costs to Repair or Rehabilitate Identified Bridges May Be Substantial. As part of this analysis, each of the 4,658 bridges for which VDOT has the primary maintenance responsibility and were identified as needing repair or rehabilitation was evaluated for each deck, superstructure, and substructure condition that was rated as five or less. Therefore, a bridge that was rated as needing maintenance attention for more than one general condition rating is included in the total estimate for each condition. According to VDOT staff, it is appropriate to count the bridge for each category, because work would need to be done to correct each component that needed repair or rehabilitation. However, the assistant State structure and bridge engineer stated that repairing a superstructure could potentially raise the deck condition above that considered to be in need of repair or rehabilitation. Based on this analysis, the total bridge repair and rehabilitation costs for VDOT maintained bridges are more than $1.52 billion. Table 15 outlines bridge maintenance needs for bridges which VDOT has the primary maintenance responsibility.

Since this estimate includes all VDOT maintained bridges with an identified need for maintenance beyond routine maintenance, it includes bridges that would qualify for federal rehabilitation funds, and would therefore not necessarily have to be funded through maintenance allocations. According to the 2001 JLARC

Table 15

Estimate of Statewide Bridge Repair and Rehabilitation Needs

Condition		Deck			Superstructure			Substructure			Total Estimated Cost
Description	Rating	Number	Total Sq. Ft. (In 1000s)	Cost Per Sq. Foot.	Number	Total Sq. Ft (In 1000s)	Cost Per Sq. Foot.	Number	Total Number Units	Cost Per Unit	
Fair	5	2,041	11,239.2	$45	2,083	11,002.8	$ 60	2,287	8,263	$10,000	$1,248,562,000
Poor	4	430	2,000.9	$45	708	2,204.9	$ 60	410	1,433	$10,000	$ 236,664,500
Serious	3 or Below	14	139.9	$45	47	427.4	$ 60	10	108	$10,000	$ 33,019,500
Total		**$ 602,100,000**			**$ 818,106,000**			**$ 98,040,000**			**$1,518,246,000**

Notes: Condition totals are greater than the total number of identified bridges in need of repair or rehabilitation because bridges may have more than one general condition rating that needs maintenance attention. Unit costs to repair bridges identified as "serious" would likely be higher than the estimated unit cost.

Source: JLARC staff analysis of VDOT bridge condition data.

report, *Equity and Efficiency of Highway Construction and Transit Funding*, currently 1,340 bridges would qualify for federal rehabilitation and reconstruction funds. VDOT receives approximately $100 million annually from FHWA for reconstruction of these bridges. Additionally, this estimate includes some bridges that are currently in the Virginia Transportation Development Plan and are scheduled to be replaced.

This estimate, however, does not include a contingency estimate or costs for maintenance of traffic. According to the assistant State structure and bridge engineer, costs for maintenance of traffic can add 30 to 50 percent to the total cost of the project. Additionally, this estimate looks only at the costs for restoring the bridges identified as in need of more than routine maintenance to their originally constructed state and does not include any costs associated with the widening or lengthening of existing bridges. Furthermore, this analysis does not include an estimate of the costs to repair or rehabilitate the majority of bridges in the urban system and other bridges for which VDOT does not have primary maintenance responsibility.

A similar analysis conducted by the VDOT structure and bridge section in April 1997 indicated that total estimated bridge maintenance and replacement needs were over $1.55 billon for the State maintained system. Additionally, the assistant State structure and bridge engineer stated that because VDOT uses maintenance funds to completely replace some bridges, and uses private contractors for the preparation of replacement plans, identified maintenance and replacement funds might be even higher.

Review of existing bridge rehabilitation needs identified by the districts indicates that funding for bridge maintenance may not be adequately prioritized within the maintenance base budget. The following example from the FY 2003 - 2004 maintenance program's supplemental budget development document illustrates this point:

> *For the Fredericksburg district, additional funds are required in order to implement a proactive bridge rehabilitation program within the Fredericksburg district. Bridge safety inspection results found in the HTRIS report "District Maintenance Management Report-Full Report" lists approximately 300 structures that require major maintenance or rehabilitative work. The current cost estimate to complete this work is over $36,000,000.*

The Fredericksburg district, which has the fewest total number of bridges, has identified 300 structures and bridges requiring major maintenance or rehabilitative work. According to JLARC staff analysis, 47 percent of the bridges in this district are considered in need or repair or rehabilitation. Additionally, the Hampton Roads district has identified $42 million in bridge needs that it is not currently able to fund. According to the Hampton Roads district maintenance engineer, "some of these bridges are considered critically deficient," with at least one general condition rating of three, and the district is only able to provide the minimal level of investment needed to keep the bridges open to traffic.

Furthermore, VDOT structure and bridge section documents indicate that in order to ensure that the condition and performance of Virginia's bridges remains at the current level of service, additional funds need to be identified for ordinary bridge maintenance work. These documents further indicate that severely deteriorated or non-maintainable bridges should be placed in the Virginia Transportation Development Plan in order to free existing maintenance funds for actual bridge maintenance activities.

Maintenance Program Is Developing Performance Targets for Bridge Condition Ratings. As part of its development of performance targets, VDOT has identified certain objectives for bridges. The goal being developed for bridges states that through the year 2003, the maintenance program will maintain a minimum of 60 percent of bridges on all systems with a general condition rating of six or greater. The current condition of Virginia's bridges indicates that because 40 percent of bridges are identified as in need of repair or rehabilitation, VDOT has met the strategic outcome area.

Since a performance target needs to present a reasonably attainable goal for bridge repair and rehabilitation needs, it is not feasible to assume that the maintenance program would be able to address all bridges identified as needing more than routine maintenance. However, it is important that the performance targets establish a clear prioritization for the repair and rehabilitation of bridges in order to more appropriately distribute maintenance allocations. Therefore, the current maintenance strategic outcome area for bridge maintenance, as well as the resulting performance target, does not provide a meaningful target for bridge maintenance and should be refined in order to more appropriately prioritize the repair or rehabilitation of bridges with identified maintenance needs greater than routine maintenance.

Recommendation (7). **The Virginia Department of Transportation should review the adequacy of current strategic planning for pavements and bridges. This review should include, but not be limited to, an assessment of performance targets for pavements and bridges being developed by the Maintenance Program Leadership Group. The findings of the assessment should be reported to the House and Senate Transportation Committees.**

Funding Available for Highway Maintenance Is Constrained

As noted earlier in this report, the General Assembly addressed the importance of maintaining the State's existing highway systems relative to the department's other functions by mandating that highway maintenance be funded first. The CTB receives a recommended allocation amount for the maintenance program from VDOT as part of its annual budget process. Typically, the CTB does not alter the amount provided in the budget.

Despite the requirements in section §33.1-23.1 of the *Code of Virginia*, it does not appear that a reasonable and necessary amount of funding is being allocated to the maintenance program. As previously described, current pavement and bridge conditions would require a substantial increase in maintenance funding in order to be rated at a satisfactory level. Nonetheless, VDOT's actions related to the highway maintenance program have not coincided with those requirements, in part because of competing funding needs and the inability to define its actual needs.

In its December 2000 final report, the Governor's Commission on Transportation Policy recognized the current maintenance funding environment in finding:

> [I]f maintenance costs continue to escalate and costs are not reduced or additional funding is not available, the Commonwealth may be faced with a choice of cutting back on the amount of maintenance on roads and highways.

Many maintenance managers interviewed for this report similarly indicated that while there was not one specific activity or function that was not being performed as a result of funding issues, current funding levels were requiring them to reduce the levels of maintenance across the systems.

The department's FY 2000-2002 biennium decision package submitted to DPB requested an increase of more than $90 million in funding for maintenance activities, of which $52 million (57 percent) was categorized as "Mandates/New Inventory" for which VDOT would have been required to maintain regardless of additional funding. Almost all of the district maintenance engineers interviewed indicated that current funding levels were impacting the districts' ability to provide adequate highway maintenance.

Current economic conditions have also affected funding amounts. Although VDOT's annual budget identifies the FY 2002 allocation for the maintenance program as approximately $872 million, in August 2001 the district maintenance engineers were told to identify reductions in their programmed activities amounting to about five percent of the allocation total, or $43 million. According to the director of the maintenance division's fiscal section, the district maintenance engineers were told to re-program their activities as if their allocations had been reduced to the FY 2001 amount of about $828 million. The 2000 Appropriations Act appropriated $848 million for FY 2002.

This action was taken based on concerns of the deputy commissioner for project management, in communication with the assistant commissioner for finance, that revenues to the Highway Maintenance Operating Fund may not equal projected revenues. The deputy commissioner told JLARC staff that by identifying those projects now, it would lessen the impact that any necessary reductions may have at the end of the fiscal year.

The Secretary of Transportation, the deputy commissioner for project management, and the State maintenance engineer stated in interviews that these

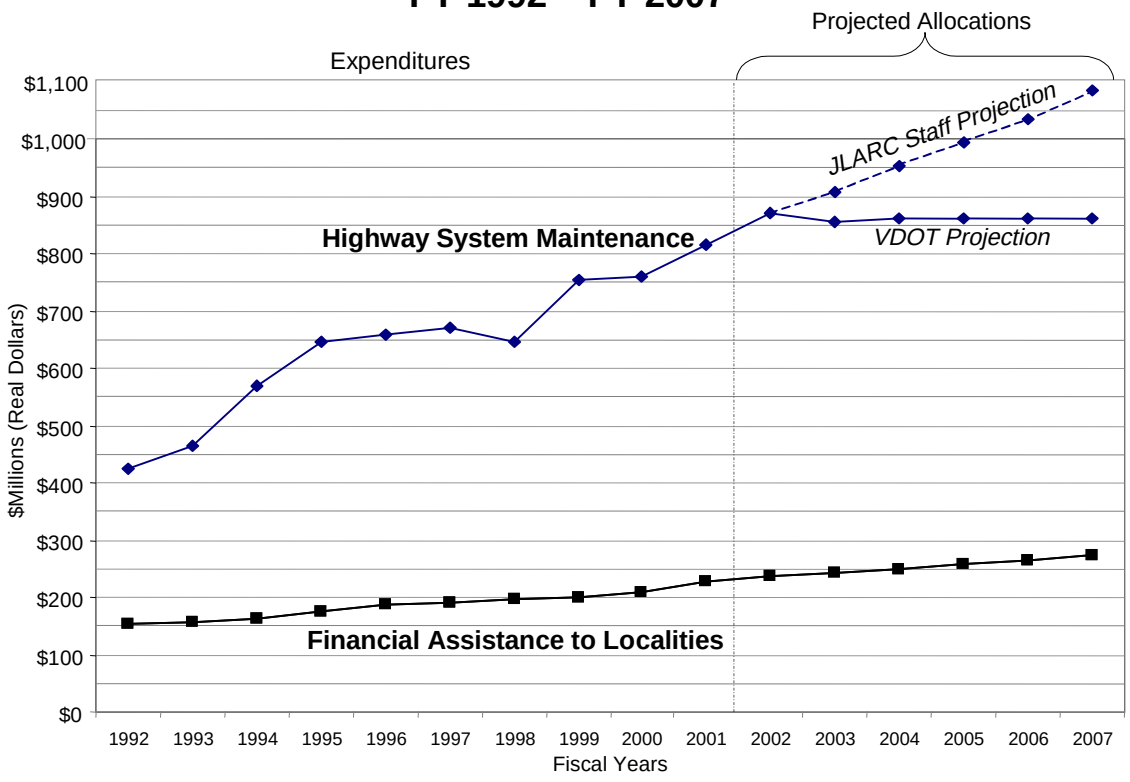
actions reflect proper financial management with respect to certain situations. This action, initiated even before the current economic environment nationwide, raises questions about the priority of the funding available for highway maintenance and the maintenance program's ability to meet the work schedule it prepared for FY 2002.

There is also some question as to whether the projects being identified for delay could be advertised, let, and completed by the end of the fiscal year. As mentioned previously, contracting for certain work, particularly pavement overlays, can be an extensive process. Because the maintenance program operates on an annualized budget, substantial problems exist with getting contracted work advertised and completed in a single fiscal year. According to the deputy commissioner for project management, the assistant commissioner for finance promised that funds allocated to specific projects delayed as a result of this action would be carried forward the following fiscal year, if not completed this year.

In addition to this action, the six-year allocation projections for the highway maintenance program appear to understate the funding that will eventually be required by approximately $670 million, based on past VDOT expenditures (Figure 12). These projections indicate that after receiving $872 million in FY 2002 and

Figure 12

Expenditures and Projected Allocations for Highway System Maintenance and Financial Assistance to Localities FY 1992 – FY 2007



Source: JLARC staff analysis of VDOT data.

$855 million in FY 2003, maintenance will be allocated approximately $861 million beginning in FY 2004 and continuing through FY 2007. Because the total amount of funding available for construction projects depends on the amount of funding left over after the funds are allocated for maintenance and other functions, projecting a level amount of funding for the maintenance program appears to provide extra funding for the construction program during those years.

However, not accounting for likely future increases in maintenance costs, such as those related to annual increases in fixed costs such as labor, materials, and fuel, raises substantial questions regarding VDOT's commitment to maintaining the State's highway system as required by law. Moreover, this is not consistent with the history of maintenance expenditures in the previous six fiscal years, in which expenditures increased by 4.39 percent, compounded annually. Furthermore, the same six-year projections indicate that VDOT expects the financial assistance to the localities for maintenance of streets and roads to increase by about three percent from FY 2004 to FY 2007. Because this allocation is driven by formula reflecting annual changes in the fixed costs mentioned previously, it is unlikely these costs will not also increase for VDOT.

In FY 2002, FEMA reimbursements accounted for almost $23 million in additional funds available for the highway maintenance program. Between FY 1997 and FY 2002, the average FEMA reimbursement was approximately $11 million. Therefore, the projections in Figure 12 may be overstated. However, if $78 million were assumed to be the FEMA reimbursement amount over the next six years ($23 million in FY 2002 and $11 for each of the remaining years) then the total amount of under-funding to the maintenance program approaches $590 million.

The former maintenance division fiscal director stated that although VDOT is looking at new technologies to produce cost efficiencies, it is unlikely these efficiencies will be sufficient to overcome the maintenance needs related to an increase in statewide highway assets as well as the deterioration of existing assets, while still providing acceptable increases in the level of service.

In addition, factors outside of VDOT's control such as the Virginia Transportation Act (VTA) passed by the 2000 General Assembly may have indirectly impacted the maintenance program. The VTA provided General Fund dollars for previously delayed construction projects and also provided mechanisms to generate additional funding to be used for construction.

While there are claims of under-funding for highway maintenance, the program is unable to identify its needs in a systematic way. Therefore, it is difficult to quantify the true funding needs of the maintenance program. The implementation of an asset management process and the development of the components of the Integrated Maintenance Management Program were supposed to deliver the tools necessary to identify the exact costs of maintenance needs. While Virginia is one of the first states in the country to attempt to implement asset management, these attempts have been significantly delayed several times since beginning in 1996, as will be discussed in Chapter IV. Therefore, the maintenance program is still unable to identify what its actual needs are versus what activities it currently performs.

Additional Funding May Be Needed to Address Highway Maintenance Deficiencies

Although the *Code of Virginia* requires CTB to prioritize a reasonable and necessary amount of funding for highway maintenance, it would appear that funding needs of the maintenance program are not being met. The deficiencies in Virginia's interstate and primary pavements as well as bridges needing maintenance attention identified by the JLARC staff analysis may require as much as $1.6 billion in additional funding for the maintenance program in order to bring those assets to an acceptable level. Moreover, these estimates do not include additional funding that may be required for secondary road pavements or other assets that may be deficient. VDOT has also taken some actions that appear to lessen the funding priority the *Code of Virginia* gives the maintenance program, including limiting the availability of supplemental funding before needs are identified and projecting level funding after the end of the next biennium.

Because additional funding should be provided to the maintenance program in order to address the identified deficiencies, VDOT should place a priority on finishing development and implementation of its asset management strategy. Under the current reactive approach to highway maintenance, the maintenance program may be performing activities that do not substantially impact the entire highway system. According to VDOT maintenance managers, one of the primary benefits of using an asset management approach would be the ability to proactively identify those functions that will provide the greatest return on investment. Therefore, any additional funding should be coupled with a stronger management process than now exists.

Recommendation (8). **The Commonwealth Transportation Board should more specifically define what level of funding is reasonable and necessary for the maintenance of all the State's highway systems and the streets and roads not maintained by the State. The Commonwealth Transportation Board should provide additional funding to the maintenance program to address deficiencies identified in this report.**

VDOT OVERSIGHT OF ROAD MAINTENANCE PAYMENTS TO LOCALITIES NEEDS IMPROVEMENT

Since 1997, Virginia has provided approximately $1 billion to the cities, certain towns, and the counties of Arlington and Henrico for the purposes of maintaining streets and roads. While VDOT does not directly maintain the more than 10,000 center line miles of roadways in the urban system, it is responsible for distribution of the State's payments to the localities required to maintain those streets, as well as oversight for the quality of the maintenance being provided. Additionally, the State makes payments to the counties of Arlington and Henrico for maintenance of certain secondary roads. However, VDOT has no oversight responsibility for these roads.

Although the State has provided substantial funding for maintenance of the streets and roads in the urban system and the two counties, many of the recipients claim these payments have been inadequate. JLARC staff analysis of VDOT urban division accounting and expenditure annual reports indicates that from FY 1997 to FY 2000, cities and towns spent about $207 million more for maintenance and maintenance related construction than was received through State payments. In addition, the method for calculating annual changes in the level of payments has been widely criticized as inadequate for capturing the changes in maintenance costs for localities. It also appears that language in the *Code of Virginia* concerning when a town must assume responsibility for maintenance of its roads may be anachronistic and should be amended to reflect more relevant criteria.

Nonetheless, except for bridges, there is little uniform data regarding the condition of road assets, such as pavement or traffic signals, available to determine the statewide conditions in the localities. Furthermore, VDOT does not perform any statewide systematic review of these conditions, although it does perform an annual evaluation of a small percentage of these roads and reviews the forms certifying expenditures by the localities. While the condition of bridges is required to be reported to FHWA, VDOT does not require any other standardized evaluation of maintenance conditions. As a result of national accounting standards, many localities are going to be required to begin reporting this information in the future.

Adequacy of Financial Assistance to Localities for Maintenance

Between FY 1997 and FY 2001, cities and towns responsible for the maintenance of streets within their jurisdictions received more than $850 million in payments from the State. However, §33.1-41.1 of the *Code of Virginia* provides only broad guidance that annual payments for roads in the urban system:

> ...shall only be made if those highways functionally classified as principal and minor arterial roads are maintained to a standard satisfactory to the Department of Transportation.

In order to ensure that roads in the urban system are maintained to a satisfactory level, the resident engineer for each residency containing a city or town is required to conduct an annual evaluation of all of the principal and minor arterial roads maintained by the cities and towns.

Additionally, between FY 1997 and FY 2001, VDOT provided more than $132 million for secondary road maintenance to the counties of Arlington and Henrico. The two counties provide VDOT with an annual update on the amount of lane mileage maintained within those jurisdictions. According to the State secondary roads engineer, VDOT does not perform the same condition assessment in Arlington and Henrico as is done for the urban system. Without a more comprehensive system for evaluating the conditions of the roads and streets in the urban system and the counties of Arlington and Henrico, there is no formal way of assessing the appropri-

ateness of the maintenance payments currently provided to them or the adequacy of the maintenance activities performed.

Virginia Provides A Significant Amount of Funding for Local Street Maintenance. The *Code of Virginia* currently requires VDOT to make annual payments to 40 towns and all 39 cities for purposes of maintenance, construction, and reconstruction of the roads within those jurisdictions in addition to the urban construction allocation. These payments, which totaled more than $228 million in FY 2001, are made by the department based on moving lane-miles (functionally classified as principal / minor arterials or collector / local roads) multiplied by an annual rate per lane-mile. Likewise, the *Code of Virginia* also requires the department to provide annual payments to any county that has withdrawn from the secondary system of State highways. Payments to the counties are also made on a per lane-mile rate. Currently, only Arlington and Henrico maintain the secondary roads in their counties.

Base amounts for the payments to cities, towns, and counties were established in FY 1986. Annual assistance to the cities and towns was set at a rate of $7,787 per lane mile for principal / minor arterials, and at a rate of $4,572 for collector / local roads. Payment to the county of Arlington was set at $7,201 per lane mile, while Henrico's base amount was determined at $3,616 (CTB provided a one time supplement in FY 2001 increasing the per lane mile amount to $5,424.) A maintenance cost index (MCI) of the unit costs for labor, equipment, and materials used in highway maintenance is used to adjust the annual payments per lane-mile. As a result of the MCI, the value of the base has increased by approximately 58 percent since its inception in 1985. The FY 2001 rate for arterials was $12,319 per mile and $7,233 per mile for local roads. Secondary lane mileage rates for the counties of Arlington and Henrico were $11,392 and $8,517, respectively, in FY 2001.

The amounts received by the localities are supposed to cover all street maintenance activities, including bridge maintenance needs. Some localities also include activities outside those VDOT performs and on which the MCI is calculated, such as leaf collection, and maintenance of alleyways and refuse containers. Of the more than $228 million paid to cities, towns, and counties in FY 2001, 16 percent was for the two counties. The value of these payments has grown by slightly more than three percent compounded annually since FY 1991.

Reported Maintenance Expenditures Were Greater than Payments. According to responses from the JLARC staff survey of cities and towns, 92 percent of those localities reported expenditures in excess of payments provided by VDOT. Moreover, 76 percent of survey respondents indicated that total local expenditures for street maintenance activities were insufficient to meet locally identified maintenance needs. Analysis of total expenditures and allocations for local street maintenance, illustrated in Table 16, indicates that on average, the total local street maintenance expenditures exceeded VDOT payments by more than $51 million from FY 1997 through FY 2000. Furthermore, local survey respondents indicated that:

> Because funding is not sufficient enough to allow all maintenance operations in a timely basis, we are frequently required

Table 16

Cities and Town Expenditures for Maintenance Exceeded State Payments, FY 1997 - FY 2000

Function	FY 1997	FY 1998	FY 1999	FY 2000
Local Expenditures	$ 214,127,191	$ 225,666,006	$ 239,753,255	$ 231,407,520
VDOT Payments	$ 167,679,709	$ 171,401,895	$ 180,990,141	$ 183,467,137
Locality Difference	$ 46,447,482	$ 54,264,111	$ 58,763,114	$ 47,940,383

Note: Payment information is reported from CARS and local expenditures from VDOT's urban division's Accounting of Expenditures and Certification Street Payment Funds Annual Report. Payments include VDOT maintenance of primary roads in 12 towns.

Source: JLARC staff analysis of VDOT urban division data.

> to repair only those conditions deemed absolutely necessary. The results of this shortfall in early [preventive] maintenance results are: much more costly repairs being made only when they rise to the top of the priority list, and a general worsening of the city's street and road system conditions. Also, many times large, one-time projects are not funded.

Interviews with representatives of local governments as well as document reviews have identified concerns that the payments provided by VDOT for local road maintenance are not sufficient to properly maintain the roads. For example, a deputy director within the city of Richmond's department of public works stated that the city has a backlog of $25 million in deferred maintenance needs. He added that for FY 2001, $3 million from the city's general fund was used to cover the difference between the VDOT payment and the actual cost of road maintenance.

The majority of localities indicated that local general fund dollars are used to supplement the considerable differences in locality expenditures and State maintenance payments. Survey respondents indicated that supplements to the city street payments generally came from a locality's general fund. According to one survey respondent:

> Funding (of the) differential between state maintenance revenues and street maintenance expenditures is made up from general fund revenues. Primary general fund revenues include real and personal property taxes, meals and lodging taxes, con-

> sumer utility taxes, business license taxes, bank franchise taxes, and shared sales taxes.

In 1996, §33.1-41.1 of the *Code of Virginia* was amended to allow cities and towns to use these payments for construction or reconstruction, as well as maintenance purposes. However, four of the six cities and towns contacted by JLARC staff indicated these payments were not used for activities that might otherwise be funded through the construction program. For example, street maintenance payments were used for construction and maintenance of curb and gutter, turn lanes, and repair and replacement of sidewalks, as well as other ordinary maintenance activities such as mowing and ditching.

Annual Adjustments to Payments May Not Reflect Actual Changes in Costs. Additionally, the MCI has been criticized for not adequately reflecting the increased costs faced by the cities and counties in providing maintenance work. On the JLARC staff survey, 45 percent of localities reported that the calculation of the MCI did not accurately reflect local maintenance expenditures. However, an additional 31 percent reported that there was insufficient information available regarding the calculation of the MCI to determine if the calculation was accurate. A coalition of 13 cities raised several specific concerns regarding the calculation of the MCI, indicating that it does not include any allowance for depreciation to approximate the costs related to age of the road, usage levels, and other factors. Several individual survey responses further illustrate concern with the adequacy of the MCI:

> The overriding deficiency is the inclusion of bridge maintenance in the moving lane mile calculation. Additionally, equipment rental costs provided by VDOT are far below real market value and the system required to develop a local index is so mired in bureaucracy as to render it impractical to undertake such an effort.
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> We do not believe that that the labor, materials and equipment factors, computed in a statewide MCI, accurately represent cost conditions or functions. In addition, the MCI does not include a "wear and tear" factor that incorporates the effects of infrastructure age and condition. Older cities have "disproportionate" maintenance needs that are not adequately accounted for in the current maintenance funding formula and distributions. VDOT funds these costs directly for roads that it maintains, but they are not accommodated in the funding formulas for jurisdictions that maintain their own roads.

Moreover, an analysis of the adequacy of the MCI conducted by the Virginia Transportation Research Council (VTRC) in 1998 recommended several changes. These included increasing the market basket of goods being used to measure changes to costs in materials, equipment, and labor from 29 items to 62 in order to capture the changed maintenance environment since 1985. For example, the new

basket would reflect increases in the use of private contractors. In addition, VTRC also recommended adopting a new formula to calculate the MCI that "uses more realistic assumptions and allows changes in its base year and item make-up" to more accurately capture changes in costs.

According to VTRC staff, the maintenance program updated the report on urban street payments to reflect more recent costs and submitted it to VDOT's management team for review. However, no action has been taken concerning the implementation of the update. VDOT maintenance staff also indicated that no action has been taken.

Requirement for Localities Performing Own Maintenance Should Be Amended. The *Code of Virginia* requires that following every decennial census localities with a population of 3,500 be required to assume maintenance responsibility for roads within their jurisdiction. This criterion was established in 1932 as part of the Byrd Act. While this criterion may have been an appropriate measure for the time in which the legislation was adopted, it is currently an insufficient measure of local capacity to handle maintenance responsibility.

As a result of this requirement, these towns must either start their own local maintenance program or hire a private contractor in order to carry out those functions. According to the State urban engineer, at that time most towns do not have the staff or the resources to operate street maintenance programs. A town respondent to the JLARC staff survey of localities suggested that the current criterion may not accurately capture conditions in the town because:

> [w]e are very industrialized and have a lot of individuals commute into Town to work. As such, the level of services provided is higher than would be [for] a bedroom community of similar population.

Therefore, in some cases, smaller towns with high vehicle miles traveled may have trouble keeping pace with maintenance needs that are not reflected in the funding formula.

Although the number of towns required to assume responsibility for local street maintenance after each census is small, this criterion does not reflect current conditions. Based on the JLARC staff survey, 43 percent of towns currently receiving State maintenance payments indicated dissatisfaction with the current population criterion. These localities raised the concern that determining local maintenance responsibility based solely on population does not accurately account for the practical demands of operating a local street maintenance program. Respondents to this question indicated a more appropriate criterion would include measures of traffic volumes, vehicle loads, and other local conditions. According to one locality, the population criterion:

> ...should be at least 8,000 - 10,000 citizens, as those localities with less than that would be unable to pay for the maintenance, and it should be VDOT's responsibility to maintain for

those who can not afford to maintain roads themselves, either by performing the work, or providing funding in amounts feasible for those smaller localities to perform the functions themselves.

Recommendation (9). **The General Assembly may wish to amend the *Code of Virginia* to update the criteria for when a town is required to accept responsibility for the maintenance of its streets.**

There Is Limited Information Regarding the Condition of Local Street and Road Assets

Section 33.1-41.1 of the *Code of Virginia* requires the cities and towns to maintain their roads "to a standard satisfactory to the Department of Transportation" in order to receive payments. In order to ensure that these roads are maintained to an acceptable standard, VDOT is required by the urban division program manual to perform an annual inspection of all roads and streets functionally classified as principal or minor arterial streets for the cities and towns receiving maintenance payments.

VDOT is not responsible for providing inspections for collector or local streets, even though they are included in the total mileage for which the locality receives payments. However, a city official responsible for street maintenance told JLARC staff that VDOT's current oversight process is largely cursory. Principal and minor arterials comprised 25 percent of the lane mileage on the urban system in 2000.

At the beginning of each year, VDOT's urban division informs the appropriate VDOT field staff and the cities and towns that it is time for inspections of the roads in the urban system. Inspections typically include: pavements, traffic lights, sidewalks, street signs, and other assets. An assistant resident engineer stated that the process is very informal and basically consists of an annual "windshield survey" inspection of the roadway assets (potholes, cracks, smoothness), noticeable drainage problems, and general pipe condition.

Following each inspection, the department sends a formal notification of the identified deficiencies to the localities, instructing what specific activities need to be done. However, this listing is not based on a representative sample of the total system mileage within the locality. In the spring, the VDOT staff ride the identified road sections with representatives from local public works departments to establish workplans for correcting these deficiencies. In the fall, the urban division asks localities about the current condition of the required repairs. Based on the localities' responses, VDOT field staff perform re-inspections and notify the urban division regarding the quality of the roads.

The urban division uses this information in order to make its decision whether or not to withhold payments. No partial payments are awarded for partial

compliance with VDOT inspections. According to the administrator of the urban division, there have been very few instances in which VDOT has threatened to withhold payments, and no documented case of these payments actually being withheld.

The counties of Arlington and Henrico are responsible for the upkeep and maintenance of more than 4,000 lane miles of secondary roads in their jurisdictions. The counties submit to VDOT an annual report outlining only the total lane miles maintained. However, the *Code of Virginia* does not require an annual inspection of these roads, and as a result, VDOT does not formally evaluate their condition according to the State secondary roads engineer. According to county transportation officials, secondary road maintenance activities and citizen expectations are different than those for roads in the primary or urban systems. Needs identified for the secondary system include: street lighting, litter pickup, street sweeping, mowing and brush clearing. However, since VDOT does not currently have a system in place for evaluating the condition of the secondary system assets in these counties, there is no formal way of assessing the condition of the assets or the adequacy of the payments provided to them.

The overwhelming majority of the localities surveyed and interviewed indicated that working relationships with VDOT staff, as well as the quality of the oversight provided, are very good, and that there is no need to increase this oversight. In addition, the current deputy commissioner for project management and the majority of transportation operations managers responding to the JLARC staff survey indicated that there was no need for an increased VDOT oversight role. Regardless, since these localities have identified a substantial need for increased funding, there appears to be a need for the department to more effectively enforce local oversight.

Recommendation (10). **The General Assembly may wish to amend the *Code of Virginia* to include more specific guidelines for the Virginia Department of Transportation oversight of local maintenance activities for the cities, towns and counties currently receiving State maintenance payments.**

Recommendation (11). **The Virginia Department of Transportation urban division should conduct a comprehensive audit of the annual inspection process conducted by the residencies in order to ensure compliance with department policy. The results of this audit should be reported to both the House and Senate Transportation Committees.**

Conditions of Pavement and Bridges Is Mixed. Nineteen of the localities responding to the JLARC staff survey indicated that the current quality of roads and other assets within their jurisdictions is deteriorating. These advocates point to inadequate levels of payments from VDOT as the primary reason behind this slippage in road quality. These jurisdictions also state that their streets are harder to maintain than the average VDOT-maintained road because of heavier traffic volume and more numerous utilities. However, the majority of survey respondents indicated that while some information was maintained by the locality regard-

ing the condition of pavements, bridges, and traffic control devices, very little information is maintained regarding the quality of other transportation assets.

According to the JLARC staff survey of cities and towns, 90 percent of respondents indicated that the principal and minor arterials in those jurisdictions were in "good" or "very good" condition. Additionally, interviews with VDOT staff and local government representatives indicated that while the arterial streets in most localities are considered to be in good condition, streets in these localities are less well kept than those maintained by VDOT. For example, the deputy director of public works in Richmond stated that only 50 percent of the city's road assets would be considered in fair or better condition. A major complaint among cities is that utility work creates significant pressure on their ability to keep the roads maintained. Although utilities do compensate cities, the amount of this compensation is generally considered by these localities to be insufficient.

Based on responses to the JLARC staff survey, it appears that without a more formal method for assessing the quality of locally maintained transportation assets, there is no accurate way of assessing the condition of pavements maintained by localities. Several survey responses further illustrated this point:

> Due to funding constraints we have not resurfaced residential streets (collector and locals) since 1986. Our current maintenance efforts include patching, crack sealing and slurry sealing of moderately distressed pavements, when funds are available. Many miles of local streets are in need of milling and resurfacing. Additionally, many miles of local streets need drainage improvements, including expanded outfalls, increased collection system piping and roadside ditch elimination in densely developed areas where ditches pose safety problems.
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> The collector and local streets need to be in better condition. These streets are now in a 25 year life cycle which should be reduced to a 15 year life cycle. Many of these streets are in need of some type of resurfacing, or complete reconstruction or minor repairs, followed by resurfacing. This is mainly due to funding being spent on arterials to maintain them in good condition.
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> The level of ordinary maintenance (preservation) is insufficient to preserve the public investment in roads, streets, sidewalks, traffic signals, signs and markings. The level of maintenance replacement (restoration) of the same asset group is insufficient to reduce the backlog of deferred maintenance. More preventive maintenance of roads and streets (for example, sealing) and traffic signals, signs and markings (for example, relamp-

> ing, sign inspection) should be done. We estimate that at least $3,000,000 more should be spent annually on preventive maintenance activities, system-wide. More resurfacing, rehabilitation and reconstruction of roads, streets and sidewalks and more replacement of traffic signal equipment, signs and markings should be done. We estimate that at least $5,500,000 more should be spent annually on deferred maintenance to reduce the backlog within a reasonable period of time, say five to seven years.

Additionally, it appears that the condition of the bridges located in the localities may be deteriorating and, based on the 40 percent of VDOT maintained bridges identified as in need of repair or rehabilitation statewide, this may have a considerable impact on local street maintenance program budgets. According to one locality:

> Many of the bridges in the system are old and in need of replacement. This impacts the Town from both maintenance and future improvements in the Six Year (Improvement) plan. There are currently two bridges in the Transportation plan for replacement in the next seven to nine years. Since we are only eligible to receive $360,000 for new construction and the bridges are estimated at $2,000,000 total the long[er] they take to be replaced, the greater burden they are on maintenance. The Town has invested $15,000 in renovations to one bridge. With the recent flooding, we have $72,000 worth of additional work to make bridges safe. That does not take into consideration the $150,000 to replace a local bridge that is not eligible for inclusion in the Transportation plan.

No Uniform Measurement of Conditions Exists. There is some concern because no policies exist regarding the level of quality required for local roadways not directly maintained by the State, that there is currently no way to accurately assess the condition of these roadway assets. According to a local transportation official, aging networks of local roads are beginning to impact the overall quality of local road systems, further compounding this concern. Additionally, the concerns have been raised that VDOT does not currently prioritize the problems it identifies as part of its review of locally maintained streets, and that there are only limited mechanisms for ensuring that any identified deficiencies are corrected. Survey responses indicate that 92 percent of localities predominately employ a windshield survey for the evaluation of local pavement conditions. According to one survey respondent:

> The Street Superintendent, Public Works Director, and Town Manager drive and rate streets annually. The lack of financial resources and personnel limit our ability to utilize more sophisticated methods of evaluation.

Nonetheless, some localities have begun implementing automated systems for measuring pavement quality. Recent changes in federal accounting standards are requiring State's and local governments to capture the capital costs of their transportation infrastructures for the first time. As a result, some Virginia localities have opted to implement automated pavement condition analysis systems in order to more accurately report this information. Based on interviews with transportation officials for both the City of Virginia Beach and Arlington County, it appears that some localities have already implemented these systems using off-the-shelf products; however, there are currently no State criteria for the data that are maintained.

Additionally, 17 percent of survey respondents indicated that they currently use, or are in the process of developing, an automated pavement management system similar to those employed by VDOT and several localities. A number of these localities indicated that while software is currently available for performing this analysis, it requires a substantial investment by the locality. According to one survey respondent:

> The Street Division of Public Works is currently in the process of implementing a pavement management system utilizing Micro-Paver, which was purchased from the American Public Works Association. In the past, and at the present time (until Micro-Paver is fully implemented) the division performs mainly windshield inspections. Streets are field inspected for pavement distress such as alligatoring, ruts, areas of base failure, potholes, utility cuts, rutting, etc. After inspecting the street the division then decides whether to perform complete reconstruction of the street, only overlay, or mill and resurface. Requests for street paving are reported by citizens, city supervisors or other departments. These streets are placed on a "master list of streets requiring resurfacing" maintained by Street Division of the Public Works Dept. They are reviewed annually and paving is determined by the type of maintenance activity required and availability of funding. Streets that are not addressed at this time are maintained on the "master list" until the following year at which time the list will be reviewed again.

A formalized and statewide perspective of the actual conditions of the pavements and other assets maintained within the cities, towns, and counties that receive State payments for maintenance purposes, similar to the evaluations performed at the State level, should be implemented in order to provide the CTB with more information about funding needs in these localities.

Recommendation (12). **The Virginia Department of Transportation should study the estimated costs for establishing and implementing a uniform measure of pavement quality for road surfaces in the urban system as well as roads maintained by counties that opt out of the State system. If possible, the department should also consider expanding the use of Inventory and Condition Assessment System methodologies to a represen-**

tative sample of assets in the urban system and secondary system not maintained by the State.

Recommendation (13). **The General Assembly may wish to consider amending the *Code of Virginia* to require the Virginia Department of Transportation to develop a uniform reporting instrument for the cities, towns, and counties receiving State maintenance payments. This report should include, but not be limited to, total allocations and expenditures for maintenance of local streets and roads, as well as the types of maintenance activities performed in those localities.**

IV. Management of the Maintenance Program

As described previously, VDOT is attempting to implement an asset management approach for the maintenance of all its assets. This approach prioritizes the monitoring of highway assets using a preventive strategy to maintain those assets in a way that is cost-effective and provides the greatest benefit to the highway systems overall. VDOT has already adopted some asset management principles and contracts a portion of Virginia's interstate highways using a performance-based approach. For example, a statewide authority, the Maintenance Program Leadership Group (MPLG), has been established within the maintenance program to address funding, scheduling, and resource allocation issues. While other states have also begun using long-term, performance based contracts, some states also still perform condition assessments for substantial portions of their highway systems.

Nonetheless, VDOT's attempts to implement an asset management strategy have been delayed for various reasons since the project's inception in 1996. These reasons include: delays in data gathering needed for automated systems, decisions on the scope of the project, and prioritization of other automated systems within the department at the expense of the maintenance program. Despite spending $39 million on systems development, an important component of the automated systems was delayed recently as the department attempts to implement a system to integrate all of VDOT's information needs. As a result, the future of the Integrated Maintenance Management Program (IMMP) is uncertain at this time.

In addition to the global management changes associated with asset management, there are several incremental management processes that could be strengthened in order to better utilize the resources used by the highway maintenance program. These include: measuring the productivity of the current resource allocations including staffing and funding to develop more efficient provision of activities, the re-allocation of unexpended funds at the end of a fiscal year, and the improved usage of information VDOT already produces concerning equipment utilization. Finally, VDOT should develop and complete the best practices manual that was supposed to supplement the changes in the *Maintenance Policy Manual* implemented in 1994.

VDOT SHOULD PLACE A HIGHER PRIORITY ON IMPLEMENTATION OF ASSET MANAGEMENT

While VDOT claims to be a leader across the country in trying to implement an asset management approach to highway maintenance, it appears not to have placed a high priority on development and implementation of asset management for work performed by State forces. In order to implement asset management, VDOT must be able to identify its assets, determine the condition of those assets, and establish performance targets for maintaining those assets. VDOT has twice

delayed the development of the Integrated Maintenance Management System (IMMS) that would be used to carry out these functions. Several VDOT staff have indicated that IMMS is critical to achieving an outcome-based approach to maintenance, and providing the department with a statewide inventory and comprehensive condition analysis of its highway assets.

The Government Accounting Standards Board Statement 34 (GASB-34) has provided recommendations for state departments of transportation to implement a more financially accountable approach to asset management by instituting a federal-level reporting requirement on highway infrastructure assets. Information generated from this new asset management approach to maintenance will assist VDOT in prioritizing activities and allocating funding and other resources, based on a statewide, preventive system. VDOT has developed some automated systems needed to implement asset management, but these do not yet provide an integrated capability. A small number of private contractors have implemented asset management approaches on a limited basis, while other states are beginning to develop their own approaches. However, no state, including Virginia, has implemented a statewide program to the extent that VDOT envisions.

Although VDOT was prepared to release a request for proposal (RFP) for its IMMS project in April of 2001, the department decided instead to halt all technology projects in lieu of developing a single, department-wide integrated system. According to VDOT's chief information officer, this new system initiative, called Synergy, will include the same business requirements developed by the maintenance program for IMMS, but it is unclear what priority the maintenance program's needs, related to asset management, will have. Despite the importance of this system to the maintenance program, Synergy appears to be progressing without a clear plan or specific project estimates for costs of development and implementation.

VDOT's Development of Asset Management

VDOT is in the process of converting its current activity-based approach to maintenance to a more preventive outcome-based approach, known as asset management. In so doing, the department hopes to gain a better understanding of its highway asset inventory and the condition of those assets, for the purpose of more efficiently and effectively budgeting and planning maintenance activities. For example, the State maintenance engineer pointed out that the maintenance program is starting to consider lifecycle costs on assets in determining needs, rather than simply concentrating on assets that are in the worst condition.

To accomplish this goal, VDOT has been developing the IMMP to consist of several automated systems. Eventually, the information captured by these systems was to be integrated through the IMMS to produce a statewide perspective of maintenance needs. The IMMS would also provide several options for maintaining the entire system based on funding levels and desired outcomes.

During the development stages of IMMP, VDOT has been gaining experience with the operation of asset management through its contract with VMS for the

maintenance of certain segments of Virginia's interstates. According to both VDOT and VMS staff, VMS has been aiding VDOT with development of its asset management program. Other state departments of transportation have also begun experimenting with performance based asset management contracts, as well as certain inventory identification and condition assessment practices.

Asset Management Is a Preventive Maintenance Process. In the mid-1990s, VDOT began taking steps toward developing an asset management approach on its highway maintenance activities and systems. This approach prioritizes monitoring highway assets and optimizes the preservation, upgrading, and timely replacement of those assets through cost-effective management, programming, and resource allocation decisions. In response to advances in technology and the rapid deterioration of the country's aging road systems, Federal Highway Administration (FHWA) has endorsed asset management as the future direction of highway maintenance for all state departments of transportation.

In addition to the long-term benefits of a preventive maintenance strategy, changes in state and local accounting standards are also pushing forward the use of asset management. GASB-34 requires all states to report on new infrastructure assets beginning after June 15, 2001, and all infrastructure assets by four years later. This will require VDOT to present the inventory and value of its long-lived, stationary capital assets in the Comprehensive Annual Financial Report starting in FY 2002. Assets to be reported on for this federal requirement include: roads, bridges, tunnels, drainage systems, water and sewer systems, dams, and lighting systems. According to GASB-34 guidelines, reporting on these assets can be presented either by depreciating infrastructure assets or using a "modified approach," whereby states may use a "preservation" system to maintain the infrastructure at a certain level. Because VDOT has not yet fully implemented a maintenance system capable of sustaining the modified approach, it will continue to use the depreciation method until such a system becomes available.

In the early 1980s, VDOT collected a complete inventory of its statewide highway assets with the intention of more effectively monitoring asset conditions in order to make better decisions regarding the priority of highway maintenance activities. According to several VDOT personnel, the information was collected and transcribed onto paper diagrams of roadways. This massive effort was extremely time consuming and difficult to maintain. Several VDOT employees involved with the data collection stated that it produced detailed "paper information" on the location of State assets, but that, as a result of limited technology at the time, the inventory was ultimately never used in a formal way to provide preventive maintenance. Since then, VDOT has generally relied on the knowledge and expertise of many tenured field workers to "eyeball" assets and assess their needs for priority funding, although pavement and bridge assets have tended to be more strictly regulated by State and federal laws.

VDOT maintains Virginia's system of highways through a largely reactive approach to deteriorating or failed conditions. This approach to maintenance focuses on specific activities performed rather than outcomes achieved, and tends to lend itself to deficiencies in assessment and planning. The process of managing as-

sets, along with evaluating maintenance needs, has been decentralized across the districts, residencies, and area headquarters. As a result, some district maintenance engineers have raised concerns that perhaps the department has not been providing a system through which consistent and optimal maintenance operations can be achieved on Virginia's highway assets.

The asset management approach is not intended to replace the way maintenance work is currently being performed. Instead, according to VDOT documents, this new approach is supposed to improve the effectiveness of resource utilization, resource acquisition, and asset condition optimization. Many VDOT staff believe that once fully implemented, asset management will provide an objective and detailed assessment of the quality of highway assets. To make this happen, contracting must still occur. The executive vice-president of the Virginia Road and Transportation Builders Association suggested VDOT continue doing ordinary maintenance but contract out the inspection process and larger maintenance activities for asset management.

If VDOT were to begin letting performance based contracts for a substantial portion of its maintenance functions, then the importance of oversight and evaluation of performance would also increase. To that end, the business of maintenance will likely change after the implementation of asset management, while the actual work associated with maintaining the highway system is supposed to remain unchanged. The development of an asset management process will impact the way in which individual maintenance crews conduct their day-to-day activities. Probably the largest impact will be felt down through the districts, particularly at the residencies and area headquarters. One district maintenance engineer suggested to JLARC staff that:

> VDOT will need to promote understanding of the concepts of asset management, employees will need to be more informed, and employee skills will change. There will be more people involved in the processes of developing contracts, inspecting assets, and monitoring contractors.

Although asset management and performance-based contracts are considered to be the future strategy for highway maintenance, VDOT has not currently established a training program for maintenance personnel to evaluate the effectiveness of contractor performance.

In order to efficiently and effectively implement and maintain this new asset management system, additional positions have been, and will continue to be created to coordinate certain maintenance activities across every district. For example, all districts have already established positions for the administration of collecting and assessing the conditions of inventory assets. In addition, VDOT recently added pavement managers at each of the districts to deal with data related issues of the Pavement Management Program (PMP). As components of the asset management system continue to be implemented around the State, more needs will be identified. However, staff in the field do not know how the roles of maintenance personnel may change as a result of asset management. Moreover, there is no formal

statewide training program currently in place to facilitate any changes that will likely occur.

Recommendation (14). **As new products and practices are developed for asset management, the Virginia Department of Transportation should consider implementing a formal training program at the district level, to assist all maintenance managers and supervisors in administering appropriate changes at the residencies and area headquarters.**

VDOT has Developed Some Components of the Integrated Maintenance Management Program. In 1995, VDOT reviewed its maintenance operations and found the Maintenance Management System (MMS/MMSI) did not adequately meet the increasingly complex needs of the maintenance program. The department's FY 1996-1998 biennium budget submission states, "[r]eviews are being conducted of all maintenance and special operations areas to determine how the work can be accomplished more efficiently and effectively." Since that time, VDOT has been developing an outcome-based, automated approach to highway maintenance through IMMP. The department also discontinued the use of the MMS/MMSI around that time.

Prior to 1996, VDOT had already implemented pavement and bridge management systems as a result of certain federal requirements. Hence, several functions of these systems are currently and independently being utilized for data storage and analysis. As IMMP was originally designed, a fully functional PMP and Bridge Management System (BMS) would be incorporated into the system by 2002. The Virginia Operational Information System (VOIS) is another component to IMMP that has been operational since 1994, as a statewide, multi-agency communications system, with the purpose of disseminating accurate and timely information, particularly in events involving incidents and emergencies.

The Inventory and Condition Assessment System (ICAS) has been under development since 1998 to house the asset inventory and condition data for the statewide transportation network within the IMMS. It has been dubbed "the foundation of the IMMP." Data collection and population of ICAS has already occurred as a pilot project in Augusta and Fauquier Counties, but remains incomplete for Fairfax County (as of when this report was written). Because of concerns that will be addressed later in this chapter, the planned statewide rollout has not yet been determined. Ultimately, VDOT would like to be able to establish life cycle trends for each asset, and make better, timelier decisions regarding repair schedules and costs.

Finally, IMMS represents the "single-point-of-entry" for the maintenance user, and was envisioned as the system through which all other components would operate within the IMMP. IMMS would also allow the maintenance program to access and transmit data with other VDOT systems outside of maintenance, such as the Financial Management System (FMS II) and the Highway and Traffic Records Information System (HTRIS).

Anticipating an eventual changeover to a comprehensive and automated asset management system, the maintenance division put together a cost-benefit

study in 1999 that analyzed the process through which such a transition would occur. The study projected costs of implementing IMMS, at the time, to be between $60.5 and $86.3 million. However, the study also stated that the initial cost of this new systematic endeavor would gradually be offset by an estimated annual savings, ranging from $24 to $72 million, once the project was completed and asset management was fully operational. What the study neglected to address was the overall impact of opportunity and sunk costs resulting from delays and unfinished goals. These will be discussed later in this chapter.

Virginia Already Contracts for Performance-Based Highway Maintenance. In 1996, as a result of the Public Private Transportation Act that had been passed the previous year, VDOT entered into an asset management contract with VMS, Inc. for the maintenance of nearly 25 percent of Virginia's interstate system. This five and one-half year, $131.6 million pilot program turned over all maintenance responsibilities to VMS for portions of Interstates 95, 81, 77, and 381; and included all work, labor, materials, services, and equipment necessary to meet the asset specific outcome and performance targets specified in the contract. The scope of the resulting VMS maintenance philosophy has involved routine repairs, preventive treatments, and rehabilitative or restorative maintenance, in addition to snow removal, emergency response, and incident management services. At the end of FY 2001, VDOT renewed the contract with VMS to continue these services on the same sections of interstate for an additional five years at a fixed cost of $162 million. The department projects future savings to amount to between $3.5 and $4 million annually.

The VMS contract includes performance targets that were established by VDOT for desired levels of service. For example, the contract states that VMS must "maintain a minimum of one lane of travel in each direction" during times of winter weather conditions. VDOT, however, maintains a "bare pavement" standard during snow events. Despite VMS successfully fulfilling and, in many cases, exceeding its contract requirement for snow removal, the company's President believes the discrepancy in this standard is why many VDOT employees have expressed dissatisfaction with VMS' performance.

Nonetheless, the purpose of these performance targets is to help measure VMS' maintenance activities, relative to the entire system, as well as each specific asset. VDOT inspectors measure VMS work in quantifiable outcomes (for example, putting a 1½ inch overlay raised the condition rating by eight points – from good to very good). VDOT, on the other hand, does not have any formal, statewide performance targets, nor can it tie its own activities to quantifiable outcomes. In fact, aside from trying to identify targets through its pavement and bridge management programs, VDOT has not officially measured productivity since the suspension of the old maintenance management system in 1995.

JLARC staff completed a review of VDOT's management of the VMS contract in 2000, which revealed that VMS conducts regular comprehensive inventory and condition assessment of the portions of interstates in the contract, and reports this information to VDOT. To accomplish this, VMS established an automated asset management system, known as the Highway Quality Management System (HQMS),

which provides the company the ability to prioritize programs, project annual workloads, issue work orders, and measure the quality of its maintenance efforts. These are somewhat equivalent to the requirements being developed through VDOT's IMMS initiative in terms of interfacing various automated functions.

HQMS also generates a monthly timeliness report that details information on damaged assets, including the location, dates, and times of maintenance work. These reports allow VMS to manage its budget on a monthly basis according to activity costs, while maintaining the level of service expected by VDOT through the contract. VMS staff have indicated they hope to have HQMS operate as an Internet application that will allow new asset data to be entered quickly and easily as maintenance activities are being performed.

The VMS approach to highway maintenance is highly preventive. To this end, VMS benefits from having less restrictive procurement policies than VDOT, which allows the company to more easily monitor and control its contracts. VMS maintains more than one contractor that can do the same type of work, which enables the company to quickly replace any contractor not meeting VMS' requirements. This allows for greater timeliness with projects and also allows for the company to address quality issues directly. VMS' subcontracts are also designed to take advantage of cost efficiencies, which sometimes means that they are based on geography (an area along the highway) or time (multiple year contracts) to get the best rates possible. Conversely, VDOT is constrained to very strict State procurement requirements and single year contracts when letting its contracts.

Since VMS began maintaining portions of Virginia's interstates, VDOT has tried some new practices, products, and technologies that have been shown to improve the efficiency and effectiveness of highway maintenance. VMS uses a mobile pothole-patching unit that allows it to patch potholes in a fraction of VDOT's time and without having to close lanes of traffic. This is a technique that some VDOT crews have since adopted as an alternative to the usual method of cutting out potholes and replacing the pavement. Additionally, according to staff, VMS has given several presentations on the development of its asset management automated system to VDOT staff within the ICAS program.

Other States Evaluate Conditions of Highway Assets. Based on a JLARC staff survey of selected other states' departments of transportation, it appears that several states perform evaluations of at least samples of roadway assets in order to determine future activities and costs, as well as report to their legislatures concerning the accomplishments of their maintenance programs. For example, North Carolina (NCDOT) is statutorily required to survey and report on the condition of the state highway system to its Joint Legislative Transportation Oversight Committee on a biennial basis. NCDOT uses this report to develop its annual maintenance program, and then at the end of each fiscal year, maintenance managers are required to certify the work performed in their sections against the maintenance program.

Florida (FDOT) and Texas (TXDOT) also perform systematic reviews of the highway assets in their systems. FDOT requires a yearly Quality Assessment

Review to be conducted for each of its seven districts in order to evaluate and "provide information that should be used to schedule and prioritize routine maintenance activities" and to provide uniform statewide condition ratings. This information is rated against established levels of service. Similarly, TXDOT personnel perform an annual review of a small sample of interstate (ten percent) and non-interstate (five percent) road assets based on one mile sections from fence-line to fence-line. Both state departments of transportation use formal rating systems to evaluate the conditions of the assets they are measuring.

Some states have also begun to develop asset management principles in their highway maintenance activities. For example, Florida has implemented asset management through performance-based contracts and describes them as "from programming and planning to preservation." According to documents prepared by FDOT, the policy revolves around the establishment of policies and plans, development of financial policies, implementation of an adopted work program, and performance measurement against established level of service. Similarly, Texas uses performance-based contracts as a method of implementing asset management practices on some of their highways. Still other states, such as Maryland and New Jersey, are beginning to collect asset condition information and develop automated systems for data collection and evaluation.

Although ICAS is being developed to measure and evaluate the statewide conditions of Virginia's highway assets, VDOT does not perform statewide assessments of asset quality as these other states do, according to several VDOT managers. Moreover, while VDOT does maintain a pavement system, the pavement data does not include any secondary roads. Among VDOT field staff there is a perception that the new automated system under development will address some of these problems. In fact, more than 70 percent of the responses to the JLARC survey of residency operations managers indicated that the IMMP would help to identify and prioritize maintenance needs. However, the current status of the IMMP and Synergy initiatives remain uncertain at this time.

Implementation of Asset Management Should Be a Priority for VDOT

The maintenance program's attempts to develop an automated system to provide asset management techniques have met several delays. VDOT has been working on this concept since 1996, and though some components are in place, delays in data collection and changing priorities have impacted its completion schedule. Currently, VDOT has again delayed a substantial component of IMMP in order to address department-wide needs for an integrated system. Although this new integrated system is being developed to capture many of the business requirements identified by the maintenance program, no decision has been made on the priority of maintenance needs.

Attempts to Implement IMMP Have Met Delays and Problems. Despite the importance of asset management to the maintenance program, VDOT has experienced several substantial delays and data collection problems that have slowed the development and implementation of the proposed automated system in-

tended to make asset management obtainable. Because several of these delays have been related to VDOT decisions, concerns have been raised over the department's commitment to asset management. Exhibit 11 illustrates the timeline of VDOT's development of asset management and the IMMP.

Exhibit 11

Key Dates Related to Development of IMMP

Early 1980s	VDOT collects complete inventory of highway assets in paper form but is unable to use it in a systematic way.
Early 1990s	Federal regulations require VDOT to establish pavement and bridge data collection systems.
1994	Virginia Operational Information System becomes operational.
1995	Use of the Maintenance Management System (MMS/MMSI) is discontinued; Business Practice Re-engineering initiated.
1996	Maintenance program begins allocating funds for the Integrated Maintenance Management System (IMMS) and the Bridge Management System (BMS).
1997	IMMS is conceptualized; Authorization to begin Inventory and Condition Assessment System (ICAS).
1998	Integrated Maintenance Management Program (IMMP) is conceptualized; maintenance program begins allocating funds for ICAS and the Pavement Management Program (PMP); request for proposal for IMMS is delayed for one and a half years due to department's cash flow problems and the implementation of the Financial Management System II (FMS II).
1999	Maintenance division conducts a cost-benefit analysis and study on the IMMS.
Early 2001	VDOT investigates use of Enterprise Resource Planning system for IMMS; consultant fails to deliver ICAS pilot project on schedule.
Mid 2001	Commissioner suspends the development of all automated systems to make way for Synergy; VDOT delays statewide rollout of ICAS; ICAS and IMMS project managers leave VDOT.
Late 2001	Previous projected date for IMMS implementation and statewide rollout of ICAS.
2002	First module of Synergy project expected to be delivered; BMS and PMP components of the IMMP projected to be fully operational for prioritization of maintenance allocations.
2004 to 2006	Projected Synergy implementation to occur and all systems of IMMP to be fully operational.

Source: VDOT documents and interviews with VDOT staff.

Since VDOT began developing the IMMP, it has put considerable amounts of time and money into the project. Table 17 shows the amount of money that has been allocated and spent on the overall IMMP since it was first initiated. According to the director of the IMMP, the primary reason why the program has been under-spent for five out of the past six years is because "various contract actions did not come to fruition."

Table 17

Total Annual IMMP Allocations and Expenditures

Fiscal Year	Allocations	Expenditures	Percent Unexpended
1996	$ 3,725,000	$ 641,094	83
1997	$ 13,750,000	$ 5,931,093	57
1998	$ 6,450,000	$ 8,085,913	-25
1999	$ 16,416,600	$ 7,016,787	57
2000	$ 14,273,931	$ 8,422,394	41
2001	$ 17,249,200	$ 8,251,762	52
2002	$ 17,781,948	$ 913,681 (YTD)	95 (YTD)
Total	N/A*	$ 39,262,724	N/A

Note: FY 2002 year-to-date expenditures are as of September 30, 2001.
* Unspent allocations carry forward from year to year and cannot be totaled.
Source: VDOT maintenance division.

The majority of unspent IMMP allocations were for ICAS and PMP data collection, along with the intended release of the RFP for IMMS in 1998, which was subsequently delayed for a year and a half due to the department's cash flow problems during that time. The IMMP director stated that when "they [the contractors] didn't deliver, VDOT didn't pay." He also indicated that VDOT adjusted the total, system-wide IMMP budget by $3,370,000 in 1998, and transferred that amount to other accounts in the central office program. Thus, 1998 was the only year that IMMP was overspent.

Beginning in 1999, VDOT programmed the largest portion of its IMMP allocations (over $10 million) to the ICAS project due to the very large and complex nature of its data collection scope and implementation process. The pilot project for ICAS required a complete asset inventory to be collected on the interstate, primary, and secondary roads in the counties of Augusta, Fairfax, and Fauquier. The level of detail involved in this process included: data collection from field inspectors carrying computerized backpacks, data collection from vans rolling with state-of-the-art, right-of-way imaging, and data collection using "land area" type high quality digital orthography to identify exact roadway positions and features. Eventually, VDOT plans to transfer this data to IMMP by linking it into the IMMS.

As the ICAS pilot project proceeded, many VDOT staff overseeing the project questioned whether there would be a need for the same level of detail and enough resources available to collect data on all statewide assets, especially those

comprising the secondary system, which includes over 47,000 miles of roadway. The company contracted to collect data for the pilot project had consistently been behind schedule on delivering the necessary asset information.

In fact, in July 2001, which was the target date for the statewide roll-out of the data collection for ICAS, VDOT made the business decision to delay this process when the contractor failed to deliver the pilot project data for Fairfax County. The department's reasoning behind this decision was to ensure that the pilot program was successfully completed and tested, with guidelines for a second phase, before authorizing the contractor to begin expanding the program statewide. Subsequently, the contractor laid off around 35 employees from the project, resulting in the loss of some institutional knowledge about the data collection effort and possible further delays for the second phase of the ICAS implementation. In addition, the former ICAS and IMMS project managers resigned from their posts during this critical time when the automated system for asset management was supposed to be rolled out to all statewide road systems – a process that was projected to take up to three to five years to complete.

VDOT completed an internal audit of the ICAS project in September 2001. The audit report praises the process through which project deliverables are evaluated and the regular reporting of project status to the assistant commissioner for operations and the State maintenance engineer. The report also expresses several concerns related to the estimated overall cost of the project and the reporting of those costs to executive level management.

The audit report cites a difference of $12 million between the consultant prepared estimate submitted to the Council on Information Management (CIM) for the ICAS project and the executed contract. Although the auditors "could not locate any quantified documentation substantiating and / or explaining the $12 million increase, nor were we able to locate any executive team-level approval of the increase," the extra costs were attributed to additional items in the final contract but not in the cost estimate submitted to the CIM.

Furthermore, the report noted that VDOT's executive team and relevant maintenance managers may not have been informed of delays of ICAS contracted deliverables or the projected and actual costs of the ICAS project. Quoting from the internal audit report:

> VDOT Executive Team-level management/Project Sponsor may not have been aware of ICAS deliverables that were in excess of 90 days past due nor aware of the impact the past due deliverables would have on the project. ...Furthermore, there is no formal policy to ensure that Executive Team-level management/Project Sponsor are made aware of the $53.6 million projected cost for the ICAS project. The approved budget-to-date for the ICAS project totaled $29.9 million. The budget amounts for fiscal year 2002 ($13.9 million) and fiscal year 2003 ($14.5 million) are pending approval.

According to the deputy commissioner for project management, although the ICAS project is behind schedule, VDOT has only expended money for ICAS components that have been delivered. Nonetheless, the audit report highlights several issues that make development and implementation of a large integrated automated system costly and time consuming.

Many maintenance managers have suggested that perhaps inventorying every asset is an unrealistic and, in some cases, unnecessary end, particularly in the secondary system. If reducing the scope of secondary system data becomes a problem for the integrity of the IMMP, the only other feasible solution for collecting all assets – if funding permits – would be to contract out many of the maintenance activities currently being done "in house."

When interviewed by JLARC staff, several transportation operations managers expressed concern that the many rural areas in Virginia with a high concentration of secondary roads may be at a disadvantage when it comes to funding distribution if information from some secondary roads with low vehicle-miles-traveled (VMT) rates are deemed excessive, and not included in the inventory. One assistant resident engineer warned, "rural areas will have an uphill battle, because their needs tend to be less than urban areas."

Recommendation (15). **To the extent that asset information has been collected in the pilot program, the Virginia Department of Transportation should implement the Inventory Condition and Assessment System statewide as soon as possible. Once implemented, asset data on the secondary system should be entered into the system only as maintenance activities are performed. If it appears full implementation of ICAS will be substantially delayed as a result of other department priorities, then a representative sample of roadway assets should be developed and implemented in the interim. VDOT should use the information from this assessment in budgeting and work planning for the maintenance program.**

The Future of the Integrated Maintenance Management Program Is Uncertain. While the IMMP that has been under development is critical to implementing asset management, an important component again was delayed when VDOT recently made the decision to implement a broader, department-wide automated system. In a memorandum to the members of VDOT's executive committee dated June 25, 2001, the commissioner halted the acquisition or implementation of all the automated business systems by the department. As a result, the RFP for IMMS was indefinitely suspended. This action, according to the commissioner, "will enable VDOT to channel financial and human resources toward support of the new business strategy."

Currently, VDOT operates out of multiple, non-integrated systems, each of which is focused on individual assets and has limited capability for recording and analyzing work that is accomplished. The new business strategy, which the department refers to as its "Synergy" initiative, would integrate data and results from all existing VDOT systems, to provide a single point of entry for scheduling resources and monitoring performance. Synergy would exist in the form of an enter-

prise resource planning system (ERP), and provide new and useful functions for the maintenance program, such as a statewide customer service request tracking system.

However, there appears to be no project plan, cost projection, or time schedule to support the Synergy initiative. VDOT's chief information officer indicated that an RFP for Synergy was scheduled to go out in November of 2001, for which he expected the department would receive around five responses, including ones from Oracle, SAP, and Peoplesoft (the current software used for FMS II). However, that data has been delayed until at least January 2002, and may even be delayed further, according to VDOT staff. He also identified several critical factors for successfully implementing the enterprise system. These factors include: VDOT's ability to "prohibit software modifications, adopt best organizational practices, deliver project successes in three to six month increments, defer financial liability until success has been attained, provide ample training for employees, and galvanize executive support."

In addition, with the full support of the MPLG, VDOT is trying to include the functional components of IMMS as the decision support tool for the business requirements needed by the maintenance program. However, according to an evaluation of the IMMS/ERP requirements by Cambridge Systematics, Inc., VDOT should anticipate a fairly significant effort to (1) develop custom modules to fill in gaps in requirements, (2) configure the standard SAP modules to address the needs of asset management, and (3) develop interfaces to legacy systems. The report also indicated a serious concern about the extent and complexity over how an enterprise system will interface to FMS II and other department-wide systems for equipment and inventory management. These findings suggest that given the current enterprise resource planning requirements, it is very likely VDOT will incur additional and unplanned costs and possible system failures that may lead to significant delays. Considering that possibility, the State maintenance engineer stated that if the Synergy initiative fails, the maintenance program could still send out the RFP for IMMS in its place.

In the meantime, VDOT can measure expenditures, but cannot determine what it is actually getting for its investment. The State maintenance engineer added, "without asset management, the program can't make distinctions of how to prioritize its needs." He went on to say that implementing ICAS and IMMP is the "way to get there."

When VDOT experienced its cash flow problems in 1998-99, after the maintenance program was asked to reduce its spending, the assistant commissioner for operations warned in a response to the assistant commissioner for finance, "deferrals and delays are not without future substantial adverse impacts" (partly in reference to the consequence of delaying IMMP projects). More recently, in response to the proposed Synergy initiative, he stated that if the IMMS is not a priority for the enterprise resource planning system, VDOT should expect major setbacks with its cost and implementation time for requirements related to asset management. As mentioned, the RFP for IMMS has been ready for about three years and has been updated to stay current. However, as per the commissioner's suspension of further

development on automated systems, IMMS remains stagnant while the department explores different vendors to supply an enterprise resource planning system that will meet VDOT's business needs, and fulfill the Synergy initiative. Exhibit 12 lists other consequences that could occur if the IMMS is not given a high priority in the development of the enterprise resource planning system.

Exhibit 12

Consultant's Identification of Consequences of Not Giving IMMS a High Priority in Enterprise Resource Planning

- Organization commitment and support will erode.
- MPLG's credibility will be compromised.
- Sunk cost – no return on investment already made.
- Negative impact on the progress of IMMP.
- Continued inability to report accomplishments.
- Ineffective budgeting – historical vs. needs based.
- Inability to optimize resources and work.
- Ineffective work reporting – multi- vs. single-system entry.
- E-Government opportunity lost.
- Program and team attrition will increase.

Source: Cambridge Systematics, Inc. Evaluation of the IMMS/ERP Requirements Crosswalk, May 30, 2001.

A report produced by the maintenance program in early 2001 suggests that addressing the organizational efficiency and effectiveness of the central office divisions' functions through a greater definition of roles in the maintenance program, "will allow for more decentralized authority, reduce the duplication of work performed, and maximize the use of available resources." But these goals cannot be achieved without the implementation of new systems and processes throughout the organization, the report concludes. This conclusion supports why implementation of the maintenance program's asset management process is largely dependent on VDOT prioritizing and putting into service an automated system containing these functions.

Although VDOT is unable to quantify projected costs and savings for the proposed enterprise system at this time, other "ERP solution" customers have realized potential cost savings according to a report adapted from the Gartner Group.

One example of what the report refers to as "benefit drivers" is the likely savings that the department would incur from automating procedures that were previously accomplished manually. VDOT's chief information officer predicts that long-term costs may amount to between $30 million and $50 million, based on his experiences at other non-transportation State agencies. However, the deputy commissioner for project management stated that those estimates are "not valid for VDOT, because they are transactional and do not reflect how VDOT handles maintenance, particularly the needs of asset management."

There remains the imminent risk of even further delays to the IMMP, and insufficient data once the implementation of the proposed enterprise system is commenced. Delays in implementing asset management have consistently occurred in the past, beginning with VDOT's cash flow problems and the implementation of FMS II, which took all the funds set aside for IMMP and delayed the project for two years. Presently, it is unclear whether the business needs of the maintenance program related to asset management would be the priority of the Synergy initiative. However, the director of IMMP contends that this project remains a department priority.

Recommendation (16). **The Virginia Department of Transportation should provide the House Appropriations, Senate Finance, and House and Senate Transportation committees with a detailed timetable of expected milestones and projected costs related to the Synergy initiative before any component of the new system is installed.**

Recommendation (17). **The Virginia Department of Transportation needs to reaffirm the commitment and priority of promptly and fully institutionalizing asset management, by communicating its initiatives throughout the department and implementing the business requirements and automated systems related to that objective as quickly as possible.**

VDOT COULD MANAGE MAINTENANCE RESOURCES MORE EFFICIENTLY AND EFFECTIVELY

In light of the fact that the implementation of an asset management approach may not occur in the immediate future, it appears VDOT could improve its use of certain resources by addressing certain short-term management issues. Prior to the initial development of IMMP, the maintenance program evaluated the productivity of its staffing, use of materials, and equipment as a component of its activity scheduling and funding needs. However, VDOT no longer performs that function, in part because maintenance managers expected IMMP to be fully implemented by now. Moreover, the department would benefit from a strategy to address the availability of unused allocations from one fiscal year to the next. According to many of the maintenance engineers interviewed for this review, the inconsistency of carry-forward funds affects their ability to adequately plan and prioritize activities into the future.

VDOT currently produces a quarterly report indicating the utilization rates of all classes of rental equipment for maintenance managers. This report specifically identifies those pieces of equipment falling below an established statewide utilization limit. However, it does not appear, based on interviews and surveys, that the equipment utilization report is used to its fullest potential. Moreover, the maintenance program implemented a policy manual in 1994 designed to streamline the standards found in previous manuals. As part of that process, the maintenance program indicated that a best practices manual of major maintenance activities would also be developed. However, after the development of a snow removal best practice, the department did not undertake a review of any other maintenance functions and has not published any best practice policies.

Most importantly, the maintenance program would greatly benefit from the prioritization and implementation of an asset management approach. While VDOT has been developing its asset management approach and the automated systems required to effectively implement that strategy since 1996, the program has been delayed several times for various reasons. VMS Inc., with whom VDOT has contracted for the maintenance of a portion of Virginia's interstate highways, provides these services based on an asset management strategy. At this time, very few, if any, other state departments of transportation have tried to implement asset management on the scale that VDOT is proposing. According to several maintenance managers, if VDOT is to develop an accurate forecast of maintenance funding needs, asset management will have to be implemented.

Maintenance Program Does Not Systematically Measure Productivity

In order to develop a true budget based on highway maintenance needs, VDOT must better understand exactly what its needs are. While VDOT does not currently evaluate how productively highway maintenance activities are performed, the department previously did this as part of its planning and budgeting processes. Prior measures of productivity were determined by VDOT to be ineffective assessments of actual maintenance work because of data validity issues and the lack of useful information generated.

Because the number of assets that are required to be maintained by VDOT continues to grow, as do the number of public requests, improved productivity will be essential as long as resources continue to be limited. In order to implement an asset management process, VDOT is currently developing performance targets based on certain level of investments in an asset and the return produced by that investment. Since development of these and other measures would likely take some time, and given that this information can be used in budgeting and work planning, it is imperative that VDOT measure the productivity of its workforce.

Productivity Measurement Existed Under Former Maintenance Management System. By the late 1970s, VDOT had a maintenance system in place, designed to help the maintenance program track the use of materials and labor as well as expenditures related to specific maintenance activities. The MMS/MMSI assisted maintenance managers in planning work and programming

funding. These reports were used by all levels of the maintenance program to assess productivity in the field.

According to a district maintenance engineer, these reports primarily showed unit costs and categorized expenditures over certain time periods. For example, a general unit cost for an acre of mowing would be maintained using previous total expenditures for mowing and the amount of acres mowed. This unit cost of mowing would then be evaluated against similar work performed by an area headquarters. Because data were collected by area headquarters, comparisons could be made between areas, residencies, and districts. This information could then be used to program how much work could be accomplished in the future given a certain level of funding.

However, many of the managers interviewed by JLARC staff expressed concern about the adequacy of the MMS/MMSI to produce useful information. First, the managers said that a real concern was whether data added to the system was accurately reflecting accomplished work or had been falsified to allow the area crew to meet or exceed the established standard. Second, the measures formally used at the time did not identify actual highway maintenance accomplishments. Instead, they measured how much of an activity was done, for example tons of stone put down per day, which does not indicate the impact on the condition of the highway system. Finally, the State maintenance engineer told JLARC staff that the maintenance program expected IMMP to be operational by now and thus the department would be able to measure outcomes. As a result of these factors, the maintenance program does not currently evaluate productivity.

Measures of Outcomes Are Being Developed. According to the State maintenance engineer, a goal of the IMMP is to provide information on outcomes related to acceptable levels of service. As data on these outcomes are gathered over time, it will provide the maintenance program with detailed information on the costs associated with providing a certain outcome, not just a measure of what amounts of materials or man-hours were used.

Because VDOT has automated systems for pavements and bridges, the State maintenance engineer stated that these would likely be the first places VDOT would focus its efforts. Still, substantial data collection and performance targeting remains before these would be operational. In addition, VDOT does not systematically measure the conditions of the State's secondary roads. Nor does it perform a maintenance condition assessment annually that would produce an indication of roadway and asset quality.

Program Cannot Currently Identify Productivity Rates on Statewide Basis. Although there was concern over the validity of the data provided to produce the previous measures of productivity, these measures at least gave the maintenance program some way to compare accomplishments in the field across the State. A primary concern of maintenance managers revolved around the accuracy of the data being provided by the crews in the area headquarters. It is quite possible that under a new automated system, questions of data validity would also be an issue. Therefore, the management of issues related to oversight of actual work per-

formed and quality control of the information being added to the system are critical if the new system is going to function as intended. Some maintenance managers indicated that current oversight of actual work is generally done by a visual inspection as they ride the areas. But no formal evaluation of the work performed by State forces is done.

In addition, managers identified the new automated system as replacing a cost approach for measuring productivity with an outcome approach. However, IMMP has been delayed several times since its inception and it is currently unclear when the system will be functional. Moreover, it will take several years to populate the databases needed to make valid interpretations of costs and outcomes.

Regardless of previous impediments, VDOT's highway maintenance program should be measuring the productivity of its work in a manner that allows for comparisons across the State, districts, residencies, and areas. A lack of consistent comparisons of activities performed along with the resources associated with the activity raises questions about whether the work being done is performed efficiently or is actually needed. Since the maintenance program's base budget is largely built on historical activities, appropriately measuring accomplishments is crucial.

Productivity affects the costs of the maintenance program. By measuring productivity accurately, the program will be able to communicate efficient maintenance practices to other areas and also address inefficient activities. For example, productivity measures could be evaluated by maintenance managers to determine why a certain practice was better able to address a certain function than another method of maintenance. According to the State maintenance engineer, some information that would be useful in providing productivity analysis may exist. For example, some productivity data can be derived from expenditures in FMS II, however this provides cost information only. VDOT could also use the workplans prepared by the area headquarters regarding what they planned and what was done.

Recommendation (18). **The Virginia Department of Transportation should prioritize the development of productivity measures for planning and scheduling purposes. This should include identifying which measures would be most useful and how they would be operationalized once established. VDOT should also put in place a system of quality control for information provided concerning productivity and actual work being accomplished.**

Completion of Planned Maintenance Activities Is Impacted by Inability to Carry Forward Funds

VDOT's maintenance program operates on an annualized budget allocation, which has resulted in unexpended funds at the end of the fiscal year. Carry forward has been described by VDOT staff as the allocation of those unspent funds. Within the maintenance program, funds are typically allocated for an entire project at the beginning of a fiscal year. Because some projects are paid off in the fiscal year following the completion of the work, carry forward funding has been used to cover

the costs of the outstanding costs of those projects. Moreover, maintenance functions can span more than one fiscal year as a result of such events as bad weather or other unexpected events.

Decisions on whether to allow carry forward funding are made by VDOT management, and have been affected by the department's previous cash flow problem and decisions to fund other functions. As Table 18 indicates, over the past five fiscal years, the maintenance program has only carried forward approximately 45 percent of the funds requested. Prior to the 2000 General Assembly session, Appropriation Act language precluded the maintenance program from retaining funds that were programmed for ordinary maintenance activities. The Appropriation Act passed in 2000 eliminated any reference to ordinary or replacement activities. As a result, VDOT is allowed to reprogram this money for any type of maintenance activity as it deems appropriate.

Table 18

Requested and Approved Amounts of Carry Forward Funding for the Highway Maintenance Program ($Millions)

Fiscal Year	Carry Forward Requested	Carry Forward Approved	Percentage Approved (%)
1997	$ 74,5	$ 28.3	38.0
1998	$ 67.1	$ 52.1	77.6
1999	$ 72.9	$ 0	-
2000	$ 53.3	$ 21.4	40.2
2001	$ 33.1	$ 33.1	100.0
2002	$ 0	$ 0	-

Note: According to the director of maintenance finances, no carry forward was requested for FY 2002 because the program's allocation and expenditures matched.

Source: VDOT maintenance division. In real dollars. Figures have been rounded.

Six district maintenance engineers expressed serious concern over the impact of not being able to retain the unspent portions of their annual maintenance allocation after the end of the fiscal year. At the April MPLG meeting, members stated that budgeting for the long term was made more difficult because they were not sure maintenance funds would be returned back. A district maintenance engineer also stated that large projects are greatly affected because they often take longer to complete and are harder to allocate funding across years. For example, the district maintenance engineer said, if a project will take two years, the district will try to allocate what they think will be spent in each of the two years. However, if the project is delayed in either of the years, it impacts the whole district because all allocated money has to be spent in that fiscal year. If they can not spend all the money allocated to that project for that fiscal year, then funding from the following

fiscal year will have to be used, resulting in less money for the other activities already planned.

The inability to carry forward this funding was also cited by 72 percent of the transportation operations managers as having impacted their residency or area headquarters since FY 1997. As a result, many managers said they operate with a "spend it or lose it" mentality, whereby allocated funds will be spent on activities for which they were not programmed, if available. A respondent to the JLARC staff survey of transportation operations managers illustrated this point:

> Because of various reasons, environmental permits, major storm events, material problems, etc. some state force bridge projects were not built during the FY that they were budgeted. The money was spent in other assets in the residency. Once the problems for the delay were cleared up, the projects were built and other scheduled projects were pushed further back.

Pavement and bridge work were the primary activities that transportation operations managers responding to the JLARC staff survey identified as being delayed or impacted by the unavailability of carry-forward funding.

Because the window of opportunity in which most maintenance work can be completed is limited to April through October, managing funding and planning activities has been described as especially difficult. These activities are further complicated as a result of the end of the fiscal year occurring in the middle of this work season.

According to many of the district maintenance engineers, identification of roads in poor condition and development of contracts to repair and overlay these road surfaces begins approximately 20 months prior to when that work will actually occur. In order to prevent being affected by this issue, maintenance managers have to predict (or as one district maintenance engineer stated, offer a "best guess") on many of their scheduled costs and other work. These estimates have to include fairly accurate cost projections for fuel, materials, and labor among other items, far in advance of when the actual work will occur.

In addition, the ability of State forces and contractors to perform certain functions depends on weather conditions, especially unexpected events such as snow. A respondent to the JLARC survey of transportation operations managers stated:

> With the amount of time it takes to get a major [pavement] maintenance contract set up, advertised and awarded. [sic] There is not enough time for the contractor to perform the work within a Fiscal Year. Particularly if there [are] weather restrictions for temperatures. Also we are limited to work times due to traffic and having to work nights on interstate and primaries.

Large events such as a substantial snow storm may impact the amount of other maintenance functions that can be accomplished and drain funding for previously scheduled work.

Although snow emergencies are reimbursed from a central office account, the reimbursement to the districts occurs late in the fiscal year, making it hard to reprogram those funds quickly enough to get a contract awarded and the work finished by the end of the fiscal year. When this occurs, managers have the option to either cancel the un-awarded contract or reschedule the activity and absorb the cost in the following fiscal year, pushing back priority work for that year.

The maintenance program does have the flexibility to shift funds between activities, if those funds are unexpended. This does provide some ability to get work done. However, since maintenance managers program their entire allocations, unexpended funds translate into unaccomplished planned activities.

Currently, MPLG has in place a process for redistributing allocations that the executive committee allows to be carried forward. According to the State maintenance engineer, a district must identify a positive balance between the contracts that were advertised on or before March and any other unspent allocations. If a positive balance is determined to exist, the district will receive an amount equal to the remaining work on those previously advertised projects up to the amount of the unspent allocations remaining in their budget at the end of the fiscal year. The determination of a positive balance and the size of that reimbursement are determined by MPLG. Funds not approved for carry forward by the executive committee are transferred into the undesignated fund balance and are unavailable for construction or maintenance activities.

Although work and expenditure planning must be done for a single year, some maintenance activities must be planned for over a longer period. Several alternatives have been suggested as solutions to this issue. First, several district maintenance engineers thought that allowing budgeters to program funds to projects regardless of how many years might be involved rather than within a single fiscal year would be beneficial. Another suggestion involved allowing maintenance managers to program funds over the biennium instead of each fiscal year. However, this situation produces the same problems at the end of the biennium as already occur at the end of a fiscal year. Finally, the State maintenance engineer indicated that programming maintenance activities over a six-year period similar to the construction budget would have benefits as well.

Recommendation (19). **The Virginia Department of Transportation should review the alternatives available to it for addressing the issues related to the maintenance program's inability to carry forward unexpended funds from one fiscal year to the next. VDOT should select the alternative that provides the maintenance program with the most information and maximum use of those funds that have been allocated to the program.**

Ability to Address Maintenance Activities Is Impacted by Availability of State Forces and Private Contractors

Until asset management and the IMMP are implemented VDOT will continue struggling to find the right mix of State forces and private contractors to provide an adequate level of highway maintenance. In addition to State forces, VDOT has access to contractors through traditional, low bid contracts, and long term performance-based contracts, as well as the Public-Private Transportation Act of 1995 (PPTA), to deliver highway maintenance services. Nonetheless, it would appear that VDOT has not been able to provide for an adequate level of staff, through either State forces or contractors, to meet the State's highway maintenance needs.

During 2000, VDOT undertook a workload planning study that recommended the addition of more than 1,800 positions for the maintenance program, based on identifying asset conditions using historical knowledge and previously inventoried data. From that information, a projection of the full-time-employee equivalent values was associated to those assets and the activities required to return them to an acceptable condition. Furthermore, the evaluation was performed considering a recommended outsourcing level of 63 percent for maintenance activities based on the availability of contractors, inmate labor, and the Adopt-a-Highway program, a figure substantially greater than what the maintenance program has been able to achieve since at least 1991.

While VDOT has renewed its performance based maintenance contract with VMS Inc., the department has not subsequently let any other long-term, fixed costs contracts, although it is trying to develop them. According to biennial budget requests prepared by the department in 1997 and included in each request since, no unsolicited PPTA proposals limited to maintenance and operations were to be accepted after the VMS contract in order to allow for proper evaluation. In late summer 2001, the department, after receiving bids, did not let a performance based contract for road striping on I-295 in the Richmond district because of bonding issues and high bid amounts.

The primary benefit of contracting for VDOT appears to be the ability to free resources for other maintenance purposes. The Commissioner of Transportation has noted that the VMS contract has allowed VDOT to focus more on the primary and secondary roads in those areas covered by the contract, a sentiment shared by the deputy commissioner for project management. VDOT's FY 2000-2002 biennium decision package for the department of planning and budget states "VDOT continues to partner with the private sector, which has resulted in costs savings and allowed State maintenance forces to concentrate primarily on emergency, safety, and priority maintenance tasks." The description continues by stating that the use of contractors and the subsequent rededication of State forces have resulted in a decrease in deficient lane miles without requiring additional staff.

These comments appear to suggest that primary and secondary roads had additional needs that were not being addressed previously. As discussed previously, most maintenance managers interviewed for this study would likely agree. Many of the district maintenance engineers interviewed said staffing in the field was inade-

quate, which is reflected through their requests for additional staff in the workload planning study. Several district maintenance engineers stated that State staffing levels have required an increased use of contractors in order to complete needed activities, but that contractor costs have been increasing in recent years, further tightening the amount of funding with which the districts have to operate. For example, a district maintenance engineer commented that although the dollar amounts for contracts could increase as a result of longer term performance based contracts, if the funds stay at the current level, VDOT will be unable to do significantly more contracting.

Sentiment on the use of contractors as a means of freeing State forces for other tasks was mixed among the transportation operations managers. When asked on the JLARC staff survey of transportation operations managers, "would increasing the use of private contractors help your residency and area headquarters perform their primary maintenance functions to VDOT standards?" the 50 respondents were evenly divided between yes and no. Of the respondents who said yes, 60 percent indicated they had been able to rededicate positions to other maintenance activities as a result of an increased use of contractors. More than half responded that they had not reduced the number of positions as a result of increased contracting.

Program Should Rely More on Equipment Utilization Reports

VDOT's equipment division produces a quarterly evaluation of the usage of all rental equipment compared against low and high usage amounts for a specific class of equipment. However, these reports do not appear to be considered useful by maintenance managers in the field. Nonetheless, a JLARC staff analysis of these reports for the past four consecutive years indicates underutilized equipment exists. Because equipment is paid for regardless of usage under the current system, an alternative approach to assessing actual costs may be appropriate.

Equipment Utilization Reports Do Not Appear to Be Used Regularly. According to the State equipment engineer, the equipment division produces a quarterly report identifying pieces of equipment that are either above or below the average rental rate for that specific piece of equipment. VDOT calculates these lower and upper limit controls with a methodology that uses district averages by equipment class, high and low rental rates for that class, and a constant based on each district. The report is designed to give maintenance managers, particularly at the residencies, the opportunity to identify equipment that may be sitting idle and then determine the actual need for this piece of equipment. Because VDOT equipment is paid for through rental rates based on usage, if a piece of equipment sits at an area headquarters unused, the area or residency will not be charged for that equipment. However, because the equipment was purchased, the equipment division has developed a depreciation charge that is paid whether the equipment is used or not.

Despite the possibilities to use these reports to identify little-used equipment, it appears the managers in the field are not using the utilization reports frequently. A JLARC analysis of four consecutive fiscal years of utilization reports in-

dicates that significant amounts of equipment have consistently appeared on these reports for at least three consecutive years (Table 19). For example, VDOT operated 1,343 standard dump trucks (30,000 pounds gross vehicle weight) during FY 2000. However, 55 of those dump trucks (four percent) appeared on at least the last three consecutive utilization reports.

VDOT also operated 282 tandem dump trucks (50,000 pounds gross vehicle weight) during FY 2000. According to the equipment utilization reports, 19, or seven percent, of these dump trucks have utilization rates below the lower control limit for at least three consecutive years. For example, the lower utilization limit calculated by the equipment division indicates that for FY 2000 these dump trucks should have operated at least approximately 84 working days. However, some specific pieces had usage rates as little as 15 to 49 days. According to a district equipment and facility manager, these dump trucks are used substantially in the maintenance program's day-to-day operations. (The majority of these two classes of dump trucks identified as being underutilized appeared on four consecutive reports.)

Maintenance managers interviewed by JLARC staff indicated that these reports mainly provided information on their equipment that was not helpful. One maintenance manager described the utilization reports as a "paper exercise" and in-

Table 19

Percentages of Underutilized Equipment, FY 1996 - FY 2000

Description of Rental Equipment	Underutilized Rental Equipment as Percentage of Equipment Class
Trailer Mounted Welders (Gas Driven)	28 %
Paver (Bituminous (Lee Boy))	19
Truck (Minivan – 4,700 GVW)	16
Grader (150 HP – 27,000 LB)	8
Tandem Dump Trucks (50,000 GVW)	7
Rollers (4 to 6 Ton – Tandem)	6
Wheel Loader (110 HP – 2 CU. Yd.)	5
Tandem Dump Trucks (30,000 GVW)	4
Tractor Mowers – Right Hand Cutter Bar	4
Truck (Pickup – Maintenance)	2

Note: Rental equipment that has appeared on the equipment division's utilization report for at least three consecutive years (FY 1997 – FY 2000). A small percentage of this equipment may also be used for construction purposes.

Source: JLARC staff analysis of VDOT equipment utilization reports for FY 2000.

dicated that the process "forces them into trying to use [a piece of equipment] they don't really need." Another manager suggested that although they "used to keep a close track on usage, they don't anymore."

Alternatives to Current Equipment Rental Process Should Be Explored. During discussions with VDOT staff concerning the appropriate use of equipment, several proposals were suggested to address the underutilization of equipment. For example, in FY 2000, the equipment division prepared and carried out a "Cash Management Action Plan to Sell Underutilized Equipment." According to the State equipment engineer, the sale of underutilized equipment resulted in savings of $415,810 across the State. In addition, approximately $640,000 was also saved by transferring underutilized equipment to other locations instead of purchasing new equipment. However, it appears this activity was a one-time effort and has not been followed up on since May 2000.

As part of the action plan, beginning in July 1999, equipment managers were to use the utilization reports to identify equipment that could be resold or transferred. Users of the equipment were given the opportunity to justify why they should retain underutilized equipment using several categories: (1) equipment meeting a critical or emergency function, (2) equipment needed to offset more costly contract work, (3) equipment needed for planned work activities, or (4) equipment that is underutilized but in newer or better condition, that can be exchanged or transferred for older equipment that is not underutilized.

The State equipment engineer has also suggested developing an internal leasing program, in which districts would pay a monthly fee to keep certain types of equipment available. An advantage of leasing equipment in this manner would be the elimination of the use of rental rates. Instead, payments would be made on a monthly basis related to the cost of that piece of equipment. In addition, equipment would be less likely to sit unused if it had to be paid for regardless of its usage amount.

Finally, a greater emphasis on leasing through private contractors may reduce the amount of underutilized equipment, as well. During calendar year 2001, the maintenance program piloted an equipment leasing program with the agricultural and industrial equipment producer John Deere for tractors to be used in VDOT's mowing program. As part of this program, residencies in the Bristol, Fredericksburg, and Richmond districts leased 17 new tractors from John Deere. According to a district equipment manager, the program called for all maintenance activity of these vehicles to be provided by John Deere and VDOT's only responsibility would be for fuel. The company is able to offer this program because the market for preused maintenance related equipment is strong.

As part of the agreement, the option exists for the equipment division to extend the program for next year. VDOT is currently evaluating the results of the program to determine whether to continue it or not. Some concerns were raised about the ability of the equipment to integrate with other pieces of VDOT mowing equipment. However, an assistant administrator for the equipment division stated

that an initial review of the hourly rates between the leasing program and the previous method found significant savings through the use of the lease program.

Of course, not all equipment will have high utilization rates or be leasable through private companies. Some equipment such as snow blowers and plows are going to have low utilization rates because of their seasonal or emergency nature. In addition, there may be the need to keep a piece or class of equipment for which there is not a large private market from which VDOT could contract for the equipment. However, this type of equipment could be purchased by the districts.

In fact, this was VDOT's policy until a few years ago, according to a district equipment and facilities engineer. At the time, VDOT had reviewed its policies on equipment that was only needed at certain times and in certain situations and decided to have the maintenance division pay off the depreciation costs of equipment that met the established criteria. Recently, when the time came to replace this equipment, the maintenance division was unable to cover the costs of purchasing and opted to return to the older policy of repayment through the rental rates and depreciation process.

Regardless of what approach the maintenance program adopts, a need exists to reduce the amount of underutilized equipment in the field. The utilization reports, which can be produced on a monthly or quarterly basis, provide the potential to address this issue as part of a process to reduce the amount of unused equipment in the State.

Recommendation (20). **The Virginia Department of Transportation should establish a process expanding the use of the equipment utilization reports produced by the equipment division as a tool for continually adjusting and monitoring the levels of equipment in the field. Equipment that is continually underutilized should be transferred or surplused and other methods of obtaining equipment should be further explored. Finally, equipment that is seasonal, or needed in emergencies only, should not be paid for under the rental rate and depreciation method.**

Development of Best Practices Needed to Ensure Activities Produce Uniform Results Across the State

In 1994, VDOT implemented a new *Maintenance Policy Manual* with revised standards for highway maintenance functions. This replaced the previous 1991 manual that provided substantial detail about the provision of highway maintenance. Partly because the new manual had much less detail, it indicated that a best practices document would also be developed. Although there appears to be interest among maintenance personnel to have a best practices manual, it has not yet been completed.

VDOT Developed a New Maintenance Policy Manual in 1994. Prior to 1994, the maintenance program operated under a *Maintenance Guidelines Manual* that provided very specific details on how the functions of the maintenance pro-

gram were to be performed. A 1991 revised version of the manual indicated that its purpose was to document the level of maintenance necessary to maintain Virginia's highways at a given level of service. The document was to:

> include written instructions that would allow one to assess a given section of roadway and identify maintenance needs based upon levels of services that would be approved by the Commonwealth Transportation Board.

This document further identified maintenance activities based on whether they were ordinary or replacement activities and established different levels of service based on the type of road system involved.

The 1991 *Maintenance Guidelines Manual* described in great detail how each activity was to be performed by VDOT maintenance operators. For example, under drainage activities the manual cites VDOT's responsibility, standards, and implementation policy which discusses the use of ditching on a regular basis to prevent failure. The manual then further gave specific directions on how cleaning and reshaping of ditches was to be performed as well as the levels of personnel and equipment that would be necessary. Exhibit 13 identifies these procedures detailed in the manual.

The 1991 *Maintenance Guidelines Manual* was replaced by the *Maintenance Policy Manual* in 1994. The preamble to the 1994 manual states that previ-

Exhibit 13

1991 Maintenance Guidelines Manual Procedures for Cleaning and Reshaping Ditches by Machine

Procedure

1. Place traffic control devices in accordance with current department guidelines, "Typical Traffic Control For Work Area Protection". See Section 14 of the Maintenance Division Policy Manual.
2. With motor grader, windrow material on shoulder in one or two passes as required, such that it can be picked up with loader.
3. Use loader to put material in trucks.
4. Haul spoil in trucks to waste area, or use material to widen shoulders in fill sections.
5. Use broom tractor to sweep pavement clean.
6. Recover traffic control devices.

Source: 1991 VDOT *Maintenance Guidelines Manual.*

ous maintenance policies and procedures standards were streamlined in order to enhance the department's efficiency and effectiveness as it attempts to meet its goals and objectives. The 1994 manual eliminated much of the more detailed information in the previous manual in favor of broader language designed to establish the parameters of each function. For example, the 21 functions related to drainage were synthesized into three identified responsibilities relating to: acquired drainage easements, easements dedicated to a county, and maintenance of drainage systems.

In addition, several maintenance managers interviewed by JLARC staff stated that a return to greater detail in the area of maintenance standards would only serve to restrict their flexibility. A district maintenance engineer reported that VDOT received complaints if an activity did not meet the level of detail in the 1991 manual. Other managers said that in some cases, stricter standards could lead to liability issues in situations where it could be determined VDOT was not meeting a specific maintenance standard. Although no one indicated that VDOT had been held liable in this type of situation previously, it was also expressed as a reason behind the adoption of the 1994 manual.

Maintenance Providers Indicated that Best Practices Would Be Useful. The 1994 *Maintenance Policy Manual* also indicated that a "separate *Maintenance Best Practices Manual* is being developed, which identifies and updates specific maintenance procedures, levels of service, standards, and methods of operation." The State maintenance engineer told JLARC staff the goal of best practices is to provide the people in the field with more help and assistance so they can perform their functions better. Best practices would likely provide useful information on how to perform an activity while allowing operators to adapt their techniques as needed. Currently, some maintenance managers interviewed by JLARC staff indicated that they return to the 1991 manual when clarification on an activity is needed. However, a manual for maintenance best practices has never been developed.

Although some work has been done already in this area, it has been limited. The State maintenance engineer stated that a snow removal best practice policy was developed shortly after the implementation of the 1994 manual, but never finalized or published. In addition, MPLG is currently examining other areas that may benefit from best practices, including pavement and bridge maintenance. MPLG also recognizes that new best practices will need to be coordinated with the performance targets being developed for use with the asset management process.

Responses to the JLARC survey of transportation operations managers indicated at least a quarter believed a best practices manual would be a useful tool for providing highway maintenance activities. Furthermore, several MPLG members stated a maintenance best practices manual was needed. A district maintenance engineer told JLARC staff that a best practices manual would require approximately two years to develop and finalize as a result of the coordination within VDOT that would be needed. Another expressed concern that development of a best practices manual has been on-going for so long, that it might never be completed.

Recommendation (21). **The Virginia Department of Transportation should complete the maintenance best practices manual described in**

its 1994 *Maintenance Policy Manual* by updating previous policies and developing new policies. The department should first focus its attention on those policies with the greatest impact on the overall performance of highway maintenance activities. The department should also provide sufficient training and support to field operators regarding these practices.

Appendixes

Appendix A

Development of a Methodology for the Determination of Virginia's Pavement and Bridge Maintenance Needs

As part of this review of the VDOT highway maintenance program, JLARC staff collected data from VDOT related to current pavement conditions, as well as contract expenditure data for the 2001 pavement overlay maintenance activities. Using the VDOT pavement condition data, JLARC staff were able to analyze the current pavement of both interstate and primary pavements across the State and identify those pavements determined to be deficient. JLARC staff then applied the average contract costs for asphalt overlays from the 2001 schedule to the identified deficient interstate and primary pavements in order to estimate the cost to provide only asphalt overlays to these pavements. Based on this analysis, JLARC staff estimate the total maintenance repair needs for the State's asphalt pavements to be at least $105.6 million.

Additionally, JLARC staff collected data from VDOT identifying the general condition ratings for the bridges and structures for which VDOT has primary maintenance responsibility as well as the costs related to the repair of bridge decks, superstructures, and substructures. Using this information, JLARC staff were able to estimate the cost to rehabilitate all bridges with identified maintenance needs based on average unit prices provided by VDOT structure and bridge section staff. Results from this analysis indicate that the baseline repair and replacement costs for these bridges to be at least $1.52 billion.

METHODOLOGY FOR THE ASSESSMENT OF PAVEMENT MAINTENANCE NEEDS

In order to estimate funding needs for pavement maintenance it was necessary, first, to determine what pavements were currently considered deficient and, second, to assess the costs associated with repairing these pavements. For the first part of this analysis, JLARC staff analyzed current pavement condition data collected by the VDOT pavement management section as part of the 2000 pavement condition survey. Using VDOT standards for determining deficient pavements, JLARC staff identified approximately 2,207 directional miles of interstate and primary pavements that would be considered deficient. For the second part of this analysis, JLARC staff applied average contract prices for asphalt overlay based on the 2001 pavement overlay schedule to determine the minimum cost for repairing the pavements identified as deficient. Based on this analysis, JLARC staff estimate that there is at least $105.6 million in pavement maintenance needs across the State.

Assessment of Current Interstate and Primary Pavement Conditions

The first objective of the JLARC staff analysis was to provide an overview of the general condition of pavements on the interstate and primary systems for each VDOT district and across Virginia's counties. For the purpose of this analysis, JLARC staff used VDOT 2000 pavement condition survey data, containing load related distress ratings (LDR) and non-load related distress ratings (NDR) for 11,174 directional miles of interstate and primary pavements, provided by the pavement management section. However, approximately five directional miles of condition data for concrete pavement sections were removed from this data due to a lack of adequate condition measures as cited by the State pavement management engineer.

For the remaining 11,169 directional miles of pavement condition data, JLARC staff developed a Critical Condition Index (CCI) rating for each pavement section included in the survey based on the lower of the LDR and NDR ratings. Using VDOT pavement management section definitions, JLARC staff determined a pavement to be deficient if the CCI was less than 60. A pavement with a critical index between 50 and 59 is considered in poor condition and would typically require repair within two to three years. A pavement with a critical index rating of 49 or less is considered to be in very poor condition and would likely be placed on the following year's paving schedule. Exhibit 6 (Chapter II) further defines the CCI ratings. Based on an analysis of all pavement sections with a CCI less than 60, JLARC staff identified 2,207 directional miles of pavements that would currently be considered deficient.

The JLARC staff methodology for identifying deficient pavement sections was developed with the assistance of the State pavement management engineer and other VDOT pavement management staff. Additionally, JLARC staff, in consultation with VDOT pavement management staff, determined that the identification of deficient pavements would be based on VDOT pavement management criteria and that the reporting of this data would be provided in VDOT directional mile measurements.

While the JLARC staff analysis was based on a similar analysis performed in the VDOT 1998 *Condition of the Pavement Report*, according to the State pavement management engineer, the 1998 analysis is not directly replicable using current condition data due to changes in the data collection methodologies. Additionally, the pavement management section prepared an overview of statewide pavement conditions using the 2000 interstate and primary pavement condition data. Similar to the pavements identified as deficient in the JLARC staff analysis, the VDOT pavement management section analysis indicated that, statewide, 20 percent of interstate and primary pavements are considered to be in poor or very poor condition. However, the VDOT analysis did not include any analysis of the general condition of the pavements for each district or county.

Different Standards for Reporting Mileage. When assessing the condition of the existing pavement sections, there are three distinct ways of communicating pavement mileage: centerline miles, directional miles, and lane

miles. Centerline miles measure the total length of both directions of a roadway regardless of the number of lanes or the direction of travel. Directional miles measure the total lane mileage of the farthest right hand lane of each direction of travel, except for undivided primary and secondary pavements in which only the primary direction (northbound or eastbound) is measured. Lane miles, on the other hand, are measured for all travel lanes in each direction. For example, considering a section of I-95 between mile points 45.0 and 46.0 with three lanes in each northbound and southbound direction, there would be: one centerline mile, two directional miles (one mile northbound and one mile southbound), or six lane miles (three lane miles northbound and three lane miles southbound).

While there is some concern that there is no common measure for communicating actual system mileage, according to a senior pavement management engineer, directional miles are the most commonly used measure in the evaluation of system wide pavement conditions and were used for both 1998 and 2000 pavement data collection exercises. According to VDOT pavement management staff, pavement sections identified as deficient are reported to the district maintenance engineers in directional mileage for use in the planning and scheduling of pavement maintenance activities. Centerline miles, on the other hand, are primarily used for federal reporting purposes as well as in the communication of total system mileage to the general public. Finally, lane miles are used as a base for the calculation of contracted material quantities for maintenance overlay contracts.

Because there is no direct way to standardize pavement mileage between directional miles, lane miles and centerline miles, JLARC staff determined the most accurate analysis of pavement condition would best be measured and reported using directional miles. Since VDOT does not have primary maintenance responsibility for roads on the urban system, and because State maintenance payments to localities are calculated using the Maintenance Cost Index based on moving lane miles, VDOT does not track directional miles for roads located in the urban system. Table A-1 compares the total reported mileage for all State maintained systems using centerline, directional, and lane mileage measures.

VDOT 2000 Pavement Condition Survey Data. The VDOT pavement management section collects condition data for pavements on the interstate and primary systems in order to both assess the current condition of Virginia's pavements and to assist in the development of the annual district pavement overlay schedules. However, the standards for the collection of this data have shifted numerous times throughout the development of the pavement management program, and there is currently not an acceptable level of continuity in the data to compare current pavement conditions against those conditions previously measured. According to VDOT pavement management staff, however, the district maintenance engineers ultimately make the decision on which pavement sections are included and the total mileage of pavement condition data collected.

As part of the 2000 pavement condition survey, the VDOT pavement management section collected and analyzed pavement condition data for 11,174 directional miles of interstate and primary pavements (approximately 88 percent of the State's total interstate and primary directional mileage). This data comprised

Table A-1

Virginia's Highway Mileage, 2000

System	Directional Mileage	Centerline Mileage	Lane Mileage*
Interstate	2,274	1,118	5,299
Primary	10,374	8,012	21,325
Secondary & Frontage	48,204	47,582	95,742
Total	**60,852**	**56,712**	**122,366**

Note: For undivided primary and secondary pavements, VDOT calculates directional mileage for only the primary (Northbound or Eastbound) direction. Lane mileage reported is as of December 31, 1999.

Source: VDOT pavement section, traffic engineering section, and VDOT web site.

1,834 directional miles (81 percent) of interstate pavements, and 9,335 directional miles (90 percent) of primary pavements. Additionally, pavement condition data were collected for five miles of concrete pavements that were removed from the analysis due to the lack of a reliable condition measure, as cited by the State pavement management engineer. Table A-2 illustrates the total directional mileage of asphalt pavements included in the 2000 pavement condition survey to the total asphalt pavements in each district.

Assessment of Virginia's Pavement Conditions. Based on a methodology developed by VDOT's pavement management section, the LDR and NDR ratings used to categorize degrees of pavement distress on a "0" to "100" scale were converted to a single CCI value from which a pavement condition classification for each section was established. For the purposes of this analysis, deficient pavements were defined as any pavement section with a CCI less than 60, based on VDOT standards and the recommendation of the State pavement management engineer. Chapter II provides a more concise discussion on the calculation of the LDR, NDR, and CCI indices.

Using the CCI condition standards, JLARC staff determined that 2,207 directional miles (20 percent of the sampled roads) of the State-maintained interstate and primary system would be considered deficient. The distribution of deficient pavements was even across both the interstate and primary systems, with 364 directional miles (20 percent) of interstate, and 1,842 directional miles (20 percent) of primary pavements considered deficient.

Assessing Pavement Conditions by County. In order to assess pavement conditions for the interstate and primary pavements in each county for which VDOT has the primary maintenance responsibility, JLARC staff stratified the

Table A-2

Total Directional Miles of Interstate and Primary Asphalt Pavements Included in the 2000 Pavement Condition Survey

District	Sample Length	Total District Asphalt Length	Sample Percent of Total Asphalt
Bristol	1,666	1,695	98%
Salem	1,500	1,528	98%
Lynchburg	1,294	1,312	99%
Richmond	1,467	1,771	83%
Hampton Roads	1,090	1,085	100%
Fredericksburg	1,149	1,108	104%
Culpeper	543	1,047	52%
Staunton	1,627	1,651	99%
Northern Virginia	833	832	100%
Totals	**11,169**	**12,029**	**93%**

Note: Total sample length for the Hampton Roads, Fredericksburg, and Northern Virginia districts exceeds total district asphalt length due to the inclusion of pavement condition data for both directions of undivided primary pavements.

Source: JLARC staff analysis of VDOT pavement section data.

2000 pavement condition survey data by the county from which each pavement section was taken. The same CCI deficiency criterion was applied to the condition data, and each county was ranked according to the total percentage of sampled roads that were determined to be deficient. Appendix B provides a listing of the total sample mileage and the percent deficient mileage reported for each of Virginia's counties.

While VDOT does not collect pavement condition data for the streets located in the cities and towns that currently receive State maintenance payments, the pavement sample included in the 2000 condition survey does include interstate and primary pavements in the counties of Arlington and Henrico, which receive State payments for the maintenance of secondary roads, as well as some rural primary pavement sections in the cities of Suffolk (Old Nansemond County) and Chesapeake within the Hampton Roads district. According to VDOT staff, the Hampton Roads district has agreed to assume maintenance responsibility for the primary roads that are located outside of the core city area for these municipalities.

Estimation of Pavement Overlay Costs

In order to estimate the baseline costs to provide asphalt overlay to the 2,207 directional miles of interstate and primary pavements identified as deficient, VDOT maintenance division contract administration staff provided line item asphalt costs for completed contracts from the 2001 pavement overlay schedule. According to VDOT staff, there were 78 contracts let as part of the 2001 pavement overlay schedule, covering multiple pavement sections across road systems and counties. From these contracts there were 606 line items for asphalt costs for which VDOT reported more than $53.7 million in total expenditures for FY 2001. Based on an analysis of the line item costs for each of these contracts, JLARC staff estimate that there is at least a $105.6 million need for asphalt overlay on the interstate and primary systems, or almost twice the current expenditure level.

According to the State pavement management engineer, the preferred pavement maintenance activity is a 1½" structural overlay that would address both the present surface conditions as well as the underlying causes of the pavement distress. However, there are a number of factors directly related to structural pavement maintenance activities that vary substantially with each project due to quantities and region, such as: total number of lanes in each section, traffic control, asphalt striping, and shoulder stabilization. Therefore, in order to provide a conservative baseline measure for the costs of repairing these pavements, the JLARC staff analysis included only contracted line item costs for asphalt overlay.

The JLARC staff analysis was based on the 606 asphalt overlay line items identified by VDOT maintenance division contract management staff. Since pavement overlay contracts are let based on asphalt tonnage, in order to standardize to directional miles it was necessary to look at the total cost of the contract, total asphalt tonnage, total mileage of the contract, and the direction of travel for the identified section. When a contract specified pavement overlay for both directions of travel for a pavement section, the total contract cost was divided in half and included in each directional total. Since interstate and primary overlay contracts would have different average costs, the analysis includes the average overlay costs for each system. VDOT maintenance division contract management staff provided JLARC staff average directional mileage costs for asphalt overlay for both the interstate and primary systems. Table A-3 describes the directional breakdown for asphalt costs for both the interstate and primary systems.

Applying the statewide average per mile asphalt overlay costs for both systems to the 2,207 directional miles identified as deficient, JLARC staff estimate that there is a need for at least $105.6 million in asphalt overlay alone, or approximately twice the amount spent on contracted asphalt costs in FY 2001. According to VDOT staff, the directional mile estimate provided would be conservative because it does not address the total number of lanes for each overlay section or other incidental items directly related to the total cost of a structural overlay for each section. Additionally, according to VDOT staff, the department's policy concerning recent changes to federal guardrail regulations would require guardrail to be repaired in the areas selected for pavement rehabilitation, however

Table A-3

VDOT Average Asphalt Costs Per Directional Mile, 2001

Direction	Interstate	Primary
Northbound	$ 95,580	$ 41,196
Southbound	$ 63,850	$ 39,426
Eastbound	$ 81,358	$ 44,207
Westbound	$ 80,977	$ 40,917
Statewide Average	**$ 80,441**	**$ 41,437**

Note: Because these figures represent costs from a single year, actual directional asphalt costs may vary due to only one direction being overlaid during that year.

Source: VDOT staff analysis of 2001 pavement overlay contracts.

these costs are considered separately from the costs of the pavement overlay schedule and are handled through separate contracts.

While JLARC staff recognize that this estimate of pavement maintenance needs for interstate and primary pavements does not account for all aspects of a complete structural overlay, VDOT staff were not able to provide an average per mile estimate inclusive of all structural overlay components. Furthermore, while VDOT may be able to generate a more accurate assessment of pavement maintenance needs with the completion of the PMP, the State pavement management engineer stated that it will be at least two more years before the department is able to use this information for the systematic planning of maintenance program budgets for all road systems.

METHODOLOGY FOR THE ASSESSMENT OF VDOT MAINTAINED BRIDGE MAINTENANCE NEEDS

Similar to the analysis performed on current pavement conditions, as part of this review of the VDOT maintenance program, JLARC staff conducted a two-fold analysis of the current condition of VDOT maintained structures and bridges and the estimated cost to repair and rehabilitate bridges with identified maintenance needs. For the first part of this analysis, JLARC staff analyzed the overall condition of the bridges for which VDOT has the primary maintenance responsibility for each road system as well as for each district based on the general condition ratings assigned to the three major bridge components. Second, using an estimate of average bridge maintenance and repair costs, prepared by the VDOT structure and bridge section, JLARC staff estimated total bridge maintenance needs based on the

specific component conditions. Using the available 2001 structure and bridge condition data and average unit prices for bridge maintenance provided by the VDOT structure and bridge section, JLARC staff estimate the minimum cost to repair and rehabilitate all bridges with identified maintenance needs at $1.52 billion.

Assessment of Current Bridge Conditions

According to the State structure and bridge engineer, the condition of Virginia's bridges and structures can best be gauged by using the present structural condition and age of the structure or bridge. As a result, the JLARC staff analysis employed the general condition ratings assigned by VDOT staff to every bridge for which VDOT has primary maintenance responsibility in order to compare the current condition of VDOT maintained bridges to their original constructed condition.

JLARC staff used the three general condition ratings for the bridge deck, superstructure, and substructure to identify maintenance needs on those bridges for which VDOT has the primary maintenance responsibility. Additionally, JLARC staff assessed the age of VDOT maintained bridges throughout each district and across each system and analyzed the total number of bridges with identified maintenance needs based on the year the bridge was constructed. However, the age of a structure was not used in the determination of maintenance needs or in the JLARC staff estimation of total bridge repair costs.

The framework for this analysis was developed in conjunction with the assistant State structure and bridge engineer, using bridge condition data collected by the structure and bridge section and Federal Highway Administration definitions for general condition ratings. For the purposes of this analysis, a bridge was considered to be in need of maintenance if any of the three general condition ratings were five or less. In order to perform this analysis, the VDOT structure and bridge section provided JLARC staff with a data set containing approximately 20,249 statewide structures and bridges for which VDOT shares the maintenance responsibility with certain cities and towns, and other private entities such as railroads or independent toll road operators listed by: component condition ratings, length, width, total square footage, total number of substructure units, state system type, and date of initial construction. Table A-4 outlines who has maintenance responsibility and the level of maintenance required for all of Virginia's bridges.

Of the 20,249 structures and bridges in the State, VDOT is directly responsible for the maintenance of 18,985 bridges and culverts or 94 percent of the entire State system. Currently, there are 59 cities and towns currently receiving State maintenance payments that have the primary maintenance responsibility for 952 bridges and other structures (five percent) within their jurisdictions. Additionally, private entities are responsible for the maintenance of 258 structures and bridges (one percent). Furthermore, there are 54 bridges and other structures (less than one percent) within the State that are closed to traffic, for which no entity has direct maintenance responsibility.

Table A-4

Maintenance Responsibility for Virginia's Structures and Bridges

VDOT Responsible			**18,985**
Culverts	7,205		
Bridges	11,775		
Bridges Needing Repair or Replacement		*4,658*	
Bridges Needing Routine Maintenance		*7,117*	
Removed	5		
Local Responsible			**952**
Culverts	262		
Bridges	685		
Bridges Needing Repair or Replacement		*207*	
Bridges Needing Routine Maintenance		*478*	
Removed	5		
Private Responsible			**258**
Culverts	77		
Bridges	181		
Closed			**54**
State Totals			**20,249**

Source: JLARC staff analysis of VDOT structure and bridge section data.

For the first part of this analysis, the 18,985 structures and bridges that VDOT has primary maintenance responsibility for were stratified by the culvert and bridge classification, and the 7,205 structures identified as culverts were removed from the analysis. A structure was identified as a culvert if it was designated by VDOT, and if a culvert condition rating was assigned to the structure. Furthermore, three structures having no general condition rating for any component, and two structures having general condition ratings for both bridge and culvert components, were removed from the analysis altogether.

JLARC staff analyzed the remaining 11,775 bridges based on each general condition rating. Based on this analysis, JLARC staff identified 4,658 (40 percent) bridges for which VDOT has the primary maintenance responsibility that are currently in need of some level of maintenance based on general condition ratings. Furthermore, 7,117 bridges (60 percent) had general condition ratings of six or greater and are considered by the maintenance division to be meeting current performance measures. While a separate analysis of the age of VDOT maintained bridges was conducted, age alone was not considered in determining bridge maintenance needs.

Assessing Bridge Conditions by City and County. As part of this analysis, JLARC staff analyzed the condition of VDOT maintained bridges for each of Virginia's counties and for those bridges located in municipalities for which VDOT has agreed to assume the primary maintenance responsibility. Additionally, the JLARC staff analysis included a separate assessment of the condition of the bridges located within the jurisdictions currently receiving State maintenance payments. In order to determine bridge conditions for each county in which VDOT has primary maintenance responsibility as well as for the cities currently receiving State maintenance payments, JLARC staff stratified the 2001 bridge condition data by the city and county in which each bridge is located.

The same general condition rating criterion was applied to the bridge condition data, and each city and county was ranked according to the total percentage of bridges that were determined to be in need of maintenance. For towns currently receiving State maintenance payments but have VDOT maintained bridges within their jurisdictions, the condition of these bridges was included in the county totals. Appendix C provides a listing of the total number VDOT maintained bridges, and the percent determined in need of maintenance, for each of Virginia's counties and cities for which VDOT has primary maintenance responsibility. Additionally, Appendix D provides a listing of the total number of bridges, and the percent determined to be in need of maintenance, for each of the municipalities currently receiving State maintenance payments.

Estimating Bridge Maintenance Needs

In order to estimate funding needs for the rehabilitation of the State-maintained bridges with identified maintenance needs, JLARC staff applied the average unit costs for bridge maintenance activities to each component with an identified maintenance needs. Since all bridges are rated on three component conditions, the total number of components with identified maintenance needs is greater than the total number of bridges with identified maintenance needs. Therefore, while this analysis provides the total estimated cost for rehabilitation of bridges with identified maintenance needs, it is not possible to identify the costs associated with a specific bridge rehabilitation project.

As discussed previously, the methodology for the JLARC staff analysis for estimating bridge maintenance and repair costs was developed in conjunction with VDOT structure and bridge section staff. Furthermore, the JLARC staff analysis was modeled on a somewhat similar analysis provided by Dr. David Hartgen at the University of North Carolina, Charlotte. (*On the Road Again: Performance, Needs, and Funding Options for North Carolina's Highways*, October 2000.) The use of a total square footage analysis for deck and superstructure conditions with identified maintenance needs, as well as the total number of substructure units, for estimating bridge rehabilitation costs was based on the recommendation of the assistant State structure and bridge engineer. Additionally, only concrete and wooden deck bridges were considered as part of this analysis. Based on the recommendations of VDOT staff, fracture critical steel deck bridges were removed from the analysis due to the

limited number of these bridges and the considerable expenses involved in the rehabilitation of these bridges.

JLARC staff obtained average cost estimates for the rehabilitation of deck, superstructure, and substructure elements from both the State structure and bridge engineer and the assistant State structure and bridge engineer. According to VDOT staff, there is a considerable range in the costs associated with bridge rehabilitation activities, and the unit prices for a specific project would vary based on the extent of deterioration to each of the components. For the JLARC staff analysis, the decision was made to use the lowest estimate provided for these activities in order to establish a conservative baseline estimate of bridge rehabilitation needs.

According to VDOT structure and bridge staff, the average cost for deck overlay or other replacement activities range from $45 per square foot to $140 per square foot depending on the total square footage of the bridge deck, extent of the surface distress, the total tonnage of asphalt required, and the location of the bridge. Superstructure costs range from $60 per square foot for concrete bridges to $75 per square foot for timber bridges. However, while it is possible that maintenance activities to repair bridge deck conditions can increase the superstructure rating beyond that considered in need of maintenance, according to VDOT staff, for the purpose of identifying bridge maintenance needs, any analysis should look at both the deck and superstructure conditions. Finally, rehabilitation of bridge substructure units range from $10,000 per unit for concrete bridges to $15,000 per unit for timber bridges.

Based on the general condition ratings and unit prices provided by the VDOT structure and bridge section, the JLARC staff analysis identified 2,485 bridges (13,380,000 square feet) which were considered to be in need of some maintenance activity based on the deck condition, and applied an estimate of $45 per square foot for these bridges. The JLARC staff analysis found 3,191 bridges (13,635,100 square feet) with identified maintenance needs based on the superstructure condition, and applied an estimate of $60 per square foot to these bridges. Finally, 2,707 bridges, containing 9,804 total units, had identified maintenance needs based on substructure conditions for which an estimate of $10,000 per unit was applied. From this analysis JLARC staff estimate the baseline cost for rehabilitation of these bridges to be $1.52 billion (Table 15 in Chapter III). However, VDOT has taken some steps towards providing more cost effective bridge repairs, such as the use of pre-cast concrete bridges produced at the districts and installed by VDOT district structure and bridge crews, which could reduce the costs for rehabilitation of some smaller bridges.

While this analysis does capture the average cost to rehabilitate each component of every bridge with an identified maintenance need, this analysis does not address the specific cost associated with a single project within those bridges with identified maintenance needs. Additionally this analysis does not capture the preliminary engineering, maintenance of traffic, and contingency costs associated with each project. According to the assistant State structure and bridge engineer, preliminary engineering and contingency costs are approximately 22 to 25 percent of

total rehabilitation costs, and maintenance of traffic costs will add 25 to 50 percent to the cost of a project. Furthermore, VDOT staff stated that these are standard prices that vary with quantity and geographic region for a given type of repair action, and it is not possible to provide a single unit price for repairing a randomly selected bridge without details of what repairs are needed.

An analysis of the condition of bridges maintained by those jurisdictions currently receiving State maintenance payments indicates that 207 of these bridges (30 percent) have identified maintenance needs at an estimated cost of more than $159 million. Table A-5 illustrates the estimated bridge maintenance and repair needs for the bridges maintained by the cities and towns currently receiving State maintenance payments.

Based on the general condition ratings and unit prices provided by the VDOT structure and bridge section, the JLARC staff analysis identified 129 bridges (1,308,000 square feet) which were considered to be in need of some maintenance activity based on the deck condition, and applied an estimate of $45 per square foot for these bridges. The JLARC staff analysis found 142 bridges (1,591,000 square feet) with identified maintenance needs based on the superstructure condition, and applied an estimate of $60 per square foot to these bridges. Finally, 115 bridges, containing 514 total units, had identified maintenance needs based on substructure conditions for which an estimate of $10,000 per unit was applied. From this analysis JLARC staff estimate the baseline cost for rehabilitation of these bridges to be $159.4 million.

Table A-5

Estimate of Locality Maintained Bridge Maintenance and Rehabilitation Needs

Condition		Deck			Superstructure			Substructure			Total Estimated Cost
Description	Rating	Number	Total Sq. Ft. (In 1000s)	Cost Per Sq. Foot.	Number	Total Sq. Ft (In 1000s)	Cost Per Sq. Foot.	Number	Total Number Units	Cost Per Unit	
Fair	5	82	851.3	$45	82	1,020.5	$ 60	75	323	$10,000	**$ 102,768,500**
Poor	4	40	386.3	$45	51	430.6	$ 60	38	178	$10,000	**$ 44,999,500**
Serious	3 or Below	7	70.9	$45	9	139.9	$ 60	2	13	$10,000	**$ 11,714,500**
Total		**$ 58,882,500**			**$ 95,460,000**			**$ 5,140,000**			**$ 159,482,500**

Notes: Condition totals may be greater than the total number of identified bridges because all bridges are evaluated for more than one general condition rating. Unit costs to repair bridges identified as "serious" would likely be higher than the estimated unit cost.

Source: JLARC staff analysis of VDOT bridge condition data.

Appendix B

Deficient Interstate and Primary Pavements (By County)

County	District	Sample Length (Directional Miles)	Deficient Length (Directional Miles)	Percent Deficient Miles
Accomack	Hampton Roads	127	42	**33%**
Albemarle	Culpeper	183	18	**10%**
Alleghany	Staunton	158	37	**23%**
Amelia	Richmond	52	2	**4%**
Amherst	Lynchburg	114	1	**1%**
Appomattox	Lynchburg	68	17	**25%**
Arlington	Northern Virginia	97	49	**50%**
Augusta	Staunton	270	51	**19%**
Bath	Staunton	75	9	**12%**
Bedford	Salem	184	35	**19%**
Bland	Bristol	113	5	**5%**
Botetourt	Salem	182	54	**30%**
Brunswick	Richmond	148	43	**29%**
Buchanan	Bristol	93	32	**34%**
Buckingham	Lynchburg	99	13	**13%**
Campbell	Lynchburg	156	7	**5%**
Caroline	Fredericksburg	174	58	**33%**
Carroll	Salem	150	26	**17%**
Charles City	Richmond	41	5	**13%**
Charlotte	Lynchburg	139	15	**11%**
Chesapeake (Rural)	Hampton Roads	64	14	**21%**
Chesterfield	Richmond	183	48	**26%**
Clarke	Staunton	72	4	**6%**
Craig	Salem	60	14	**23%**

County	District	Sample Length (Directional Miles)	Deficient Length (Directional Miles)	Percent Deficient Miles
Culpeper	Culpeper	27	10	**35%**
Cumberland	Lynchburg	53	5	**10%**
Dickenson	Bristol	82	11	**13%**
Dinwiddie	Richmond	63	13	**21%**
Essex	Fredericksburg	84	7	**8%**
Fairfax	Northern Virginia	380	130	**34%**
Fauquier	Culpeper	129	33	**26%**
Floyd	Salem	54	14	**26%**
Fluvanna	Culpeper	18	2	**11%**
Franklin	Salem	123	12	**10%**
Frederick	Staunton	209	15	**7%**
Giles	Salem	115	32	**28%**
Gloucester	Fredericksburg	93	27	**29%**
Goochland	Richmond	134	35	**26%**
Grayson	Bristol	120	23	**20%**
Greene	Culpeper	21	5	**26%**
Greensville	Hampton Roads	71	9	**13%**
Halifax	Lynchburg	202	28	**14%**
Hanover	Richmond	137	42	**31%**
Henrico	Richmond	172	42	**24%**
Henry	Salem	167	64	**38%**
Highland	Staunton	71	3	**4%**
Isle of Wight	Hampton Roads	101	32	**32%**
James City	Hampton Roads	103	23	**22%**
King and Queen	Fredericksburg	68	3	**4%**
King George	Fredericksburg	104	13	**12%**
King William	Fredericksburg	56	7	**13%**

County	District	Sample Length (Directional Miles)	Deficient Length (Directional Miles)	Percent Deficient Miles
Lancaster	Fredericksburg	63	6	**10%**
Lee	Bristol	140	13	**9%**
Loudoun	Northern Virginia	172	37	**21%**
Louisa	Culpeper	75	49	**66%**
Lunenburg	Richmond	54	4	**7%**
Madison	Culpeper	29	4	**15%**
Mathews	Fredericksburg	32	0	**0%**
Mecklenburg	Richmond	157	41	**26%**
Middlesex	Fredericksburg	63	15	**24%**
Montgomery	Salem	136	20	**14%**
Nelson	Lynchburg	130	15	**12%**
New Kent	Richmond	93	10	**11%**
Northampton	Hampton Roads	75	27	**36%**
Northumberland	Fredericksburg	55	7	**12%**
Nottoway	Richmond	88	13	**14%**
Orange	Culpeper	17	4	**21%**
Page	Staunton	70	1	**1%**
Patrick	Salem	101	15	**15%**
Pittsylvania	Lynchburg	224	8	**3%**
Powhatan	Richmond	40	10	**26%**
Prince Edward	Lynchburg	109	26	**23%**
Prince George	Richmond	104	40	**38%**
Prince William	Northern Virginia	183	52	**29%**
Pulaski	Salem	80	3	**3%**
Rappahannock	Culpeper	45	5	**12%**
Richmond	Fredericksburg	48	8	**17%**
Roanoke	Salem	148	23	**16%**

County	District	Sample Length (Directional Miles)	Deficient Length (Directional Miles)	Percent Deficient Miles
Rockbridge	Staunton	226	47	**21%**
Rockingham	Staunton	245	69	**28%**
Russell	Bristol	147	34	**23%**
Scott	Bristol	145	19	**13%**
Shenandoah	Staunton	158	18	**11%**
Smyth	Bristol	135	14	**11%**
Southampton	Hampton Roads	96	28	**30%**
Spotsylvania	Fredericksburg	128	40	**31%**
Stafford	Fredericksburg	111	45	**40%**
Suffolk (Rural)	Hampton Roads	164	68	**42%**
Surry	Hampton Roads	46	2	**5%**
Sussex	Hampton Roads	142	23	**16%**
Tazewell	Bristol	178	35	**19%**
Warren	Staunton	74	0	**0%**
Washington	Bristol	186	11	**6%**
Westmoreland	Fredericksburg	70	2	**2%**
Wise	Bristol	164	18	**11%**
Wythe	Bristol	163	15	**9%**
York	Hampton Roads	97	23	**24%**
Statewide Totals		**11,165**	**2,210**	**20%**

Note: Interstate and primary mileage measures are included for rural sections of the cities of Chesapeake and Suffolk for which the Hampton Roads district has agreed to provide maintenance.

Source: JLARC staff analysis of VDOT 2000 pavement condition survey data.

Appendix C

Identified Maintenance Needs for VDOT-Maintained Bridges, by City and County

County / City	District	Total Bridges	Total Bridges With Identified Maintenance Needs	Percent Bridges With Identified Maintenance Needs
Accomack	Hampton Roads	28	10	**36%**
Albemarle	Culpeper	258	103	**40%**
Alexandria	Northern Virginia	23	11	**48%**
Alleghany	Staunton	187	95	**51%**
Amelia	Richmond	54	22	**41%**
Amherst	Lynchburg	136	30	**22%**
Appomattox	Lynchburg	66	22	**33%**
Arlington	Northern Virginia	113	18	**16%**
Augusta	Staunton	455	235	**52%**
Bath	Staunton	97	41	**42%**
Bedford	Salem	222	80	**36%**
Bedford (City)	Salem	6	5	**83%**
Bland	Bristol	141	100	**71%**
Botetourt	Salem	227	96	**42%**
Bristol	Bristol	18	11	**61%**
Brunswick	Richmond	133	60	**45%**
Buchanan	Bristol	171	57	**33%**
Buckingham	Lynchburg	73	26	**36%**
Campbell	Lynchburg	123	31	**25%**
Caroline	Fredericksburg	71	38	**54%**
Carroll	Salem	138	35	**25%**

County / City	District	Total Bridges	Total Bridges With Identified Maintenance Needs	Percent Bridges With Identified Maintenance Needs
Charles City	Richmond	13	5	**38%**
Charlotte	Lynchburg	89	32	**36%**
Charlottesville	Culpeper	2	2	**100%**
Chesapeake	Hampton Roads	62	11	**18%**
Chesterfield	Richmond	172	12	**7%**
Clarke	Staunton	49	20	**41%**
Clifton Forge	Staunton	5	2	**40%**
Colonial Heights	Richmond	6	0	**0%**
Covington	Staunton	7	3	**43%**
Craig	Salem	77	24	**31%**
Culpeper	Culpeper	85	28	**33%**
Cumberland	Lynchburg	38	19	**50%**
Danville	Lynchburg	20	2	**10%**
Dickenson	Bristol	78	44	**56%**
Dinwiddie	Richmond	125	58	**46%**
Emporia	Hampton Roads	15	3	**20%**
Essex	Fredericksburg	23	9	**39%**
Fairfax	Northern Virginia	370	68	**18%**
Fauquier	Culpeper	221	80	**36%**
Floyd	Salem	106	32	**30%**
Fluvanna	Culpeper	52	18	**35%**
Franklin	Salem	192	81	**42%**
Frederick	Staunton	155	57	**37%**
Fredericksburg	Fredericksburg	3	1	**33%**

County / City	District	Total Bridges	Total Bridges With Identified Maintenance Needs	Percent Bridges With Identified Maintenance Needs
Giles	Salem	128	53	**41%**
Gloucester	Fredericksburg	13	9	**69%**
Goochland	Richmond	50	8	**16%**
Grayson	Bristol	137	67	**49%**
Greene	Culpeper	41	12	**29%**
Greensville	Hampton Roads	70	15	**21%**
Halifax	Lynchburg	122	51	**42%**
Hampton	Hampton Roads	35	23	**66%**
Hanover	Richmond	129	39	**30%**
Harrisonburg	Staunton	17	8	**47%**
Henrico	Richmond	131	39	**30%**
Henry	Salem	125	48	**38%**
Highland	Staunton	88	26	**30%**
Hopewell	Richmond	6	0	**0%**
Isle of Wight	Hampton Roads	69	15	**22%**
James City	Hampton Roads	35	8	**23%**
King and Queen	Fredericksburg	29	16	**55%**
King George	Fredericksburg	20	8	**40%**
King William	Fredericksburg	24	14	**58%**
Lancaster	Fredericksburg	7	4	**57%**
Lee	Bristol	219	137	**63%**
Lexington	Staunton	1	1	**100%**
Loudoun	Northern Virginia	225	37	**16%**
Louisa	Culpeper	91	26	**29%**
Lunenburg	Richmond	77	30	**39%**

County / City	District	Total Bridges	Total Bridges With Identified Maintenance Needs	Percent Bridges With Identified Maintenance Needs
Lynchburg	Lynchburg	16	4	**25%**
Madison	Culpeper	73	20	**27%**
Mathews	Fredericksburg	5	5	**100%**
Mecklenburg	Richmond	120	64	**53%**
Middlesex	Fredericksburg	8	3	**38%**
Montgomery	Salem	185	87	**47%**
Nelson	Lynchburg	113	33	**29%**
New Kent	Richmond	49	15	**31%**
Newport News	Hampton Roads	37	23	**62%**
Norfolk	Hampton Roads	146	42	**29%**
Northampton	Hampton Roads	2	0	**0%**
Northumberland	Fredericksburg	10	0	**0%**
Norton	Bristol	8	3	**38%**
Nottoway	Richmond	49	26	**53%**
Orange	Culpeper	61	19	**31%**
Page	Staunton	86	40	**47%**
Patrick	Salem	169	69	**41%**
Petersburg	Richmond	36	8	**22%**
Pittsylvania	Lynchburg	202	80	**40%**
Portsmouth	Hampton Roads	26	4	**15%**
Powhatan	Richmond	26	9	**35%**
Prince Edward	Lynchburg	77	27	**35%**
Prince George	Richmond	82	17	**21%**
Prince William	Northern Virginia	135	19	**14%**

County / City	District	Total Bridges	Total Bridges With Identified Maintenance Needs	Percent Bridges With Identified Maintenance Needs
Pulaski	Salem	101	47	**47%**
Rappahannock	Culpeper	99	47	**47%**
Richmond	Fredericksburg	15	5	**33%**
Richmond (City)	Richmond	72	29	**40%**
Roanoke	Salem	172	78	**45%**
Roanoke (City)	Salem	26	12	**46%**
Rockbridge	Staunton	354	177	**50%**
Rockingham	Staunton	352	153	**43%**
Russell	Bristol	149	45	**30%**
Scott	Bristol	277	191	**69%**
Shenandoah	Staunton	245	80	**33%**
Smyth	Bristol	256	128	**50%**
Southampton	Hampton Roads	106	64	**60%**
Spotsylvania	Fredericksburg	57	23	**40%**
Stafford	Fredericksburg	53	26	**49%**
Suffolk	Hampton Roads	95	33	**35%**
Surry	Hampton Roads	26	11	**42%**
Sussex	Hampton Roads	90	16	**18%**
Tazewell	Bristol	172	68	**40%**
Virginia Beach	Hampton Roads	22	3	**14%**
Warren	Staunton	74	27	**36%**
Washington	Bristol	239	157	**66%**
Waynesboro	Staunton	7	0	**0%**
Westmoreland	Fredericksburg	15	4	**27%**

County / City	District	Total Bridges	Total Bridges With Identified Maintenance Needs	Percent Bridges With Identified Maintenance Needs
Williamsburg	Hampton Roads	1	0	**0%**
Wise	Bristol	166	71	**43%**
Wythe	Bristol	187	99	**53%**
York	Hampton Roads	32	16	**50%**
Statewide Totals		**11,775**	**4,658**	**40%**

Notes: Includes all bridges for which VDOT has primary maintenance responsibility. City totals do not include locality maintained bridges. Actual totals for bridges located in Towns receiving State maintenance payments are included within the county totals. Cities with bridges within their jurisdiction for which VDOT does not have primary maintenance responsibility are not included in this list.

Source: JLARC staff analysis of VDOT structure and bridge section data.

Appendix D

Identified Maintenance Needs for Locally Maintained Bridges, by City and Town

Municipality	District	Total Number of Bridges	Total Bridges With Identified Maintenance Needs	Percent Bridges With Identified Maintenance Needs
Abingdon	Bristol	4	3	75%
Alexandria	Northern Virginia	12	0	0%
Bedford	Salem	2	2	100%
Big Stone Gap	Bristol	6	4	67%
Blackstone	Richmond	1	1	100%
Bluefield	Bristol	8	5	63%
Bristol	Bristol	22	11	50%
Buena Vista	Staunton	7	1	14%
Charlottesville	Culpeper	10	8	80%
Chesapeake	Hampton Roads	60	9	15%
Christiansburg	Salem	4	2	50%
Clifton Forge	Staunton	6	3	50%
Colonial Heights	Richmond	4	1	25%
Covington	Staunton	3	0	0%
Culpeper	Culpeper	5	2	40%
Danville	Lynchburg	28	3	11%
Elkton	Staunton	1	0	0%
Emporia	Hampton Roads	3	1	33%
Fairfax	Northern Virginia	4	0	0%

Municipality	District	Total Number of Bridges	Total Bridges With Identified Maintenance Needs	Percent Bridges With Identified Maintenance Needs
Farmville	Lynchburg	2	2	100%
Franklin	Salem	1	0	0%
Fredericksburg	Fredericksburg	11	4	36%
Front Royal	Staunton	8	2	25%
Galax	Salem	5	0	0%
Hampton	Hampton Roads	34	11	32%
Harrisonburg	Staunton	20	4	20%
Hopewell	Richmond	3	2	67%
Lebanon	Bristol	5	0	0%
Leesburg	Northern Virginia	6	0	0%
Lexington	Staunton	7	7	100%
Luray	Staunton	6	0	0%
Lynchburg	Lynchburg	51	14	27%
Manassas	Northern Virginia	1	0	0%
Marion	Bristol	11	4	36%
Martinsville	Salem	5	2	40%
Newport News	Hampton Roads	21	4	19%
Norfolk	Hampton Roads	32	16	50%
Norton	Bristol	10	2	20%
Petersburg	Richmond	13	5	38%
Portsmouth	Hampton Roads	5	4	80%
Pulaski	Salem	13	4	31%
Radford	Salem	2	1	50%

Municipality	District	Total Number of Bridges	Total Bridges With Identified Maintenance Needs	Percent Bridges With Identified Maintenance Needs
Richlands	Bristol	9	3	33%
Richmond	Richmond	40	11	28%
Roanoke	Salem	56	16	29%
Rocky Mount	Salem	2	1	50%
Salem	Salem	15	8	53%
Saltville	Bristol	2	1	50%
Smithfield	Hampton Roads	1	0	0%
South Boston	Lynchburg	3	2	67%
Staunton	Staunton	9	1	11%
Suffolk	Hampton Roads	3	0	0%
Tazewell	Bristol	11	8	73%
Vinton	Salem	2	0	0%
Virginia Beach	Hampton Roads	51	10	20%
Waynesboro	Staunton	14	1	7%
Williamsburg	Hampton Roads	4	0	0%
Wytheville	Bristol	1	1	100%
Total Local Maintained		**685**	**207**	**30%**

Note: Condition data for locally maintained bridges only. Does not include bridges located within municipal jurisdictions for which VDOT has the primary maintenance responsibility.

Source: JLARC staff analysis of VDOT bridge section data.

Appendix E

Agency Responses

As part of the extensive data validation process, State agencies involved in a JLARC assessment effort are given an opportunity to comment on an exposure draft of the report. Appropriate technical corrections resulting from written comments have been made in this version of the report. This appendix contains the response from the Commissioner of Transportation.

NOV 2 0 2001

COMMONWEALTH of VIRGINIA

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

CHARLES D. NOTTINGHAM
COMMISSIONER

November 20, 2001

Mr. Philip A. Leone, Director
Joint Legislative Audit and Review Commission
Suite 1100
General Assembly Building
Capitol Square
Richmond, Virginia 23219

Dear Mr. Leone:

I appreciate this opportunity to provide the Department of Transportation's (VDOT) written response to the JLARC study of "Adequacy and Management of VDOT's Highway Maintenance Program." I have also attached a written response to each of the recommendations contained in the report. In addition to these written comments, VDOT staff continues to meet with your staff to discuss specific issues, additional comments or any disagreements that might still exist.

At the outset, I again want to compliment your staff on their efforts to tackle the highly complex and often ambiguous business of maintenance. I am confident that the access to VDOT's maintenance professionals that we afforded your staff helped to provide as good an understanding of the business as possible. I am also very pleased with the cooperation that our staff showed yours throughout this study. I trust that you are similarly disposed.

I appreciate the JLARC report acknowledging that Virginia's highway system is in generally good condition. This is testament to the hard work of many generations of our dedicated cadre of maintenance workers and managers. We also hear from many Virginian's of their satisfaction with the condition of their roads, particularly after they return from travels in others states. This is reflected in the recently completed customer satisfaction survey that showed a significant high percentage of Virginians satisfied with road conditions.

It is also reflected by the fact that 80% of our interstate and primary pavements are rated in good condition. This compares favorably to the 75% similarly rated in 1998. We have also seen the percentage of Virginia's bridges that are rated in good condition increase steadily over the last several years. Annual reports by state departments of transportation regularly show Virginia as significantly better than the national average in this aspect as well.

Our commitment to maintenance as our first priority shows through in the fact that this year's maintenance budget is about $871 million, representing over a 30% increase in the last five years. We have continued to provide increases in the maintenance program to support an aging infrastructure, greater and heavier traffic on all roadways and greater public demand for services. We will continue to provide the resources that are necessary to continue to meet these challenges. Today over one-half of the VDOT workforce is dedicated to maintenance and operations.

I was very pleased to see the JLARC staff recommendation that we continue to implement and institutionalize asset management at VDOT. As stated during my comments at the JLARC meeting, VDOT is recognized nationally and internationally as a leader in the ongoing development of asset management for highway maintenance and operations. One of the many challenges of being a national leader is that much of what we learn is learned by trial and error. With few other states or governments to learn from, VDOT's maintenance professionals are having to develop, test, implement and modify the policies, the processes and the doctrines of asset management. With less than five full years of work on this, I believe that we have accomplished very much in advancing asset management, although much work remains to be done.

I remain committed and the agency fully supports the full implementation of the Integrated Maintenance Management Program (IMMP) — our asset management initiative. We continue to advance system development of the base management and decision support system that will be needed once the IMMP is fully operational. Already, VDOT is using the Pavement Management System (PMS), the Bridge Management System (BMS), and the Virginia Operational Information System (VOIS) in our work. In fact, VOIS recently received a national award for its use in emergency management. We continue to develop the Inventory and Condition Assessment System (ICAS) and expect the pilot to conclude in the next few months. A statewide rollout is already being planned. This rollout will ensure that lessons from the pilot will result in faster rollout and utility at less cost.

It is true that I have delayed the request for proposal of the Integrated Maintenance Management System (IMMS). I did this to allow the agency to explore the possibility of an enterprise solution. Dr. Bernie Hill, VDOT's Chief Information Officer is leading this initiative. Once Dr. Hill has completed his analysis of the potential for an enterprise solution that would satisfy the needs of the maintenance and operations programs and all other VDOT core business functions, we will decide the appropriate approach to satisfying this final information component of the IMMP. I want to reassure you that I remain committed to delivering either the IMMS as a separate system or as a part of a larger enterprise effort in the next three to four years. With a potential start-up and development cost estimated to be in excess of $20 million with substantial annual system maintenance costs to follow, I am sure that you can understand why VDOT has not rushed forward with a procurement of the overall IMMS.

Once the various components are in place we should benefit from the expected costs savings that result from better decision making that are integral to asset management. We believe our maintenance program will be much more customer oriented. Our decisions will be directed toward investments that make the best sense over the long term, providing the longest life at the least cost. Additionally, we will be able to commit in advance the outcomes that we will achieve based upon the resources that are invested. This will be the true public benefit of asset management as it will allow us to clearly articulate in policy the conditions and service levels that are to be delivered and to establish a mechanism for real accountability at all levels of VDOT's maintenance program.

I am pleased that JLARC staff recognizes the outstanding performance of the Maintenance Program Leadership Group (MPLG). This innovative approach to statewide management is unique to Virginia, and much like asset management is an area where we see other states attempting to replicate our work. The MPLG provides a statewide focus on the program and provides a platform on which issues can be debated and resolved. It is able to address the program needs and emergency situations rapidly and effectively, as witnessed by our response to Hurricane Floyd, the tragedy of September 11 and other critical events. The MPLG will continue to play an active role in communicating the needs of the program to VDOT's executive management.

Although I was truly dismayed at the choice of wording that JLARC staff selected to describe the conditions of Virginia's bridges, I appreciate your personal commitment to having the term "deficient" removed as a descriptor of bridges in future printed copies of the report. That term has some very specific meanings when used in the transportation community. As such, when your staff used the term "deficient" and at the same time developed its own criteria that had

the effect of inflating the number of bridges in need of maintenance, it tended to provide an overly negative view of the condition of Virginia's bridges. It also tended to inflate the estimate of future expenses. It is unfortunate that we were unable to address this and have a revised report before the report entered the public domain.

Our agreement to revise the wording to indicate that about 40% of VDOT's bridges may require maintenance over the next few years is correct. We believe that over the course of three or four years, we will have performed routine repairs, rehabilitation, reconstruction or replacement on an equivalent population of bridges. It is important to point out that in any given year, VDOT is likely to have over $250 million of bridge work either in the improvement program or in maintenance and repair work.

When JLARC staff attempted to determine the number of bridges that may need some type of maintenance over the next few years, it adopted a methodology that is certainly appropriate. Although we would make some different assumptions and perhaps employ a different approach, we will not dispute the methodology—differing assumptions and differing approaches to these types of issues are fundamental to maintenance. We might take exception to the total dollar estimate of what is needed, as again different choices of work and different decisions would naturally lead to differing costs. However, with the limited time allowed for this response we will not pursue this further.

I believe the area where we continue to have the greatest difference with your recommendations involves our future role in city street payments. Currently VDOT acts as a conduit to provide maintenance payments to cities, towns and the two counties that maintain their own systems. The amount of payment is established by the General Assembly. VDOT local office representatives review the maintenance practices of the local authorities. This process is already in place and we are willing to continue in that role. Should the General Assembly desire that VDOT take a more aggressive and active role in auditing and monitoring city maintenance work, I would urge careful consideration and discussion with effected stakeholders.

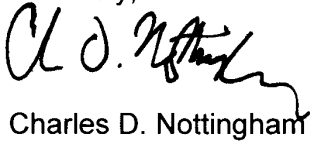
Lacking an objective measure of outcomes, any overview of city street payments that is performed, whether by VDOT or some independent organization, will be subject to second-guessing and debate. Any linkage of funding to this review is likely to result in requests for assistance from the General Assembly. A key component of asset management is identifying those objective measures and reporting against them. We believe that the local governments and the local populations need to establish the outcomes and

service levels that they desire. At this time we are unaware of any Virginia jurisdiction having the necessary foundation to implement a full asset management approach at this time, and it is unlikely that a clear community consensus on the outcomes is practical in the short term.

We believe that the Government Accounting Standards Board (GASB) Statement No. 34 contemplates that responsible units of government will take the lead in determining what is acceptable in terms of maintenance of their infrastructure. This suggests a greater role is appropriate for the local jurisdictions than appears to be considered in the JLARC recommendation. I understand the intent of JLARC that there ought to be a better accounting of the expenditure of state dollars for urban street maintenance. However, I remain uncomfortable in the role that you propose for VDOT.

In closing, let me again thank you for this opportunity to comment on the draft report. Your staff has performed in a professional manner and tackled an extremely complex issue in a thoughtful manner. VDOT staff will continue to work with your staff as described at the outset of this letter. Please accept this letter and its attachment as VDOT's official response to the draft report, "Adequacy and Management of VDOT's Highway Maintenance Program."

Sincerely,



Charles D. Nottingham

Cc: Honorable John A. Rollison, III
Honorable Martin E. Williams

Adequacy and Management of VDOT's Highway Maintenance Program
By Joint Legislative Audit and Review Commission

November 5, 2001

VDOT Response

JLARC Recommendation

The Virginia Department of Transportation needs to conduct a more thorough review of the pavement conditions of all the highway systems in Virginia. For example, the department should rate the conditions of the total directional mileage for the interstate and primary pavements. In addition, VDOT should rate the pavement conditions of at least a representative sample of the secondary roads using the same rating scales as is used on the interstate and primary pavements. Finally, the overlay schedules should be developed using these ratings as a method for prioritizing repair activities. (Source: pg. v)

VDOT Response

The Pavement Management System (PMS) provides the tools to do a thorough review of pavement condition data for any highway in the Commonwealth. The successful development of the electronic data collection technology for pavement has been an incremental process. The Department's two earliest efforts to develop this technology with contractors have achieved only marginal success. These contracts were expected to collect pavement condition data on all interstate and primary highways. The Department is preparing a business case analysis to determine if we would be better served in developing in-house capabilities to collect pavement condition data.

The electronic pavement data collection component of the Integrated Maintenance Management Program (IMMP) begins with the interstate and primary systems and we plan to move toward the assessment of the secondary system once the technology can be fully implemented.

While the methodology of using total directional mileage can be one way to determine overall pavement conditions, it does not give a representative picture of pavement conditions. For example, using total directional mileage gives the same weighting to a two-lane road as it would a multi-lane interstate highway.

The Department currently uses, and will continue to use, all pavement condition ratings to prioritize pavement maintenance activities on interstate and primary highways. As the Department refines and improves the data collection and analysis, this information will form the basis of future maintenance allocations and work plans for all highways including the secondary system.

JLARC Recommendation

The Commonwealth Transportation Board should review the current deficiencies on Virginia's highways and bridges and use the information obtained from these condition assessments in determining a reasonable and necessary amount of funding for maintenance of the State's existing highway systems. (Source: pg. ix)

VDOT Response

The Commonwealth Transportation Board (CTB) is responsible for providing funding to meet the desired outcomes; these outcomes need to be defined in terms of condition, level of service and other outcome-based measures. Once the outcomes are identified, funding can be provided to meet them. The public needs to be involved in determining these outcomes since it is the public that will be providing the investment.

The proposed maintenance budget presented to the CTB for review is derived using input from the VDOT residencies, districts and divisions. This input combined with available condition assessment information becomes the basis of the proposed maintenance budget. The FY 02 budget is approximately $871 million which represents a 30% increase over the last five years.

In the area of highways, in 1998, 75% of Virginia's interstate and primary pavements were rated in good condition. The most recent assessment, as verified in the JLARC report, indicates that this number has increased to 80% of the interstate and primary pavements being in good condition.

The Department has seen the percentage of Virginia's bridges rated in good condition consistently increasing over the last several years. The exposure draft stated that approximately 40% of the Commonwealth's bridges will require maintenance funding of approximately $1.5 billion over an unspecified time period. When the JLARC staff attempted to determine the number of bridges that may need some type of maintenance over the next few years, it relied upon a methodology that differs from VDOT's approach to addressing maintenance needs. Although the Department would make some different assumptions and perhaps employ a different approach, VDOT will not dispute the methodology - differing assumptions and differing approaches to these types of issues are commonplace in the highway maintenance business. VDOT's maintenance and construction programs will continue to address all projected bridge maintenance and replacement needs in a safe and thoughtful manner. Given the fact that VDOT routinely performs maintenance or construction work on approximately 20% of Virginia's bridges each biennium, it is reasonable to estimate that approximately 40% of all bridges will receive some degree of attention over the next few years and will, in fact, receive the necessary attention pursuant to VDOT's established record and work plans.

The Department believes that over the course of the next three or four years, we will have performed routine repairs, rehabilitation, reconstruction or replacement on an equivalent population of bridges. It should be noted that in any given year, VDOT is

likely to have over $250 million of bridge work either in the improvement program or in maintenance and repair work.

VDOT appreciates the JLARC staff commitment to having the term "deficient" removed from the report. It is unfortunate that the mistaken use of the term "deficient" was circulated in the media before VDOT had an opportunity to comment on the exposure draft.

JLARC Recommendation

The Virginia Department of Transportation should establish a systematic and regular review of pavement and bridge conditions in the localities as a way of identifying the maintenance functions and needs on the urban system and in the counties that have chosen to withdraw from the State-maintained system. This information should be reported to the General Assembly on a regular basis. (Source: pg. xi)

VDOT Response

Lacking an objective measure of outcomes, any overview that is performed, whether by VDOT or some independent organization will be subject to debate. Prior to adding additional oversight responsibilities, VDOT would need to know what objective outcome is desired as well as what objective measurement method would be used to determine if the outcome is being met. Based upon the definition of the desired outcome, appropriate resources could then be determined.

Expanding the role of VDOT in determining the satisfactory provision of maintenance services by cities and towns may usurp the responsibilities those jurisdictions currently have regarding maintenance obligations. This implies that VDOT should assume the responsibility for directing the localities in their maintenance activities. VDOT assuming a larger role could potentially put VDOT at odds with the strategies and planning efforts of the localities in the administration of their maintenance program. VDOT conducts annual inspections to determine that the streets are maintained to an acceptable standard.

The Department is willing to share our methodologies and experiences with the cities, towns and counties. However, there is a wide variance among the jurisdictions in their ability to use this information due to the substantial data and complexity involved.

JLARC's finding that many urban jurisdictions are allocating general funds to road and sidewalk improvements does not necessarily indicate that funding from the Commonwealth is inadequate. Urban jurisdictions often decide to prioritize "streetscape" improvements and other amenities not required to meet basic safety and service levels. These investments are commendable and VDOT often supplements these projects through the $20 million a year Transportation Enhancement grant program. JLARC's report overlooks the significance of this program.

The Department is reluctant to assume the additional responsibility for the urban system not maintained by the State without a clear mandate from the General Assembly. This mandate should also include sufficient funding to respond to the task. The Department can develop a reporting mechanism in conjunction with the cities, towns and counties. If it is the pleasure of the General Assembly to receive this information, the Department will provide a report upon their request.

JLARC Recommendation

The Virginia Department of Transportation needs to place a higher priority on the development and implementation of an asset management approach and the automated systems required. In addition, the department should continue to use the information being obtained through the Inventory and Condition Assessment System, and determine the minimum level of inventory collection and condition assessment needed to provide useful information for essential maintenance functions. (Source: pg. xii)

VDOT Response

VDOT fully recognizes the need to implement asset management and is continuing to systematically move toward full implementation.

The Department is a national leader among state transportation agencies in the development of asset management and is committed to making it a fundamental element of the maintenance and operations business function at VDOT. The continuing investment and development of the Pavement Management System (PMS), Bridge Management System (BMS), Inventory Condition Assessment System (ICAS) and Virginia Operations Information System (VOIS) further demonstrates the Department's commitment to asset management.

The three-county pilot of ICAS will be completed in the spring of 2002. Work is already underway to analyze the results of the pilot and determine the appropriate level of inventory and condition assessment needed to implement on a state-wide basis for future decision-making and prioritizing of needed maintenance functions.

Governor Gilmore offered specific legislation in the 2001 General Assembly to require VDOT to adopt an asset management approach to maintenance and to establish certain reporting requirements. This bill would have codified the asset management approach to maintenance while putting the General Assembly clearly on the record as supporting asset management. Unfortunately, this bill was not approved by the General Assembly.

JLARC Recommendation

The Virginia Department of Transportation should develop best practices for the major highway maintenance functions as soon as possible and provide adequate access and training as appropriate. (Source: pg. xiv)

VDOT Response

The use of best practices in VDOT is a compendium of a variety of methods that can successfully implement the different maintenance services provided by VDOT. It is a tool that defines successful ways to deliver services and provide a resource for maintenance managers to analyze the best approach to be used considering the task at hand, geographic and climate differences etc.

VDOT recognizes the need to document "best practices" for our significant maintenance functions. Shortly after the implementation of the 1994 Maintenance Policy Manual Update, a best practices for snow removal was developed and distributed to the field. In the summer of 2001 the State Maintenance Engineer and the State Materials Engineer assembled a group to develop a strategic plan for managing pavements which includes a "best practices " document for pavement maintenance. VDOT will develop additional best practices that continue to support the asset management approach to the maintenance program.

JLARC Recommendation #1

The Virginia Department of Transportation should place a higher priority on the electronic collection and analysis of pavement condition information for 100 percent of Virginia's interstate and primary roads. (Source: pg. 53)

VDOT Response

The electronic collection and analysis of pavement condition is and will continue to be a high priority at VDOT. The Department included very specific requirements for electronic collection and analysis in the ICAS contract. The Department has continued to work to bring new technology in this area into the Pavement Management Program (PMS). The successful development of the electronic data collection technology for pavement has been an incremental process. The Department's two earliest efforts to develop this technology with contractors have met only marginal success, and the Department is preparing a business case analysis to determine if VDOT would be better served in developing in-house capabilities.

JLARC Recommendation #2

The Virginia Department of Transportation should continue to develop an appropriate methodology for the collection of pavement condition information for the secondary road system, and implement this system as soon as possible. The department should report on the status of this project to both the House and Senate Transportation Committees. (Source: pg. 53)

VDOT Response

VDOT recognizes the need to develop and implement a methodology for collecting pavement condition data on the secondary system. The electronic pavement data collection component of the Integrated Maintenance Management Program (IMMP) begins with the interstate and primary systems and VDOT plans to move toward the assessment of the secondary system once the technology can be fully implemented.

It is envisioned that this approach would be developed and implemented using a three-phase approach. The first is the inclusion of the highest volume secondary roads with the interstate and primary data collection. The second is the expansion of the data collection to bituminous concrete (asphalt) roadways. Finally, the third phase would include the expansion of the data collection effort to the remaining hard-surface roadways.

This approach will require that a sampling methodology be employed versus a collection of condition assessment data on 100% of the secondary roadways on an annual basis.

The Pavement Management program staff has discussed this and is developing the methodology and identifying the data to be collected on the secondary system. A group of pavement engineers within VDOT has been formed to track the progress of this effort and monitor the development of automated tools to support this effort.

If it is the pleasure of the General Assembly to receive this information, the Department will provide a report to the Committees upon their request.

JLARC Recommendation #3

The Virginia Department of Transportation should base its maintenance schedules and expenditures for maintaining pavements on the analysis of accurate pavement condition data from all State maintained highway systems as soon as a system is in place for the secondary system. (Source: pg. 53)

VDOT Response

Available pavement condition data is the basis for developing maintenance schedules for interstate and primary pavements. When secondary data is available it will be used in the same manner This information will form the basis of future maintenance allocations and work plans as VDOT refines and improves the data collection and analysis. Each district has a pavement management engineer assigned to support the pavement maintenance program. District pavement management engineers are directly involved in using the pavement condition data to develop the priorities for pavement schedules. The analysis of available pavement data is a core function of the District Pavement Management Engineer in assisting the district in setting pavement maintenance priorities.

JLARC Recommendation #4

The Virginia Department of Transportation should assess the need for additional maintenance beyond that currently identified on non-pavement assets pending full implementation of its asset management program. The Maintenance Program Leadership Group could make such an assessment based on requests for non-pavement maintenance from the residencies. (Source: pg. 79)

VDOT Response

VDOT recognizes the need to have an assessment tool for all assets and is determining the best methodology for implementing the ICAS statewide. While delayed in its delivery, ICAS has demonstrated the ability to gather this type of information that can be used to effectively identify and prioritize maintenance needs on all assets. ICAS needs to be combined with an analysis tool (IMMS) to provide the full effectiveness of this type of assessment for planning, budgeting and allocation of resources. Resources to deploy a manual, subjective process to do these assessments would be more effectively focused on the implementation of ICAS and IMMS

In addition, the successes to date of ICAS include the collection of centerline data and video imagery which are being used in the development of the Geographical Information System (GIS). This information will provide significant future value to the Department as a whole. For example, this information can be used in public hearings, citizen information meetings and other situation to visually depict the actual roadways being discussed as well as the assets along the facility.

The three-county pilot of ICAS will be completed in the spring of 2002. Currently, ICAS has been delivered and is being used by the VDOT maintenance staff in Fauquier County, the system is operational and user training is currently ongoing in Augusta County, and the final data quality assurance review and loading of the data in the system for Fairfax County is taking place. As these maintenance employees become more familiar with the system, it will be further used in their decision-making process concerning the application of resources in maintenance activities.

Work is already underway to analyze the results of the pilot and determine the appropriate level of inventory and condition assessment needed to implement on a state-wide basis for future decision-making and prioritizing of state-wide maintenance needs.

JLARC Recommendation #5

The Virginia Department of Transportation should prioritize the development of a system for the determination of pavement maintenance costs for interstate and primary pavement sections. Additionally, the department should develop a process for the identification and tracking of routine pavement maintenance costs for interstate and primary pavements. (Source: pg. 99)

VDOT Response

The Pavement Management System (PMS) within IMMP provides the Department with a tool that tracks what work has been completed, where it has occurred and the resources that were required to complete the task. The models in the PMS will consider historical data surrounding work, cost and resources in the analysis of pavements to assist in prioritizing future maintenance needs and optimizing future maintenance strategies. This information is the foundation of PMS. The VDOT Financial Management System (FMS) as currently enabled does not contain the level of detail that is provided by PMS, however, VDOT is investigating the utility of FMS to support the Department's efforts prior to the implementation of IMMS.

Recent implementation of the Pavement Maintenance Management System (PMMS) for use in developing schedules allows VDOT to more accurately capture and analyze costs on these contracts. The ability to analyze these costs to the detail recommended would be supported by the requirements and integration with other systems that the IMMS would provide.

JLARC Recommendation #6

The Virginia Department of Transportation should develop a clear plan for the development of a system for the identification and tracking of both rehabilitative pavement maintenance costs and routine maintenance costs for pavements on the secondary system. (Source: pg. 99)

VDOT Response

VDOT recognizes the need to accurately identify the costs for all pavement maintenance activities. The Financial Management System (FMS) as currently enabled does not contain the level of detail that is provided by PMS, however, VDOT is investigating the utility of FMS to support the Department's efforts prior to the implementation of IMMS. The Maintenance Division staff worked closely with the Fiscal Division staff to develop a Maintenance Accounting Code (MAC) that will be used to capture the more detailed information on work done and costs in an asset management environment. The ability to analyze these costs to the detail recommended would be supported by the requirements and integration with other systems that the IMMS would provide.

JLARC Recommendation #7

The Virginia Department of Transportation should review the adequacy of current strategic planning for pavements and bridges. This review should include, but not be limited to, an assessment of performance targets for pavements and bridges being developed by the Maintenance Planning Leadership Group. The findings of the

assessment should be reported to the House and Senate Transportation Committees. (Source: pg. 106)

VDOT Response

The strategic planning process for pavements and bridges is iterative and builds upon experiences learned from the past, and applied to the future. Performance needs to be measured against objectives and any correction to either performance or performance targets should be made at that time. Performance targets should be representative of the outcome expected for the investment made. The development of performance targets must incorporate planning in the full range of maintenance activities not just a prioritized list of bridges needing repair or replacement. Performance target setting is still at an early stage and should be carefully adjusted when additional experience and understanding of the process is achieved. PMS and BMS are the tools to be used in this process, and their continued development and application will allow VDOT to further develop the Department's skills in the setting of performance targets.

If the JLARC report is recommending higher performance targets, it is certainly within the purview of the General Assembly to establish these targets and the Department will provide the impacts of this should it be considered. If it is the pleasure of the General Assembly to receive this information, the Department will provide a report to the Committees upon their request.

JLARC Recommendation #8

The Commonwealth Transportation Board should more specifically define what level of funding is reasonable and necessary for the maintenance of all the State's highway systems and the streets and roads not maintained by the State. The Commonwealth Transportation Board should provide additional funding to the maintenance program to address deficiencies identified in this report. (Source: pg. 113)

VDOT Response

The amount of payment to cities, towns and the two counties that maintain their own system is established by the General Assembly. VDOT acts as a conduit to provide the maintenance payments. Should the General Assembly desire that VDOT take a more aggressive and active role in city maintenance payments, a careful consideration and discussion with effected stakeholders should be undertaken. This public policy dialogue may indicate a higher service level as an outcome which would require an analysis of additional resources to achieve.

JLARC Recommendation #9

The General Assembly may wish to amend the *Code of Virginia* to update the criteria for when a town is required to accept responsibility for the maintenance of its streets. (Source: pg. 122)

VDOT Response

Increasing the population limits will directly affect the maintenance budget. The Department would need to assess the condition of the jurisdiction's street system and make a determination of any remedial work that is identified. Should it be the desire of the General Assembly, the Department could provide an assessment of the effect upon resources that would be needed to accompany any changes to the *Code of Virginia.*

JLARC Recommendation #10

The General Assembly may wish to amend the *Code of Virginia* to include more specific guidelines for the Virginia Department of Transportation oversight of local maintenance activities for the cities, towns and counties currently receiving State maintenance payments. (Source: pg. 125)

VDOT Response

Currently, as identified in the *Code of Virginia*, the Department serves as a conduit of maintenance funding for the cities, towns and counties receiving State maintenance payments.

Expanding the role of VDOT in determining the satisfactory provision of maintenance services by cities, towns and counties may usurp the responsibilities of those jurisdictions having maintenance obligations. Increased expenditures by localities do not necessarily reflect increased spending on maintenance activities and do not consider the outcomes (conditions) achieved through that spending. As noted in the report, cities, towns and counties use street payments for construction of turn lanes, curb and gutter in addition to normal maintenance activities. These types of improvement-related activities would not be typically funded through the VDOT maintenance program therefore every dollar spent on these types of activities results in less funding for maintenance related work.

The Department will provide an assessment of the effect upon resources should the General Assembly desire to amend the *Code.* Any changes in the *Code* effecting the Department's role should also consider the implications of Government Accounting Standards Board (GASB) Statement No. 34 which requires governmental units to report on the effectiveness of their infrastructure maintenance.

JLARC Recommendation #11

The Virginia Department of Transportation urban division should conduct a comprehensive audit of the annual inspection process conducted by the residencies in order to ensure compliance with department policy. The results of this audit should be reported to both the House and Senate Transportation Committees. (Source: pg. 125)

VDOT Response

The Department will review the current process of street review with the local jurisdictions staff and more clearly articulate the expectations to the VDOT residency staff involved in conducting these reviews within the next two years. If it is the pleasure of the General Assembly to receive this information, the Department will provide a report to the Committees upon their request.

JLARC Recommendation #12

The Virginia Department of Transportation should study the estimated costs for establishing and implementing a uniform measure of pavement quality for road surfaces in the urban system as well as roads maintained by counties that opt out of the State system. If possible, the department should also consider expanding the use of Inventory and Condition Assessment System methodologies to a representative sample of assets in the urban system and secondary system not maintained by the State. (Source: pg. 130)

VDOT Response

The Department is reluctant to establish specific methodologies state-wide. The application of a state-wide methodology may be too rigid to apply in all situations due to varying conditions, engineering needs etc. VDOT can provide to these localities the methodologies that the Department is using if it is the intent to provide a state-wide comparison.

The Department believes that the local governments and local populations need to establish the outcomes and service levels that they desire. At this time, VDOT is unaware of any Virginia jurisdiction having the necessary foundation to implement a full asset management approach, and it is unlikely that a clear community consensus on the outcomes is practical in the short term.

JLARC Recommendation #13

The Virginia Department of Transportation should develop a uniform reporting instrument for the cities, towns and counties receiving State maintenance payments. This report should include, but not be limited to, total allocations and expenditures for maintenance of local streets and roads, as well as the types of maintenance activities performed in those localities. (Source: pg. 130)

VDOT Response

The Department will review the current reporting document with the affected cities, towns, and counties to ensure the appropriate documentation of expenditures.

It is the Department's understanding that GASB Statement No. 34 will require local governmental units to report on the effectiveness of their infrastructure maintenance.

JLARC Recommendation #14

As new products and practices are developed for asset management, the Virginia Department of Transportation should consider implementing a formal training program at the district level, to assist all maintenance managers and supervisors in administering appropriate changes at the residencies and area headquarters. (Source: pg. 138)

VDOT Response

VDOT agrees with this finding and has included the need for training into the implementation plan for each system as well as the overall plan for the implementation of asset management. Establishing, measuring and reporting on performance targets will be the first major training initiative under asset management.

JLARC Recommendation #15

To the extent that asset information has been collected in the pilot program, the Virginia Department of Transportation should implement the Inventory Condition and Assessment System statewide as soon as possible. Once implemented, asset data on the secondary system should be entered into the system only as maintenance activities are performed. If it appears full implementation of ICAS will be substantially delayed as a result of other department priorities, then a representative sample of roadway assets should be developed and implemented in the interim. VDOT should use the information from this assessment in budgeting and work planning for the maintenance program. (Source: pg. 151)

VDOT Response

The ICAS pilot will be completed in the spring of 2002 and will allow the Department to determine the most efficient and cost effective methodology to collect this data, and implement a structured statewide roll-out. Work is already underway to analyze the results of the pilot and determine the appropriate level of inventory and condition assessment needed to implement on a state-wide basis for future decision-making and prioritizing of needed maintenance functions.

The goals of statewide implementation include identifying high value asset information, using legacy information and reducing the final cost of data acquisition.

JLARC Recommendation #16

The Virginia Department of Transportation should provide the House Appropriations, Senate Finance, and House and Senate Transportation Committees with a

detailed timetable of expected milestones and projected costs related to the Synergy initiative before any component of the new system is installed. (Source: pg. 156)

VDOT Response

The VDOT Chief Information Officer is analyzing the potential for an enterprise solution that would satisfy the needs of the maintenance and operations program and all other VDOT core business functions. The reason VDOT is exploring new information technology strategies is because existing systems are too often incompatible with other systems resulting in costly inefficiencies. It is VDOT's objective to avoid purchasing expensive "stovepipe" systems that solve only targeted problems while creating incompatibility and inefficiency costs. The Synergy project is at a conceptual state and no advertisement for delivery has been established. If it is the pleasure of the General Assembly to receive this information, the Department will provide a report to the Committees upon their request.

JLARC Recommendation #17

The Virginia Department of Transportation needs to reaffirm the commitment and priority of promptly and fully institutionalizing asset management, by communicating its initiatives throughout the department and implementing the business requirements and automated systems related to that objective as quickly as possible. (Source: pg. 157)

VDOT Response

VDOT remains fully committed and supports the full implementation of the Integrated Maintenance Management Program (IMMP). The Department is a national leader among state transportation agencies in the development of asset management. VDOT will continue to advance system development of the base management and decision support system that will be needed once the IMMP is fully operational. Already, VDOT is using PMS, BMS, and VOIS in our work. The Department will continue to develop the ICAS and expect the pilot to conclude in the next few months. A state-wide rollout is already being planned. This rollout will ensure that lessons from the pilot will result in faster rollout and utility at less cost.

The Department's commitment to the maintenance program is well documented with the allocation of 300 additional positions in the past four years and a 30% increase in funding through the past five years. As stated in the JLARC report, 80% of the Commonwealth's pavements are designated as being in good condition which reaffirms our service in providing a high quality road system.

The Governor's introduced legislation in the 2001 General Assembly to require VDOT to adopt an asset management approach to maintenance and to establish certain reporting requirements was not successful.

JLARC Recommendation #18

The Virginia Department of Transportation should prioritize the development of productivity measures for planning and scheduling. This should include identifying which measures would be most useful and how they would be operationalized once established. VDOT should also put in place a system of quality control for information provided concerning productivity and actual work being accomplished. (Source: pg. 163)

VDOT Response

Production measures are key components of fact-based business decisions anticipated by asset management. Staff is continuing to work with FMS to provide greater capture of information to assist in this effort. The Maintenance Division staff worked closely with the Fiscal Division staff to develop a Maintenance Accounting Code (MAC) that will be used to capture the more detailed information on work done and costs in an asset management environment. The implementation of IMMS and its analysis tools are crucial to being able to measure productivity in an asset management environment.

JLARC Recommendation #19

The Virginia Department of Transportation should review the alternatives available to it for addressing the issues related to the maintenance program's inability to carry forward unexpended funds from one fiscal year to the next. VDOT should select the alternative that provides the maintenance program with the most information and maximum use of those funds that have been allocated to the program. (Source: pg. 168)

VDOT Response

The Department's goal is to annualize the maintenance program so that resources are available to meet the identified work plan for any given year. Natural occurrences such as weather and flooding as well as unanticipated and uncontrollable events affect the ability to plan at a 100% level.

The goal of maximizing the effectiveness and efficiency in investing public funds in the maintenance program is complicated by a multi-year financing program that can build significant balances that could be designated for other work.

JLARC Recommendation #20

The Virginia Department of Transportation should establish a process expanding the use of the equipment utilization reports produced by the equipment division as a tool for continually adjusting and monitoring the levels of equipment in the field. Equipment that is continually underutilized should be transferred or surplused and other methods of obtaining equipment should be further explored. Finally, equipment that is seasonal, or

needed in emergencies only, should not be paid for under the rental rate and depreciation method. (Source: pg. 176)

VDOT Response

The effective use of equipment is an important part of IMMP. The IMMS integrates with multiple systems such as Equipment Management System (EMS) to allow the identification of resources including equipment and would include optimization of resources. VDOT is continuously seeking the proper balance between owned-equipment and leased or "on-call" equipment. Emergencies preparedness is a top priority at VDOT and adds complexity to the equipment utilization issue.

JLARC Recommendation #21

The Virginia Department of Transportation should complete the maintenance best practices manual described in its *1994 Maintenance Policy Manual* by updating previous policies and developing new policies. The department should first focus its attention on those policies with the greatest impact on the overall performance of highway maintenance activities. The department should also provide sufficient training and support to field operators regarding those practices. (Source: pg. 180)

VDOT Response

The use of best practices in VDOT is a compendium of a variety of methods that can successfully implement the different maintenance services provided by VDOT. It is a tool that defines successful ways to deliver services and provide a resource for maintenance managers to analyze the best approach to be used considering the task at hand, geographic and climate differences etc.

VDOT recognizes the need to document "best practices" for our significant maintenance functions. Shortly after the implementation of the 1994 Maintenance Policy Manual Update, a best practices for snow removal was developed and distributed to the field. In the summer of 2001, the State Maintenance Engineer and the State Materials Engineer assembled a group to develop a strategic plan for managing pavements which includes a "best practices " document for pavement maintenance. VDOT will develop additional best practices that continue to support the asset management approach to the Department's maintenance program.

JLARC Staff

DIRECTOR: PHILIP A. LEONE
DEPUTY DIRECTOR: R. KIRK JONAS

● DIVISION I CHIEF: GLEN S. TITTERMARY
DIVISION II CHIEF: ROBERT B. ROTZ

SECTION MANAGERS:
PATRICIA S. BISHOP, FISCAL AND ADMINISTRATIVE SERVICES
JOHN W. LONG, PUBLICATIONS AND GRAPHICS
GREGORY J. REST, RESEARCH METHODS

PROJECT TEAM LEADERS:
LINDA B. FORD
HAROLD E. GREER, III
CYNTHIA B. JONES
● ERIC H. MESSICK
WAYNE M. TURNAGE

PROJECT TEAM STAFF:
ARIS W. BEARSE
KELLY D. BOWMAN
WENDY N. BROWN
ASHLEY S. COLVIN
GERALD A. CRAVER
● SCOTT F. DEMHARTER
LISA V. FRIEL
ANNE E. OMAN
● JASON W. POWELL
M. ELIZABETH SILVERMAN
CHRISTINE D. WOLFE
SANDRA S. WRIGHT

FISCAL ANALYSIS SECTION:
WALTER L. SMILEY, SECTION MANAGER
DANIEL C. ONEY
KIMBERLY A. SARTE

ADMINISTRATIVE AND RESEARCH SUPPORT STAFF:
JOAN M. IRBY
BETSY M. JACKSON
PAULA C. JOHNSON
BECKY C. TORRENCE
DAN FELDMAN, INTERN

● *Indicates JLARC staff with primary assignment to this project*

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JLARC
Suite 1100
General Assembly Building
Capitol Square
Richmond, Virginia 23219
(804) 786-1258 Fax: 371-0101
http://jlarc.state.va.us