REPORT OF THE
JOINT LEGISLATIVE AUDIT
AND REVIEW COMMISSION

IMPROVEMENT OF HAZARDOUS HIGHWAY SITES IN VIRGINIA

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

HOUSE DOCUMENT NO. 13

COMMONWEALTH OF VIRGINIA
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Members of the Joint Legislative Audit and Review Commission

Preface

House Joint Resolution No. 579 (1997) directed the Joint Legislative Audit and Review Commission (JLARC) to study the procedures for identifying and funding the improvement of hazardous roadway sites. This report is focused on the performance of the Virginia Department of Transportation (VDOT) in defining, identifying, and making appropriate improvements to sites in the State highway system that pose potential or actual hazards to the traveling public.

VDOT follows a reasonably systematic process for identifying potentially hazardous roadway sites. This process includes the analysis of accident and traffic data, consideration of public input, and reliance on professional engineering judgment. However, additional actions can be taken to prevent the occurrence of, or more effectively identify, potentially hazardous roadway locations. For example, improved administration of statutory provisions governing commercial entrances to State highways could provide VDOT with greater influence over local land-use decisions which can create roadway hazards. Other actions recommended in this report include the development of more accurate highway inventory, traffic, and accident data, and the identification and replication of best practices throughout the department.

This review also found that VDOT has a difficult job in balancing its internal procedures and the public's concerns about hazardous roadway locations. The department makes reasonable efforts to improve roadway sites that pose potential hazards to the traveling public. However, in its attempts to be responsive to community concerns, VDOT occasionally acts outside of its normal process in making improvement decisions.

The report also presents recommendations concerning the Hazard Elimination Safety Improvement Program, and the State Traffic Operations and Safety Improvement Program, that are designed to improve VDOT's ability to more efficiently and effectively implement relatively low-cost improvements in order to enhance the relative safety of the State highway system. Finally, the report also recommends that VDOT work cooperatively with other State and local agencies in order to identify effective methods to enhance highway safety with a focus on improving the compliance of motorists with highway safety laws.

On behalf of the Commission staff, I would like to thank the management and staff of the Virginia Department of Transportation for the assistance, especially extensive computer programming support, provided in the preparation of this report.

Philip A. Leone
Director

October 28, 1997

JLARC Report Summary

Improvement of Hazardous Roadway Sites in Virginia

October 1997

Joint Legislative Audit and Review Commission

House Joint Resolution (HJR) 579 of the 1997 Session directed the Joint Legislative Audit and Review Commission (JLARC) to study the procedures for identifying and funding the improvement of hazardous roadway sites. Many types of factors, including local land use decisions, poor driver behavior, and inadequate road maintenance, can serve to create hazardous roadway sites.

Virginia's highway fatality and injury rates have steadily declined over the past 20 years. In fact, Virginia has one of the lowest state highway fatality rates in the country. Only five states had lower fatality rates in 1995. However, these rates vary substantially by type of road and area of the State. There is also substantial variation among localities in terms of the number of highway injuries and fatalities. However, as seen in the table on the following page, a few localities consistently appear to have the most. Furthermore, highway safety challenges remain due to factors such as increased traffic volumes and changing vehicle characteristics.

The Virginia Department of Transportation (VDOT) follows a reasonable set of procedures intended to identify and improve hazardous roadway locations. These include highly objective components based on accident rate data, professional components based on the engineering judgment of VDOT staff, and relatively subjective components based on information provided by citizens. However, VDOT does not always follow its procedures precisely in order to prioritize and make highway improvements. Furthermore, two specific VDOT programs that are designed to expedite small-scale highway projects to enhance roadway safety would benefit from more timely, streamlined procedures and better management.

JLARC's review found that:

- VDOT has a difficult job in balancing its internal policies and procedures and the concerns about hazardous sites of communities across Virginia. VDOT attempts to be responsive to community concerns, but this occasionally results in the department acting outside of its normal process.

- Improved administration and enforcement of statutory provisions governing commercial entrances to State highways could provide VDOT with greater influence over local land-use

Localities with Greatest Number of Fatal Highway Accidents -- 1994

Interstate		***Primary***		***Secondary***	
Locality	Number	Locality	Number	Locality	Number
Fairfax	12	*Fairfax*	21	*Fairfax*	27
Montgomery	9	Suffolk	12	Chesterfield	10
Norfolk	9	Accomack	11	*Prince William*	8
Prince William	6	*Prince William*	10	Henry	8
Hanover	6	*Rockingham*	10	Halifax	7
Rockingham	5	Mecklenburg	9	*Rockingham*	7
York	5	Pittsylvania	8	Loudon	7
Stafford	4	Franklin	8	Fauquier	7
Prince George	4	Southampton	8	Sussex	6
Mecklenburg	4	Albemarle	7	Spotsylvania	6

decisions which can create hazardous roadway locations.

- Problems with the accuracy and timeliness of highway crash, inventory, and traffic data may impede VDOT's process for identifying hazardous locations.

- The Hazard Elimination Safety (HES) program could be made more timely and effective through a new approach wherein available federal funds are used to reimburse the State for previous allocations for safety projects.

- The State Traffic Operations and Safety Improvement program (STOSIP) requires an updated policy statement and improved management.

- Alternative methods of improving the State's highways, which focus on improving the compliance of Virginia motorists with highway safety laws, would be beneficial to VDOT as a supplement to highway construction.

In addition, some roadway sites identified by VDOT as posing potential safety problems may not be immediately improved because of insufficient funding. Providing sufficient funding for all sites was beyond the scope of this study.

Several Factors Contribute to Hazardous Roadway Sites

Four basic factors can interact to cause motor vehicle crashes: the driver, the vehicle, the roadway, and the surrounding environment. The number and types of vehicles, driver characteristics, the age and condition of the road, and the extent of surrounding development are all factors that can change. The evolution of these factors can effect the relative risk of accidents at a location.

The effects of local land use decisions can have consequences for the relative safety of a roadway site. VDOT works with local governments to review site plans, evaluate traffic impacts, and recommend roadway improvements needed to serve proposed development sites. However, VDOT has relatively little influence concerning land use decisions which affect the highway system. Nevertheless, VDOT continues to bear the ultimate responsibility for ensuring that the system continues to function properly.

Section 33.1-198 of the *Code of Virginia* governs the ability of private businesses to connect their commercial entrances to the State highway system. New commercial entrances are obtained through a permitting process administered by VDOT that is intended to ensure that entrances are safe and appropriate. The permit process is the most direct source of influence that VDOT has over the traffic-related impacts created by local land use decisions.

Several VDOT district administrators and traffic engineers believe there are limitations to the commercial entrance permit process which may impede its effectiveness. For example, new or expanded commercial entrances are often created without proper, timely notification provided to VDOT. In these cases, VDOT learns of the entrance long after the fact and must approach the developer or business owner to ensure that the entrance is safe and appropriate.

Recommendation (1). *The Virginia Department of Transportation should examine the adequacy of its procedures for administering and enforcing statutory provisions pertaining to commercial entrances to ensure that permitting requirements are enforced uniformly across the State. The Department should report the findings of its evaluation to the House and Senate Transportation committees.*

Procedures for Identifying Hazards Are Sound

VDOT has in place a process that is used to identify locations which require modifications in order to improve the degree of safety at the site. This process consists of highly objective components based on accident rate data, professional components based on the engineering judgment of VDOT staff, and relatively subjective components based on information provided by citizens. The use of accident rate data, professional engineering judgment, and citizen input are important to the overall identification process.

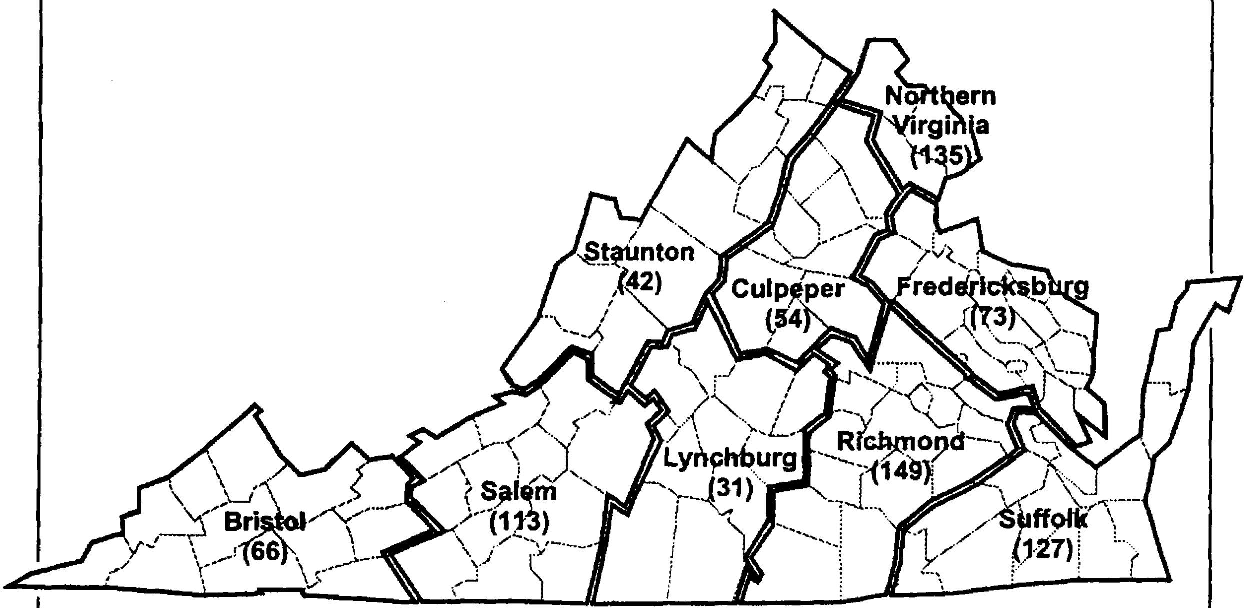
VDOT uses a methodology which compares the average accident rate for different types of roadway sections and intersections with a computed "critical" rate in order to identify sites with accident rates that are higher than expected. VDOT has identified nearly 800 interstate and primary roadway sections, and more than 1,900 intersections with accident rates higher than the critical rate (see figures on next page). Appendix D presents accident rate data for the State in more detail. These potentially hazardous sites are examined in greater detail by VDOT traffic engineering staff to determine the actual extent of problems, and any appropriate corrective measures.

JLARC staff identified numerous problems while examining VDOT's critical rate data, and its crash, traffic count and roadway inventory data. These data problems, coupled with a lack of timeliness on the part of VDOT in making these data available, raise questions concerning the accuracy of State highway system data and its utility in identifying hazardous roadway sites.

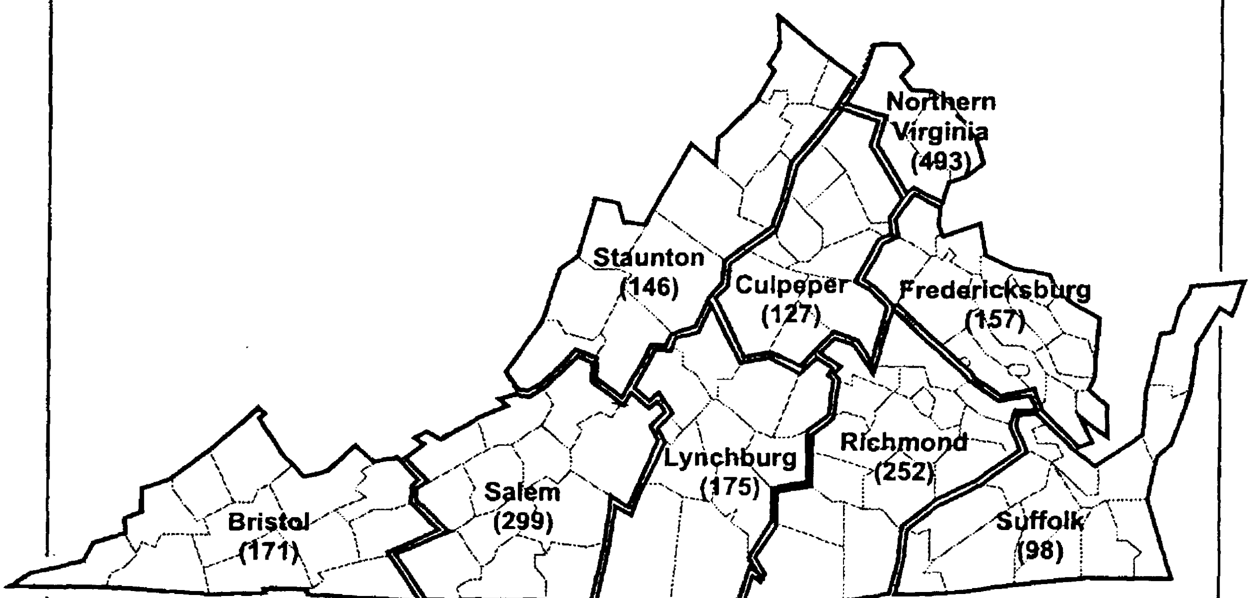
There may be opportunities for VDOT to expand the use of its critical rate data in order to improve operations. At least one VDOT district strives to incorporate the critical rate data into its daily activities, including the preliminary scoping process for design of new projects, the review of private land development proposals, and the scheduling of pavement maintenance, so that areas of concern can be addressed in a proactive manner.

Recommendation (2). *The Virginia Department of Transportation should identify best practices by its districts concerning use of the critical rate data on a daily opera-*

Number of Interstate and Primary Highway Sections With Accident Rates Greater Than the Critical Rate (Shown by District)



Number of Intersections with Accident Rates Greater Than the Critical Rate (Shown by District)



tional basis and implement those practices in other districts and divisions.

Recommendation (3). *The Virginia Department of Transportation should take all necessary actions to ensure that data prepared for publication in the critical accident rate listings and the Summary of Crash Data publication is provided in an accurate and timely fashion.*

HES Program Has Improved, But Process Needs to Be More Timely

The intent of the Hazard Elimination Safety Improvement (HES) program is to provide funding for relatively low-cost improvements, at locations with abnormally high accident rates, which are expected to produce substantial benefits in terms of accident reduction. Following a competitive statewide process, VDOT selects those projects that have the highest benefit/cost ratios. VDOT district staff credit the traffic engineering division in the central office with being proactive through the implementation of numerous improvements to the HES program over the past three years. However, the HES program is not always administered in a purely competitive manner. Over the past few years, the HES application evaluation process may have been unduly affected by several factors, including economic development considerations, highly-publicized fatal accidents in certain localities, and a lack of automated traffic count data for cities.

In addition, the HES program frequently is hampered by substantial project cost increases above the original estimate as a result of changes to project scope. There is also a prolonged time period from submission of the funding application to the beginning of construction as a result of waiting for official federal funding authorization. Given that federal approval of safety projects selected by Federal Highway Administration (FHWA) is considered a formality, VDOT could accelerate the typical start of construction for HES projects by about one year, and perhaps allow less time for "scope creep" to set in, by using the federal HES funds as reimbursement for appropriated State funds. VDOT should examine the feasibility of this approach with the FHWA.

Recommendation (4). *In order to expedite the design and construction of approved safety projects, the Commonwealth Transportation Board and the Virginia Department of Transportation should work with the U.S. Federal Highway Administration to develop a plan to use available federal funds to reimburse appropriated State funds for the Hazard Elimination Safety Program. The Department should submit its plan for approval by the 1999 General Assembly.*

Recommendation (5). *The Virginia Department of Transportation should develop plans for the automation of currently available traffic count data for streets in Virginia's cities and towns. The department should use that automated data, in conjunction with other automated traffic count data obtained through its new urban traffic count program, to calculate critical accident rates for Virginia's cities and towns in order to better evaluate applications for hazard elimination safety program funding.*

STOSIP Program Requires Improved Management and Oversight

The State Traffic Operations and Safety Improvement Program (STOSIP) is intended to quickly implement improvements in response to unanticipated operational or safety problems which may suddenly develop at some roadway sites. District administrators have considerable discretion in when and how these funds are used. The allocations for each district varies considerably, from $100,000 to $200,000, and is a line item in the primary system allocations. Consequently, STOSIP funds can not be spent on the secondary highway system. The rationale for allocation variance among the districts is not clear.

While VDOT believes that it is imperative that STOSIP projects be authorized and constructed within the same fiscal year that funds are allocated, and does not permit funds to be carried over by from one fiscal year to the next, it has experienced difficulty in managing these funds in accordance with established policy. From FY 1994 through FY 1997, there were substantial differences between the amounts allocated to the districts and the amount expended during the fiscal year. There were also substantial differences in the amount of STOSIP project expenditures authorized by the district administrators and the amount actually spent during the fiscal year. In three cases, Culpeper district in FY 1994, Fredericksburg district in FY 1995, and Suffolk district in FY 1997, VDOT data shows that the districts did not spend any STOSIP funds during the fiscal year. Also in FY 1997 the Northern Virginia district apparently did not authorize any new STOSIP expenditures during the fiscal year. These examples indicate difficulty on the part of VDOT in actually implementing projects using STOSIP funds. JLARC staff also identified cases of districts spending well in excess of their STOSIP allocations. During FY 1997, the Bristol district had STOSIP expenditures 491 percent greater than its STOSIP allocation.

Recommendation (6). *The Virginia Department of Transportation should develop an updated policy statement governing the State Traffic Operations and Safety Improvement Program. The policy statement should (a) state a clear rationale for the amount of the annual allocation to be received by each district, (b) state to what extent allocations can be used to purchase right-of-way, and (c) provide clear guidance on situations in which allocations may be carried over or exceeded. The Virginia Department of Transportation should also determine whether the current STOSIP allocation levels remain appropriate, and consider the benefits and costs of making STOSIP funds available to the secondary highway system.*

Recommendation (7). *The Virginia Department of Transportation should more aggressively and proactively monitor the State Traffic Operations and Safety Improvement Program in order to ensure that allocated funds are expended during the fiscal year for which they are allocated, and that project authorizations and expenditures are made in accordance with allocation policy.*

Alternative Highway Improvement Methods Would Be Beneficial

It is unlikely that there will ever be sufficient public funds available to make all of the physical highway improvements that VDOT and others would like to implement in order to improve safety. Even if funding limitations did not exist, other factors such as environmental protection, historical preservation, and driver behavior would serve to limit the potential scope and reach of such improvements. Aggressive, reckless, inattentive driver behavior, in particular, is repeatedly cited by VDOT staff as a critical factor affecting all aspects of VDOT's operations.

VDOT has taken steps to develop some new approaches in order to complement highway construction and further improve safety on the State highway system. These include Smart Travel Virginia, the Safety Management System, the Corridor Safety Improvement Program, and Access Management. VDOT should continue to build on those efforts, while addressing issues that have been previously raised concerning these various initiatives.

Recommendation (8). The Virginia *Department of Transportation should work cooperatively with other State and local agencies in order to identify effective methods and strategies that are available to enhance safety on the State highway system with a focus on improving the compliance of motorists with Virginia's highway safety laws and regulations.*

Table of Contents

I. Introduction

Motor vehicle travel, and the public roadways used for this travel, are vital aspects of Virginia's economy and the lives of most Virginians. However, operating any type of motor vehicle has an element of associated risk, and can result in either property damage, personal injury, or death. The annual cost to Virginia's economy of the deaths, injuries, and property damage resulting from highway crashes is estimated to be nearly $3 billion.

The Virginia Department of Transportation (VDOT) is responsible for maintaining the 56,000 mile State highway system in order to help facilitate the movement of people and goods. There are many different types of roads and roadway environments within the highway system. Significant differences include the number of lanes, pavement width, the presence of traffic control and protective devices, the local terrain, and the extent of surrounding development. As a result of this extreme variation, some roads are more tolerant and forgiving of driver error, inattention, or irresponsibility than others.

House Joint Resolution 579 (HJR 579) of the 1997 General Assembly Session directed the Joint Legislative Audit and Review Commission (JLARC) to study the procedures for identifying and funding the improvement of hazardous roadway sites (Appendix A). This chapter reviews highway safety trends at the national and State levels, provides background information concerning Virginia's highway improvement program, and discusses the study methodology.

OVERVIEW OF HIGHWAY SAFETY TRENDS

In several respects, travel on Virginia's State highway system is safer now than it has ever been. Virginia compares favorably with other states in terms of highway injuries and fatalities. In fact, Virginia is well below the national average for highway injury and fatality rates. However, while highway fatality and injury rates declined substantially in Virginia over the past 10 years, they are no longer continuing to decline at the same rate that they once did. Moreover, there is substantial variation in these measures among different types of roads, and among the different regions of the State. In addition, these rates are subject to sudden spikes upward or downward for reasons that are difficult to determine. For example, the number of highway fatalities in Virginia for the first six months of 1997 was 17 percent greater than the same period in 1996, increasing from 397 to 463.

National Highway Safety Trends Are Positive, But Challenges Remain

Over the past 20 years, the overall safety record of the nation's highways has improved. Two of the most commonly-used indicators of highway safety, fatality rates and injury rates, both have declined during this time. Furthermore, about two-thirds of the crashes that occur on the nation's highways do not result in any fatalities or injuries. Historical data indicate that since 1988 only about 33 percent of crashes have resulted in injuries while less than one percent have involved fatalities.

Fatality Rates. The average U.S. highway fatality rate decreased from 3.4 deaths per 100 million vehicle miles traveled (VMT) in 1975 to 1.7 in 1995. This represents a 50 percent reduction in the rate at which people die as a result of motor vehicle crashes.

Injury Rates. The national highway injury rate declined from 169 injuries per 100 million VMT in 1988, to 136 in 1993, or about a 20 percent reduction. However, after remaining at 136 in 1994, the injury rate increased to 141 in 1995. Therefore, while the degree of safety has improved since 1988, recent data indicates that continued improvement may be a challenge. One of the limitations in analyzing national highway injury rates is that, unlike fatality rates, extensive historical data are not available.

Challenges for Continued Improvement. There are numerous factors, including highway safety improvement efforts and new highway construction and reconstruction by state governments, that have contributed to reduced fatality and injury rates. It is also likely that improvements in vehicle safety features over the past 20 years have also contributed. However, newly emerging factors and issues pose challenges to continued highway safety improvement.

A 1997 report by the Roadway Safety Foundation (RSF) noted that changing conditions make it necessary to continually monitor roadway safety. The RSF is a coalition of public and private sector organizations including representatives of the insurance industry, motorist organizations, the Federal Highway Administration (FHWA), and the American Association of State Highway and Transportation Officials (AASHTO). The report, *Improving Roadway Safety: Current Issues*, stated:

> Changes in traffic, technology, environmental conditions and fleet characteristics influence safety problems and their solutions. Today's growing traffic volumes increase everyone's potential exposure to accidents. Traffic on many roadways greatly exceeds original design assumptions which reduces their safety and efficiency and raises their maintenance costs.

The RSF report also states a contention that the design characteristics of vehicles and mix of traffic have also changed in ways that could actually reduce the safety provided by existing design standards. For example:

- Minivans and utility vehicles are increasingly popular but potentially less stable in run-off-the-road scenarios than the vehicles used to establish existing design standards for side slopes and road shoulders; and

- The trend toward lower front-end profiles for passenger vehicles may present special problems for existing roadside safety devices.

Virginia Highway Safety Trends Compare Favorably with Other States

Safety record improvements on Virginia's State highway system have reflected, and in several instances surpassed, improvements at the national level. For example, from 1975 to 1995, Virginia's highway fatality rate decreased from 2.9 to 1.3 deaths per 100 million VMT. This represents a 55 percent reduction in the fatality rate over a 20 year period, exceeding the 50 percent national reduction. However, as the components of Virginia's highway system continue to be used by more vehicles traveling longer distances, the exposure of motorists to potential crashes with other vehicles and roadside elements will likely increase.

Comparison with Other States. In 1995, the most recent year for which data are available, Virginia's highway fatality rate of 1.3 deaths was substantially below the national average of 1.7 (Figure 1). In fact, Virginia has one of the lowest state highway fatality rates in the country. Only five states had lower fatality rates in 1995. Virginia's highway injury rate of 118 per 100 million vehicle miles traveled was also among the lowest in the country in 1995, substantially below the national average of 149 (Figure 2). Only 13 states had 1995 highway injury rates that were lower than Virginia's rate.

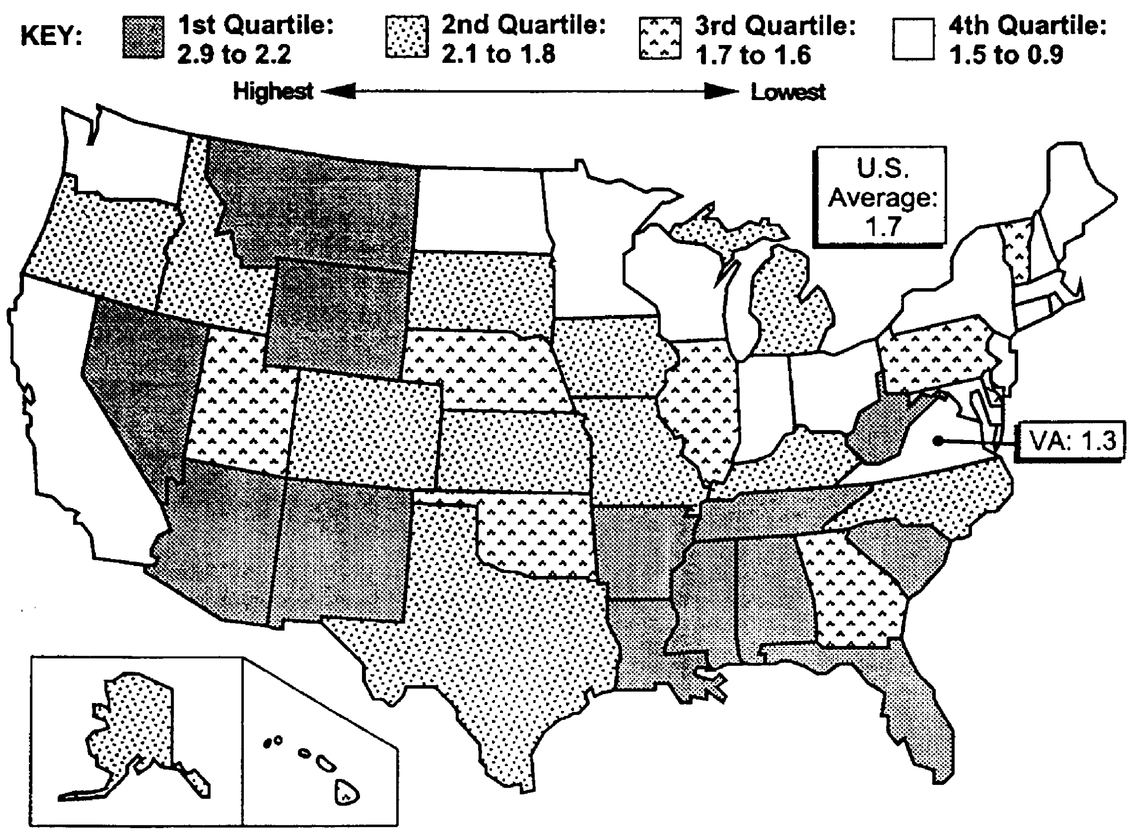
Motor Vehicle Crash Exposure in Virginia. As traffic volume increases on the State highway system, without corresponding increases in available highway mileage, it is reasonable to anticipate that the potential exposure of motorists to collisions with other vehicles and fixed objects would also be likely to increase. Over the past ten years, the number of miles traveled by vehicles on the Virginia's public roads increased by 38 percent, from 51 billion to 71 billion. This is despite the fact that the number of registered vehicles and licensed drivers increased by only about 25 percent during the same period of time. The total lane mileage of all public roads in Virginia, by contrast, increased by only five percent from 1985 to 1994. Additional data concerning motor vehicle crash exposure in Virginia is presented in Appendix B.

Motor Vehicle Crash Experience in Virginia. Despite the increases in traffic volumes in recent years, most Virginia motorists have been successful in avoiding crashes. Crash rates, injury rates, and fatality rates all decreased markedly on Virginia's public roads from 1986 to 1996. The crash rate decreased by 33 percent, from 271 to 183 crashes per 100 million vehicle miles traveled. The injury rate decreased by 25 percent, from 153 to 115 . Virginia's highway fatality rate demonstrated the greatest decline, 44 percent, during this period from 2.16 to 1.21 deaths per 100 million vehicle miles traveled. However, since about 1993 the rate of decrease for these three safety indicators appears to have been slowing. For example, the crash rate of 183 is essentially the same as it was in 1993. Appendix B presents information concerning Virginia's 1994 highway crash, injury, and fatality rates in greater detail.

Figure 1

Highway Fatality Rates, 1995

(Fatalities per 100 Million Vehicle Miles Traveled)



Source: JLARC staff analysis of data contained in *Traffic Safety Facts, 1995*, published by U.S. Federal Highway Administration.

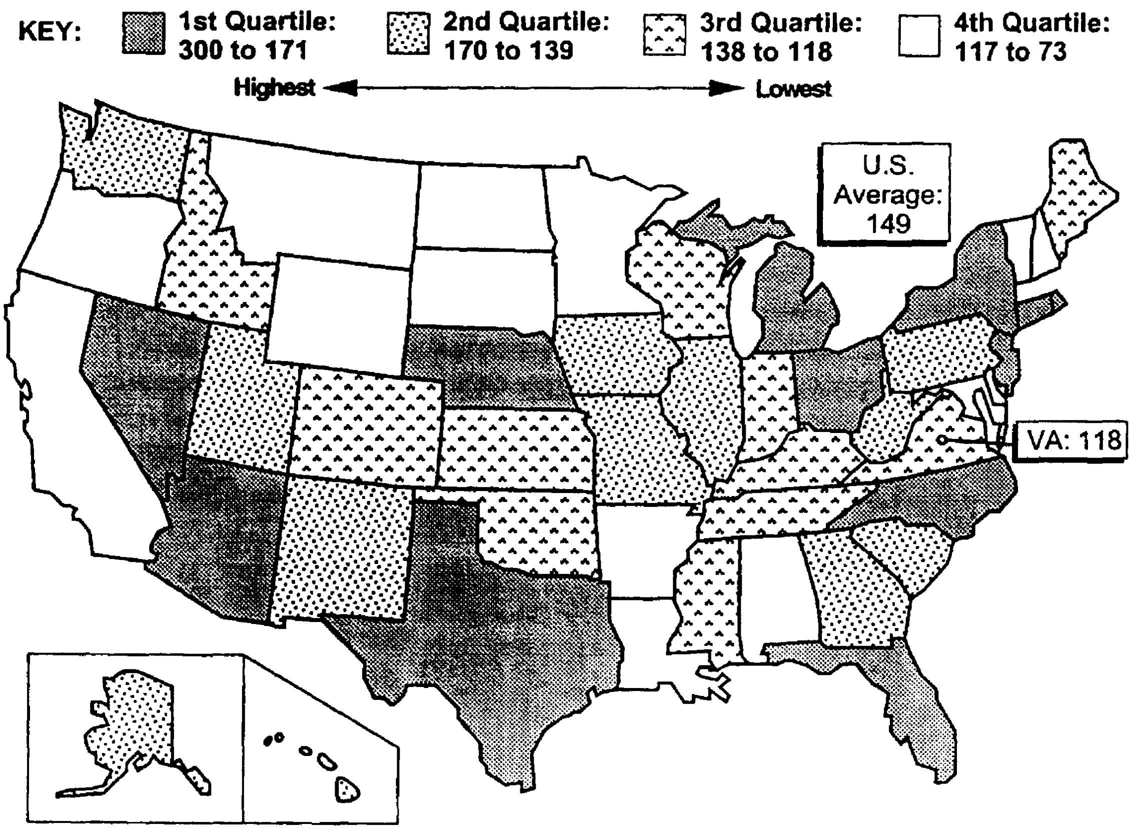
Injury rates and fatality rates on the State highway system vary substantially depending on the type of road and also depending on the area of the State or even specific localities. Table 1 summarizes the differences between accident, injury and crash rates among Virginia's interstate, primary and secondary highway systems for 1994 and 1995. The 46,000 mile secondary system, comprising 84 percent of State highway system mileage, is by far the worst in terms of these three safety indicators.

As will be discussed in greater detail in Chapter II, VDOT's accident, injury, and fatality data for 1995 and 1996 that were provided to JLARC staff during this study appear problematic in several respects. Accurate data for 1996 were not available as of July 1997. For that reason, 1994 data were used most extensively by JLARC staff in order to obtain comparative highway accident data for VDOT districts and Virginia localities.

Figure 2

Highway Injury Rates, 1995

(Injuries per 100 Million Vehicle Miles Traveled)



Note: Reported data are incomplete for Connecticut and Louisiana. Data are for 1994 for the following: DC, GA, IA, MO, NJ, NY, OH, UT, VT. Data not available for MA.

Source: JLARC staff analysis of data contained in *Highway Statistics, 1995*, published by U.S. Federal Highway Administration.

Highway fatality and injury rates do vary considerably depending upon the VDOT district. For example, 1994 interstate highway injury rates range from 69 in the Suffolk district to 28 in the Salem district. Primary system injury rates vary from 147 in the Northern Virginia district to 83 in the Culpeper district. Likewise, the Bristol district had the highest secondary system injury rate at 187 while Northern Virginia had the lowest at 134.

There is also substantial variation among localities in terms of the number of highway injuries and fatalities. However, a few localities consistently appear to have the most. For example, in 1994, Fairfax, Prince William and Rockingham counties were among the top ten localities in terms of number of fatal accidents for the interstate, primary, and secondary systems (Table 2). Fairfax and Prince William were also among

Table 1

Crash Rates on Virginia's Three Component Highway Systems

	Crash Rate		*Injury Rate*		*Fatality Rate*	
	1994	1995	1994	1995	1994	1995
Interstate	69	66	42	41	0.8	0.7
Primary	143	136	106	100	1.7	1.7
Secondary	245	240	157	157	2.2	2.3

Note: Rates are per 100 million VMT.

Source: JLARC staff analysis of data contained in 1994 *VDOT Summary of Crash Data*, and unpublished 1995 crash data provided by VDOT staff.

Table 2

Localities with Greatest Number of Fatal Highway Accidents -- 1994

Interstate		*Primary*		*Secondary*	
Locality	Number	Locality	Number	Locality	Number
Fairfax	12	Fairfax	21	Fairfax	27
Montgomery	9	Suffolk	12	Chesterfield	10
Norfolk	9	Accomack	11	Prince William	8
Prince William	6	Prince William	10	Henry	8
Hanover	6	Rockingham	10	Halifax	7
Rockingham	5	Mecklenburg	9	Rockingham	7
York	5	Pittsylvania	8	Loudon	7
Stafford	4	Franklin	8	Fauquier	7
Prince George	4	Southampton	8	Sussex	6
Mecklenburg	4	Albemarle	7	Spotsylvania	6

Source: JLARC staff analysis of data published in 1994 *VDOT Summary of Crash Data*.

the top ten localities in terms of the number of injury accidents on each of the three highway systems. VDOT's 1996 accident data indicated that, with a few exceptions, these same general trends continued.

Highway injury and fatality rates also vary by locality in Virginia. Typically, rural localities with small populations and low traffic volumes will have higher accident rates than larger, urban localities. This is despite the fact that the larger localities usually have many more accidents. Appendix B contains additional data concerning the number of highway accidents, and the rates at which they occur for Virginia's cities and counties.

VIRGINIA'S HIGHWAY IMPROVEMENT PROGRAM

The U.S. Highway Safety Act of 1966 established the framework for a systematic approach to resolving highway safety problems, and required states to develop highway safety programs. Subsequent legislation, including the Highway Safety Acts of 1973 and 1978, the Surface Transportation Assistance Act of 1982, the Commercial Motor Vehicle Safety Act of 1986, and the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, expanded the role of federal, state, and local governments in highway safety activities.

VDOT is responsible for identifying appropriate and cost-effective countermeasures designed to improve hazardous roadway sites within the 56,000 mile State highway system. All highway construction and reconstruction is planned and implemented as part of VDOT's six-year highway improvement program. This section provides an overview of VDOT's organizational structure, provides background information concerning the State's highway improvement program, and explains the composition of the State highway system.

VDOT Is Responsible for Highway Safety Programs

There are relatively few provisions of State statutes pertaining to VDOT that specifically mention highway safety or safety-related issues. Under Section 33.1-13 of the *Code of Virginia*, the State Transportation Commissioner has the statutory authority "to do all acts necessary and convenient for constructing, improving and maintaining the roads embraced in the system of state highways...."

In addition, the Commonwealth Transportation Board (CTB) has numerous statutory responsibilities stated in Section 33.1-12 of the *Code of Virginia*. Two of these include:

- to establish traffic regulations, and
- to cooperate with the federal government, AASHTO, and any other organization..."in the taking of measures for the promotion of highway safety."

These requirements for VDOT and the CTB are implemented through the traffic engineering operations at the central office and in the districts.

Traffic Engineering. Traffic engineering is a function performed by VDOT in order to address safety and operational issues that develop on highways after construction has been completed and the road has been opened to traffic. Addressing the varied issues that can arise involves a combination of physical science and social science. Traffic engineering draws upon established engineering standards pertaining to highway design and construction, as well as those pertaining to various traffic control and protective devices. However, it is also very much concerned with human factors, primarily the reasons motorists behave and react as they do in various types of driving conditions, such as when they operate vehicles in extreme congestion, poor weather, or over hills and around curves. Within VDOT, traffic engineers are at the forefront of the agency's efforts to deal with the safety-related consequences of certain motorists who, for whatever reason, operate vehicles in an inattentive, irresponsible, or even aggressive manner.

The traffic engineering division in the central office works with traffic engineering staff in the nine district offices as well as the residency staff in order to identify hazardous roadway sites and develop recommended improvement projects. Within the central office, the programming and scheduling division, secondary roads division, and urban division all play supporting roles in coordinating the six year improvement program for the interstate, primary, secondary and urban highway systems.

Safety-Related Strategic Planning Objectives. VDOT's Strategic Plan for the 21st Century places a high priority on safety. The first of VDOT's six mission objectives is that "people will recognize that our transportation system represents the highest standards of safety and quality." The first of VDOT's six value guidelines is to "put safety in everything we do." As part of the implementation of its strategic plan, VDOT is developing a series of strategic outcome performance measures, including the crash rate and the amount of traffic moved per hour by certain corridors. These are being developed in conjunction with the goal statement that VDOT will "maintain and operate its assets to the highest standards of safety and quality."

Highway Safety Improvement Programs

Funding for safety improvements comes from a number of programs administered by VDOT, including the general highway construction program and two specific safety programs. Each year, VDOT publishes an updated six-year program for the improvement of Virginia's interstate, primary, and urban highway systems. This publication represents the programming and funding — through preliminary engineering, right of way acquisition, and construction — of highway improvements that have been determined by the CTB to be of the highest priority. In addition, the board of supervisors in each county prepares a six-year program for improvements to the secondary roads in the county. This program is updated each year in conjunction with the VDOT resident engineer for the county. In addition to these general construction programs, VDOT also administers the Hazard Elimination Safety Improvement program and the State Traffic Operations and Safety Improvement program.

Interstate, Primary, and Urban Six-Year Program. Under the current six-year program, approved by the CTB in June 1997, approximately $1 billion in funding has been allocated for highway improvement projects in FY 1998. These projects can include, in addition to construction, preliminary engineering studies, design activities, acquisition of right of way, and relocation of utilities.

The CTB updates the six-year program for the interstate and primary systems after reviewing requests received at annual pre-allocation hearings held in each VDOT district. These hearings provide a means for public officials and ordinary citizens to have input into the determination of highway improvement needs and priorities, including critical safety-related projects. The CTB also receives the recommendations of VDOT staff for updating the six-year program. The staff considers such factors as projected revenues, project priorities, safety, continuity of development, present-day needs, and coordination of plans with financing for the proposed improvements.

Updating the six-year improvement program for the urban street system in cities and towns is handled separately. Projects to be included in the program are identified and selected by the city or town council through a formal resolution. These resolutions are submitted to VDOT's Urban Division, which prioritizes the projects identified by the governing body. This prioritized list is submitted to the programming and scheduling division for inclusion in the overall six-year program.

Secondary System Six-Year Programs. County boards of supervisors, working with VDOT resident engineers, make most improvement decisions for secondary roads. Each county has a six-year program for improvements to the secondary roads located in its jurisdiction. Therefore, there are 95 unique six-year programs for improvements to Virginia's secondary highway system. These programs reflect a wide variety of needs and priorities.

The *Code of Virginia* contains numerous requirements for development of six-year programs by the counties. Each program is required to be based upon best estimates of funds to be available to the county. Following the preparation of the program, which must identify the estimated cost of proposed improvements, the governing body and VDOT are required to hold a public hearing. After the hearing, the governing body and the VDOT resident engineer finalize and officially adopt the six-year program. At least once every two years, the six-year program is required to be updated.

On an annual basis, the VDOT resident engineer is required to meet with the board of supervisors to prepare a budget for the expenditure of improvement funds during the next fiscal year. After receiving an updated estimate of funds from VDOT, the board of supervisors and the resident engineer jointly prepare the list of projects to be undertaken in that fiscal year. These projects are selected from the six-year program, and represent the priorities for the year. In selecting these priority projects, the board of supervisors and the resident engineer are required to generally follow "the policies of the CTB in regard to statewide secondary highway system improvements." The list of priority projects for the fiscal year must be presented at a public hearing, and then officially approved.

Hazard Elimination Safety Improvement Program. Under this program, referred to as HES, funds are made available on a statewide, competitive basis in order to improve roadway sites where there is an abnormally high incidence of accidents. VDOT's traffic engineering division performs a cost/benefit analysis of proposed projects in order to make funding decisions. The federal government provides 90 percent of the funding for approved projects, with the State and localities providing the remaining 10 percent. In FY 1998, approximately $7.4 million in funding has been allocated to this program. However, this amount is not representative of the typical annual allocation for HES, and reflects the impact of a one-time increase in federal funds attributable to the correction of a 1994 federal accounting error. Since the enactment of ISTEA, annual HES allocations have been approximately $4 million.

State Traffic Operations and Safety Improvement Program (STOSIP). VDOT established the STOSIP program in 1987 in order to quickly implement improvements in response to unanticipated operational or safety problems which may suddenly develop at certain locations. Unlike HES, STOSIP funds can be used for projects at locations that do not necessarily have an abnormally high accident rates. District administrators have a considerable degree of discretion concerning the use of these funds. Total STOSIP allocations, which are part of each district's primary system allocation, are $1.4 million for FY 1998.

JLARC REVIEW

HJR 579 of the 1997 General Assembly Session directed JLARC to study the procedures for identifying and funding the improvement of hazardous roadway sites. An impetus for this study, as specifically referenced in HJR 579, was circumstances involving improvement projects at two roadway sites located along State route 220 within VDOT's Salem district. One location was at the intersection of routes 220 and 902 in Henry County. The second location was at the intersection of routes 220 and 605 in Franklin County. HJR 579 cites the need to establish a system to identify and correct problems at various highway locations in order to "prevent needless deaths and injuries due to motor vehicle accidents at such sites." This section describes the research activities undertaken by JLARC staff, and provides an overview of the remaining chapters of this report.

Study Approach

This study was designed to focus on the procedures used by VDOT to identify and improve hazardous roadway sites. As previously discussed, VDOT's efforts are just one part of broader State efforts to improve highway safety. Programs and activities carried out by the Department of Motor Vehicles (DMV), the State Police, local law enforcement staff, and others are outside the scope of this study and were not reviewed. However, as is discussed later in this report, VDOT does work with many of these other entities in several ways as part of its efforts to improve highway safety.

Several research activities were undertaken to address the issues in this study. These activities included structured interviews, analysis of highway accident data, analysis of improvement project data from a sample of high accident rate roadway sites, analysis of hazard elimination safety improvement program data, a survey of

VDOT district administrators, safety improvement program file and document reviews, and a site visit to the Salem District.

Structured Interviews. During the study, JLARC staff conducted structured interviews, either in person or by telephone, with the following:

- the current and prior Commonwealth Transportation Commissioners;
- VDOT's assistant commissioners for operations and finance;
- VDOT traffic engineering division management and staff;
- top management from VDOT's programming and scheduling, urban, secondary roads, transportation planning, and maintenance divisions;
- VDOT district administrators;
- VDOT district traffic engineers;
- Virginia Transportation Research Council staff; and
- Federal Highway Administration staff.

Analysis of Highway Accident Data. This research activity had two general components. The first was a review of historical accident rate data maintained by VDOT and DMV. VDOT's critical accident rate data were available as of June 30, 1996 for sections, and December 31, 1995 for intersections. These data, computed by VDOT using its own methodology, identify roadway sites having higher accident rates than are expected for various types of sections and intersections. JLARC staff also reviewed many types of crash data contained in the *Summary of Crash Data*, published by VDOT, and *Virginia Traffic Crash Facts*, published by DMV.

Analysis of Hazard Elimination Safety Improvement Program Data. JLARC staff analyzed data concerning the number of HES funding applications submitted from 1993 to 1996. The analysis focused on the localities which generated the most applications, the approval and disapproval rates, the extent to which approved projects were funded, and the most common types of improvement projects for which funding was sought. Issues concerning administration of the HES program were also a focal point of structured interviews with VDOT staff.

Analysis of Improvement Project Data From a Sample of High Accident Rate Roadway Sites. At the request of JLARC staff, VDOT information systems staff developed a computer program that identified the roadway sections and intersections with the highest accident rates as of December 31, 1993 and December 31, 1996. For both time periods, the resulting data for sections was stratified by VDOT district and by traffic volume. The traffic volume break points that were chosen, expressed in terms of average daily traffic (ADT), were more than 10,000 vehicles per day (relatively high traffic volume), and 10,000 and below (relatively low traffic volume). The resulting data for intersections were stratified by district, and by whether or not the intersection had a traffic signal.

JLARC staff used the data to select a sample of high accident-rate sections and intersections from the December 31, 1993 listing for further analysis. Eight roadway sections and two intersections were selected for each district. In each case, four high traffic volume and four low traffic volume sections were selected. Likewise, one signalized and one unsignalized intersection were selected. For the sample, JLARC selected the section or intersection within each stratum that had the highest accident rate, provided that the location had had at least one fatal or injury accident. If the highest accident rate site had only property damage accidents, it was not selected.

Working with staff from the VDOT's traffic engineering division, JLARC staff requested various types of data from the districts concerning these sites. The purpose of the data collection and analysis was to determine the extent to which VDOT had addressed the highest accident rate sites as of December 31, 1993 sometime during the subsequent three and one-half years. To the extent that certain sites had not received improvements, the districts were asked to explain why. The final part of this analysis by JLARC staff involved determining the extent to which the highest accident rate sites from 1993 were still among the highest accident rate sites as of 1996. This was done by comparing one list against the other.

Mail Survey of VDOT District Administrators. JLARC staff conducted a mail survey of the nine district administrators. The survey was designed to obtain information in three different areas. First, the survey requested information concerning the status of HES projects which had previously been applied for but not funded. JLARC staff wanted to determine the extent to which these projects had been implemented using other funding sources.

Second, using the data generated from the previously mentioned VDOT computer program, JLARC staff identified the four high volume roadway sections, four low volume roadway sections, one signalized and one unsignalized intersection with the highest accident rates as of December 31, 1996. The district administrators were asked whether they agreed that these sites represented the most hazardous locations in their districts. The district administrators were also asked to identity the five most hazardous locations in their districts, and describe actual or planned improvements for those locations. Finally, the survey requested comments from the districts concerning how VDOT's policies, procedures, or provisions of State law could be modified in order to enhance VDOT's ability to identify and improve hazardous roadway sites.

Site Visit to the Salem District. Since the study mandate specifically identified two roadway sites in the Salem district, JLARC staff visited the Salem District to interview VDOT staff and observe the cited locations. First, the district administrator and district traffic engineer were interviewed. JLARC staff then visited the sites with the district administrator and resident engineers. The history of problems at the two sites were discussed, traffic patterns were observed, and the status of improvement plans were discussed. During the trip, the district administrator also identified several other problem locations along Route 220.

Highway Improvement Program Document and File Reviews. JLARC staff examined extensive documentation concerning how the highway improvement projects are developed and implemented. In addition, a significant amount of documentation concerning how the HES program is administered was reviewed. Other types of documents that were utilized concerned when, where, and how various types of traffic control and protection devices are utilized by VDOT as part of the improvement program.

JLARC staff also examined approximately 20 files maintained by the traffic engineering division involving various locations around the state that, due to a number of factors, have created some difficulties for the department over the past few years. These files were reviewed for a number of reasons, one of which was to obtain examples of how VDOT's established procedures are applied in cases of unusually intense pressure for roadway improvements in locations that are perceived by the public to be hazardous.

Report Organization

This chapter has provided an overview of highway safety trends in Virginia, and the State's highway improvement program as administered by VDOT. Chapter II examines the procedures used by VDOT to identify hazardous roadway sites. Chapter III assesses the policies and procedures used by VDOT to improve hazardous roadway locations.

II. Identification of Hazardous Roadway Sites

VDOT follows a reasonably systematic process for identifying hazardous roadway sites. The identification process is characterized by comparison of actual to expected accident rates, professional engineering judgment concerning the degree of hazards and appropriate countermeasures, and response to public concerns. The site identification process is complicated by the fact that the term "hazardous roadway site" does not have an agreed upon definition. Roadway hazards are, to a great extent, in the eye of the beholder. VDOT has operationalized this term, to a degree, to refer to locations that experience accident rates that are higher than VDOT expects for a specific type of roadway. Still, it is not always clear whether abnormally high accident rates, or abnormally high numbers of accidents, serve as VDOT's primary indicator of roadway hazards.

The identification process is further complicated in trying to determine whether the primary factor causing an abnormally high number of accidents at a location is the roadway environment or the driver. Therefore, even if a site does have an abnormally high number of accidents, roadway improvements may not be considered necessary by VDOT if most crashes were the result of driver error or inattention. Another factor which can complicate the identification process is the degree of inaccuracy present in VDOT's accident, roadway inventory, and traffic data.

To put VDOT's process in perspective, this chapter first examines the many factors which contribute to accidents, injuries, and fatalities on Virginia's highways. This chapter also discusses several factors, including local land use decisions, which actually contribute to the creation of locations which are relatively more hazardous than others. Then, the chapter assesses the process used by VDOT to identify such sites.

SEVERAL FACTORS CONTRIBUTE TO HAZARDOUS SITES

Four types of factors can interact to cause motor vehicle crashes: the driver, the vehicle, the roadway, and the surrounding environment. These factors evolve over time, for the better or for the worse. Sections of roads that have never had any accident problems can develop them fairly quickly as conditions change. The number and types of vehicles, driver characteristics, the age and condition of the road, and the extent of surrounding development are all factors that can change and affect the relative risk of accidents at a location. In addition, some types of roads in the State highway system are much more forgiving and tolerant of driver mistakes and inattention than others. While the interstates provide significant room for error, many secondary routes provide little if any margin for driver error. This section examines several types of factors which may help to create hazardous roadway sites.

Motorist and Vehicle Factors Contribute to Roadway Hazards

Many VDOT district administrators and traffic engineers interviewed expressed the opinion that most roads in the State highway system are inherently safe, and that the majority of problem locations exist due to poor driver behavior. For example, two district administrators stated as follows:

> I believe that the roads are inherently safe. The user creates the hazard. Driver rage has become unbelievable. This is not to say that there are not booby traps out there, such as the dropping off of a low shoulder. Our job is to make the roads as error free as we possibly can. I firmly believe that each project in the six-year program improves safety by providing the best highway system possible.
>
> * * *
>
> It is becoming more difficult to get people to obey traffic signals, signs, laws and speed limits. The culture of American drivers is becoming less obedient. I don't know what the State can do about this. But when accidents start happening, people say that something has to be done to improve the road. We feel that we have done all that is reasonable from an engineering standpoint.

Public perceptions concerning roadway hazards can influence VDOT's identification process, as noted by two other district administrators:

> We need to be more careful about what we call hazardous roadways. There needs to be more definition of this term. The media gets input on hazardous locations from people who often don't have all of the facts, details and data to support the contention that a particular site really does pose a problem. But if VDOT makes a statement that there is no problem with the road, we are portrayed as being against God, country and apple pie. Emotions become involved, and people get upset. We can't always get our story across.
>
> * * *
>
> Safety is in the eye of the beholder. The perception of the public is that the Capital Beltway is hazardous. But in terms of interstates it is about average in terms of its accident rate.

Driver behavior is a factor in the development of hazardous roadway sites. In recent years, VDOT has seen the need to respond to this factor. A staff member with the Virginia Transportation Research Council had this to say:

Over the past 20 years, VDOT has changed its tune concerning driver responsibility. "A highway is as safe as a driver makes it" used to appear on the bottom of VDOT stationary. However, the State Traffic Engineer very much believes that highways need to be made as forgiving as possible, and need to better take into account foolish behavior on the part of motorists.

Driver-Related Crash Factors. According to data published by DMV, 92 percent of all crashes on Virginia roads in 1996 involved violation of a State traffic law by at least one motorist. Violations of speed limits, and drinking while driving, were involved to a lesser extent. Table 3 summarizes the driver-related factors contributing to motor vehicle crashes on Virginia's public roads.

Table 3

Crash Circumstances in Virginia - 1996

Circumstance	Percent of Total Crashes	Percent of Fatal Crashes
Traffic Law Violated	92	54
Speed Law Violated	11	19
Drinking Driver	8	17
Defective Driver	4	6
Defective Vehicle	4	5

Note: Driver defects include illness, physical defects, fatigue and sleep. Totals add to more than 100 percent due to multiple circumstances contributing to some accidents.

Source: Department of Motor Vehicles, Transportation Safety Services Division.

There are many different types of improper or illegal actions on the part of drivers that can potentially cause motor vehicle crashes. However, inattention on the part of motorists and the failure to yield to other traffic were the two most prevalent factors contributing to motor vehicle crashes in Virginia during 1996. According to DMV's data, these two factors alone contributed to 23 percent of all crashes. Additional data concerning driver-related crash factors is contained in Appendix C.

As a result of various inattentive or improper actions taken by motorists, various types of motor vehicle crashes can occur. Rear end accidents, angle accidents during turning movements, and hitting fixed objects off the roadway are the most common types of collisions on the State highway system. However, these vary by the type of roadway. For example, the type of fixed object most often hit on an interstate highway is a guardrail. On primary and secondary roads, however, embankments and trees are the most commonly struck fixed objects. Table 4 summarizes the most common types of collisions on the interstate, primary, and secondary highway systems.

Table 4

Types of Crashes on the State Highway System
(Percent of Total Crashes)

Type	Interstate	Primary	Secondary
Rear End	40%	33%	16%
Angle	1	28	25
Sideswipe -- Same Direction	16	8	4
Fixed Object Off Roadway	32	20	36
All Other	11	11	19
	100%	100%	100%

Source: JLARC staff analysis of VDOT 1994 crash data.

Vehicle-Related Crash Factors. Very few of the vehicles involved in highway crashes on Virginia's public roads in 1996 had any defects at the time of the crash. According to JLARC staff analysis of data published by DMV, nearly 98 percent of the vehicles involved in crashes had no reported defects. Those defects that were reported were as follows:

- Lights -- 0.2 percent of vehicles,
- Brakes -- 0.5 percent,
- Steering -- 0.6 percent,
- Tires -- 0.5 percent,
- Motor -- 0.1 percent, and
- Other -- 0.4 percent.

Environmental Factors. Most crashes on Virginia roads occur in broad daylight and in clear weather. In 1996, 68 percent of all crashes occurred in the daylight hours, and 58 percent occurred in clear weather. In contrast, only 27 percent occurred at night, with half of those taking place on lighted roadways. In addition, only 17 percent of accidents occurred during periods of rain or snow.

Roadway Design Features Contribute to Hazardous Locations

Some types of roads, particularly those that have proper sight distance and adequate clear zones, are more forgiving of driver inattention and error than others. Proper sight distance helps ensure that vehicles will not collide with one another. If they do collide, adequate clear zones assist in safely controlling and stopping the vehicle. Motor vehicle crashes on sections of the State highway system that have these features are probably less likely to result in injury or death than those which do not.

VDOT has design standards concerning sight distance and clear zones. However, these standards are most easily applied to new construction. Many sections of the secondary system, in particular, lack these features because these roads were never actually designed, but merely evolved from original dirt roads that were eventually paved.

Sight Distance. This refers to the degree to which a motorist can see around a curve, or beyond the crest of a hill, in order to determine whether it is safe to enter the roadway. Many sections of primary and secondary roads, due to the nature of the local terrain, have limited sight distance. Consequently, vehicles that are entering the roadway in these sections, from either a residence or a business, do not have much time to react to oncoming traffic. If oncoming traffic is in excess of the speed limit, reaction time is further reduced.

One circumstance in which sight distance typically becomes an issue, particularly on primary highways, involves the spacing of unsignalized crossovers. A crossover enables a motorist traveling in a particular direction on a divided highway to access the other side of the road to travel in the opposite direction. Without a signal at the crossover, the motorist must use judgment as to when to enter the opposite travel lane. The available sight distance at that crossover, and the distance to the next closest crossover, can affect the relative risk involved in using that crossover. VDOT has adopted spacing criteria for all crossover locations that are based on highway design speed and minimum sight distance. For example, VDOT standards require crossovers on a highway with a design speed of 55 miles per hour to be spaced at least 800 feet apart, and to have a minimum sight distance of 650 feet.

Clear Zones. This refers to a traversable recovery area for errant vehicles beyond the edge of the pavement. Ideally, the clear zone should be free of obstacles such as unyielding sign and lighting supports, non-transversable drainage structures, utility poles and steep slopes. The recommended width of a clear zone according to VDOT guidelines is influenced by the traffic volume, speed, and embankment slope. Higher design speeds coupled with higher traffic volumes and steeper embankments are recommended to have wider clear zones.

Utility poles are a source of some concern for VDOT in terms of establishing clear zones. VDOT has a pilot program underway on the Eastern Shore where five breakaway utility poles have been installed. VDOT believes that such poles should result in less severe crashes if they are hit, and plans to evaluate the results. However, evaluation of this test is not possible at this time since none of the poles have yet been hit. VDOT is also conducting a two-year study, using federal funding, to identify utility poles that have been hit repeatedly by motorists so that they can be marked with reflective devices. Roadway sections in three districts, Bristol, Culpeper, and Suffolk, will be examined during the study.

According to VDOT staff, some utility companies have not been easy to work with in terms of mitigating the potential for adverse consequences posed by the utility poles.

> It has been very difficult working with utility companies. From a liability perspective, utility companies are very leery of calling attention to poles that have been hit repeatedly. They don't want to help us install breakaway utility poles, despite the fact that federal funds would pay 100 percent of the costs. Utility companies look at safety differently than we do. Currently, if a pole is hit and breaks off, the utility company replaces it with a larger pole so that it does not break off the next time it is hit. The utility company doesn't want to have live power lines lying on the ground. That is why our pilot program for installing breakaway utility poles is being done on the Eastern Shore, where the poles are owned by Delmarva Power.

Inadequate Maintenance of Roadway Assets Can Contribute to Hazards

VDOT utilizes, and is responsible for maintaining, many different kinds of traffic control and safety devices. These include regulatory signs, pavement markings and markers, reflective devices, lighting devices, concrete median barriers, guardrail, and impact attenuators. To the extent that such devices are not adequately maintained to the point at which they no longer function properly, they will not provide the anticipated safety benefits to the public.

1995 Maintenance Quality Evaluation. An evaluation by consultants hired by VDOT in 1995 indicated that, systemwide, traffic control and safety devices were failing to properly function at a rate much higher than had been assumed. From July to October 1995, VDOT's engineering consultant inspected more than 6,400 sites as part of what was, at the time, VDOT's Maintenance Quality Evaluation System. For sample selection purposes, a 21 percent failure rate was assumed for all maintenance elements, including traffic control and safety equipment. This assumed rate was greatly exceeded, particularly on the primary and secondary systems. The actual failure rates were:

- Interstate -- 27 percent,
- Primary -- 33 percent, and
- Secondary -- 46 percent.

The consultant analyzed the level of service (LOS) provided at each of the 6,400 test sites. The LOS was defined as the percentage of items at a test site that met established quality criteria, such as:

- Guardrails -- minimum height of 25 to 29 inches for a strong post system, and 28 to 32 inches for a weak post system;

- Concrete barriers -- No missing sections or structural problems;

- Impact attentuators -- Properly aligned and undamaged;

- Regulatory signs -- Seven foot minimum height with one sign on pole, five foot minimum height with two signs on pole; and

- Lights -- 90 percent function, with 100 percent of electrical cover plates secured.

The traffic control and safety devices on the primary and secondary systems were found to be providing a level of service of less than 80 percent.

Integrated Maintenance Management System. VDOT did not perform another statewide maintenance quality evaluation in 1996. Instead, VDOT has been developing a new Integrated Maintenance Management System (IMMS). According to VDOT, IMMS "represents a fundamental change in how maintenance is conceived, planned and implemented." The IMMS will consist of several major components, including a new Inventory Condition and Assessment System as well as upgrades to the Pavement Management System and Bridge Management System which were first developed by VDOT in the 1980's.

Several key issues form the foundation of IMMS, including:

- outcome-based approach for program management;
- consistent statewide asset condition and service quality assessment; and
- shared responsibility and accountability between central office and districts.

VDOT plans to begin implementing IMMS over a three-year period beginning in the Fall of 1997.

Local Land Use Issues Can Affect the Relative Safety of a Roadway Site

VDOT works with local governments to review site plans, evaluate traffic impacts, and recommend roadway improvements needed to serve proposed development sites. VDOT has two roles in the review of site plans: regulator and advisor. The regulator role includes: (a) issuing permits for work performed within VDOT's right-of-way, including entrances to State highways, and (b) regulating subdivision street development for streets to be included in the secondary system. Much of the work in this regard is performed by staff in VDOT's residency offices. However, staff in the district offices and the central office also play a role.

VDOT Influence Concerning Land Use Decisions. According to VDOT's land development manual, "careful reviews of proposed development plans are important because in the past the traffic impacts of new developments have been very costly for both VDOT and the local jurisdictions." However, during interviews, many VDOT district administrators and traffic engineers described an operational environment in which VDOT has relatively little influence concerning land use decisions which affect the highway system. Nevertheless, VDOT continues to bear the ultimate responsibility for ensuring that the system continues to function properly. Comments from district administrators and traffic engineers included:

> Counties recognize the transportation problems and issues associated with development, but they stop short of insisting on roadway improvements. The county can not insist on a proffer for improvements to an adjacent secondary road. But the county can negotiate. Counties focus on sewers and schools. In many counties in our district, there is an inappropriate level of appreciation of the impact of land use decisions on transportation. They don't want developers to go elsewhere because they are making it too expensive. It is very easy for local governments to say that transportation is VDOT's problem.

* * *

> Quite frankly, the counties totally disregard what VDOT's requirements are. They have agendas different from ours. Its a tax base issue to them. Many times a county's attitude is we will get the development in and let VDOT worry about fixing the traffic problems later.

* * *

> It is easier to exert influence in rural, slow growth localities than in larger, rapidly growing localities. In the latter, land use decisions are often made years prior when importance of transportation issues were not fully appreciated. Today things are developing so fast its almost impossible for VDOT to keep up.

There are, however, areas where VDOT is able to work with localities and developers to ensure, based on VDOT's professional judgment, the integrity of the highway system:

> I won't say we hold developers hostage, but we have been very successful in getting funding for installing signals and building roads. The development community sees the benefit of doing so. We press the developers pretty hard to get the funding for improvements that we deem necessary.

Commercial Entrance Permits. Section 33.1-198 of the *Code of Virginia* governs the ability of private businesses to connect their commercial entrances to the State highway system. The provisions of this section include the following:

- The Commonwealth Transportation Commissioner shall permit suitable connections so as to provide for the users of such entrances safe and convenient means of entrance and exit;

- Any person desiring such an entrance shall first be required to obtain a permit therefore from the Commonwealth Transportation Commissioner and shall provide the entrance at his expense and construct or have constructed the same;

- The entrance shall include such safety structures as are required by the Commonwealth Transportation Commissioner, pursuant to the Minimum Standards of Entrances to State Highways;

- All commercial entrances shall be maintained at all times by the owner of the premises in a manner satisfactory to the Commonwealth Transportation Commissioner; and

- Any person violating these provisions shall be guilty of a misdemeanor and upon conviction shall be fined no more than $100 for each offense.

New commercial entrances are obtained through a permitting process administered by VDOT resident engineers. Any time that a commercial property is sold, and the new property owner wants to change the type of business or use of the property, a new entrance permit is required by VDOT. As part of the permit process, site plans must be submitted for review by VDOT. A traffic engineering investigation may also be performed as part of the review process.

The permit process is the most direct source of influence and control that VDOT has over the traffic related impacts created by local land use decisions. For example, the minimum standards state that "the tenure of commercial entrances is not infinite nor is it meant to be transferred from one owner to another." The minimum standards further provide that:

> If it is determined by Department representatives that an entrance is substandard or that safety, use, or maintenance of the entrance has changed significantly to require corrections, then necessary corrections shall be made or the entrance may be closed at the direction of the Commissioner or his representative.

However, during interviews with JLARC staff, several district administrators and traffic engineers commented on the limitations of the commercial entrance permit process.

> Development may be located on a secondary road, but it is often demonstrated by our traffic impact study to negatively impact an intersection five miles away. However, we can't require the developer to make an "off-site improvement" as part of the entrance permit. Several localities in the district do not have zoning ordinances. In those, we are frequently not involved in commercial entrances. We rely on the counties.

* * *

There is a lot of bluff on VDOT's part regarding conditions necessary to be met in order to get an entrance permit. Many of the things VDOT demands can't actually be enforced or required.

* * *

At one time, VDOT tried to administer the permitting process on a uniform and consistent basis at the district level. Now, each residency administers the process as they see fit and only call on the district where they see a need. I am not as satisfied with this process as I once was.

District staff also stated that new or expanded commercial entrances are often created within their jurisdictions without proper notification provided to VDOT. In these cases, VDOT learns of the entrance long after the fact and has to play catch up with the developer or business owner to ensure that the entrance is safe and appropriate:

According to one VDOT district administrator: "Most of our counties don't have zoning ordinances. So we are the enforcer, and become very unpopular. We make known that any time there is a new entrance, or modification to an existing entrance, they need to see us. However, we often lack prior notice of construction of commercial entrances. A particular problem is mom and pop businesses who claim ignorance of the standards and process."

* * *

VDOT staff in the Bristol District learned of a new industrial park in Buchanan County only after a shell building had been constructed. According to the district staff, the proposed commercial entrance was totally unworkable in that it was too steep and had poor sight distance. After learning of the commercial entrance very late in the process, the district staff had to get the developer to move the entrance. The original estimated cost for the entrance was $50,000. The final cost of the entrance, after all of the recommended safety improvements were agreed to, was $200,000.

* * *

VDOT staff in the Staunton District did not learn of an entrance for a new day care center until one month after an occupancy permit had been issued by Rockbridge County. The commercial property consisted of a house that had been converted into a day care facility. Upon learning of the new business, VDOT determined that the entrance to *the State highway system was inadequate. However, there was some reluctance on the part of the business owner to recognize the problem. Ultimately, the owner agreed to make improvements recommended by VDOT at her own expense.*

Staff comments and examples such as these indicate a need for VDOT to ensure that statutory provisions governing commercial entrances are being effectively and uniformly administered on a Statewide basis.

Recommendation (1). **The Virginia Department of Transportation should examine the adequacy of its procedures for administering and enforcing Section 33.1-198 of the *Code of Virginia* pertaining to commercial entrances to ensure that permitting requirements are enforced uniformly across the State. The Department should report the findings of its evaluation to the House and Senate Transportation committees.**

THE PROCESS FOR IDENTIFYING HAZARDOUS ROADWAY SITES IS SOUND, BUT DATA PROBLEMS EXIST

VDOT has in place a process that is used to identify locations which require modifications in order to improve the degree of safety at the site. This process consists of highly objective components based on accident rate data, professional components based on the engineering judgment of VDOT staff, and relatively subjective components based on information provided by citizens. The use of accident rate data, professional engineering judgment, and citizen input are important to the overall identification process.

Data maintained and generated by VDOT pertaining to crash rates, traffic counts, and roadway inventory appear to be problematic in their accuracy and timeliness. If not appropriately addressed, these problems may impede VDOT's ability to identify hazardous locations. This section assesses VDOT's procedures for identifying hazardous roadway sites, and reviews issues pertaining to the integrity of crash-related data maintained by VDOT.

Critical Rate Analysis Is Used to Identify Potentially Hazardous Roads

VDOT's traffic engineering staff use a methodology that compares the average accident rate for roadway sections and intersections with a computed "critical" rate in order to identify sites with accident rates that are higher than expected. This methodology was recommended to VDOT by the Federal Highway Administration (FHWA). According to VDOT safety improvement program documentation, an accident rate greater than the critical rate indicates that a roadway section or intersection may be hazardous in some respect. Exhibits 1 and 2 describe the formulas that are used to calculate average and critical accident rates for roadway sections and intersections.

Exhibit 1

VDOT Methodology to Calculate Average Accident Rates

Roadway Section

r = C(100,000,000)/(365)(T)(ADT)(M)
where:
r is the average accident rate per 100 million vehicle miles
C is the number of accidents during time period T
ADT is the average daily traffic
M is length in miles of the section

Intersection

r = C(1,000,000)/(365)(T)(ADT)
where:
r is the average accident rate per million vehicle miles
C is the number of accidents during time period T
T is time period in years
ADT is the average daily traffic

Source: VDOT Safety Improvement Program documentation.

Exhibit 2

VDOT Methodology to Calculate Critical Accident Rates

P = C + k(Square Root C/M) + 1/2M
where:
P = critical accident rate
C = average accident rate for roadway category
M = average vehicle accident exposure for the study period at the location
k = a constant term of 1.645

Note: C expressed in accidents per 100 million vehicle miles for roadway sections, and in accidents per million vehicles for intersections. M expressed per million vehicle miles for roadway sections, and per million vehicles for intersections.

Source: VDOT Safety Improvement Program documentation.

According to VDOT, accident rates vary with the nature of the highway. Consequently, a critical rate is calculated for each possible combination of roadway functional classification, type of facility and access control, and number of lanes. The critical rate is a function of section length, time, traffic volume and the average accident rate for the roadway category. The critical rate for intersections is a function of whether or not the intersection is signalized, and of the number of approaches to the intersection. The same type of roadway classification, or the same type of intersection, may have a different critical rate in different VDOT districts.

HTRIS System. Traffic engineering division staff utilize data in VDOT's Highway Traffic Records Information Safety System (HTRIS) to perform the critical rate analysis. HTRIS is used to maintain three major types of data: roadway inventory, accidents, and traffic. All accident data are originally collected by the State Police or by local law enforcement personnel. The State Police transmit all of the accident data to DMV, which matches the accident data with data concerning the vehicle and driver involved in the accident. That combined data are then sent to VDOT, which matches the accident, vehicle, and driver data with data identifying the roadway location where the accident occurred.

The HTRIS system is programmed by VDOT staff to construct roadway section lengths such that each section includes all accidents that occur within 0.2 miles of each other. Once HTRIS identifies an accident on a roadway that is more than 0.2 miles from the previous accident, it begins a new section at the next intersection or jurisdictional boundary. HTRIS is also programmed to require that each section be at least 0.3 miles long. For intersections, HTRIS considers all accidents occurring within 0.03 miles of an intersection to have occurred at the intersection. As will be discussed in greater detail in Chapter III, local streets located in cities and towns that are not part of the State highway system are not included in the critical rate analysis. VDOT staff explain this is because automated traffic count data for these streets are not contained in HTRIS at this time.

Distribution of the Critical Rate Listing Report. Upon completion of the critical rate analysis, the traffic engineering division sends a listing of high accident locations to the following VDOT divisions units: Transportation Planning Division, Urban Division, Secondary Roads Division, Programming and Scheduling Division, and each district administrator. Some of these recipients are supposed to further disseminate the information concerning the high accident locations. The Transportation Planning Division is supposed to send a list to the Metropolitan Planning Organizations (MPOs) for informational purposes and for any actions the MPOs deem appropriate. The Urban Division is to send a list to all cities and towns with a population greater than 3,500 people for consideration. Within each district, hazardous sites located on primary roads are to be given to the District Traffic Engineers. Secondary route locations are to be given to the resident engineers, who act as liaisons for the counties. The listing sent to the Secondary Roads Division is intended for information purposes only.

There Are Many Potentially Hazardous Roadway Sites in Virginia

One means for determining the prevalence of potentially hazardous roadway sites in the State is to identify the number of roadway sections in each VDOT district, by functional classification, that have total accident rates greater than the applicable critical rate. Such sites have experienced crash rates, over a 12 month period, that are greater than VDOT expects for a particular type of highway facility, such as undivided two-lane road, a divided four-lane highway, or a signalized intersection. Based on JLARC's staff analysis of VDOT's critical rate data, there are potentially hazardous roadway sites located in every region of the State and on many different types of roads. In addition to the information discussed below, Appendix D presents more extensive data concerning the results of JLARC's critical rate data analysis.

Interstate and Primary Highways. For the 12 months ending December 31, 1996, a total of 790 sections of road on the State interstate and primary highway systems had accident rates which exceeded the applicable critical rate. Richmond district had the most such locations, while Lynchburg had the least. Many of these sections were small, often just 0.3 miles long. Figure 3 illustrates the prevalence of these locations in each VDOT district.

Secondary Highways. According to data produced by VDOT for the 12 months ending June 30, 1996, 37 of Virginia's 95 counties had at least one section on their secondary roads where the crash rate exceeded the critical rate. The counties having the greatest number of such sites were:

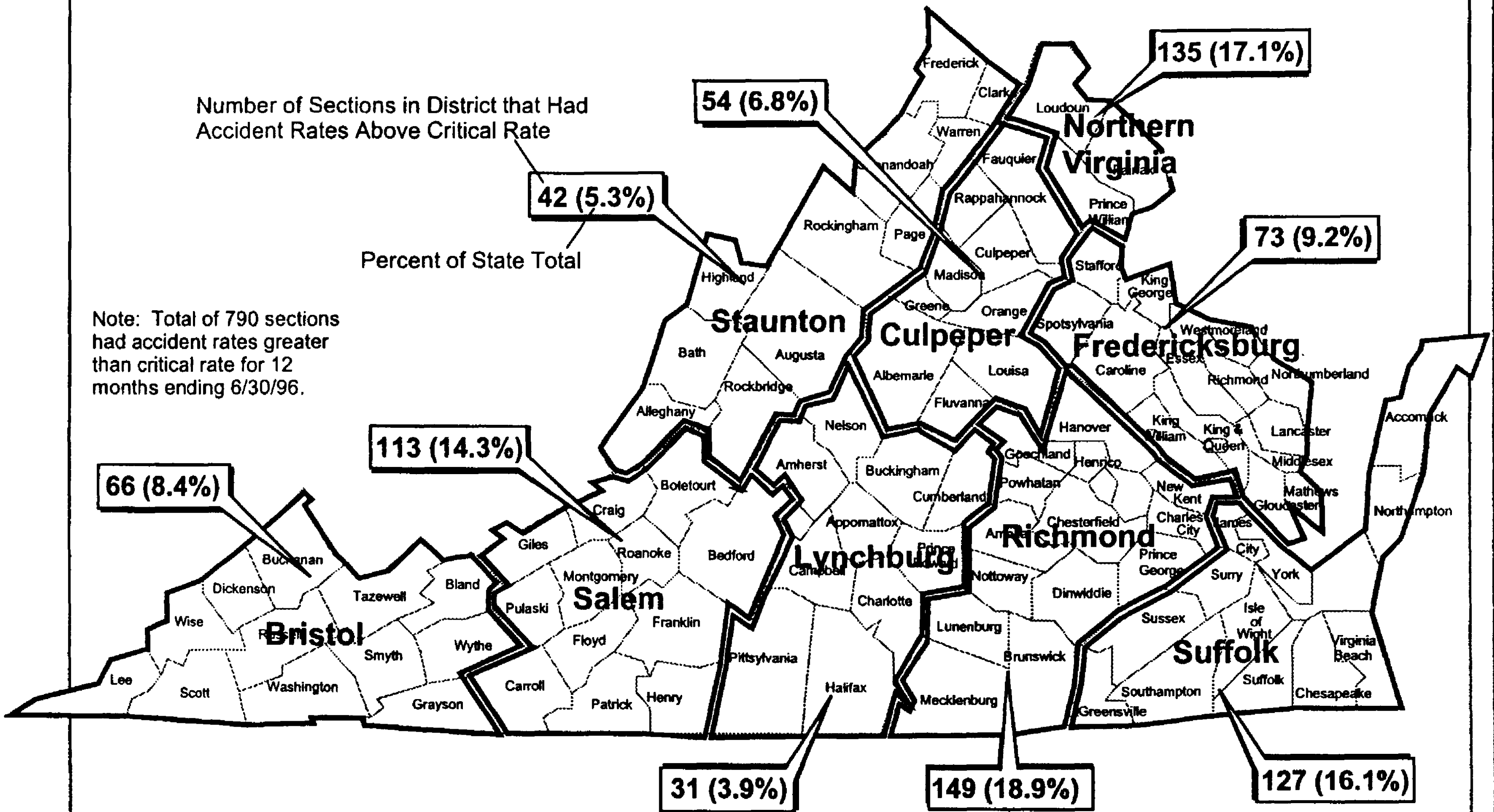
- Fairfax -- 16
- Prince William -- 13
- Buchanan -- 9
- Chesterfield -- 9,
- Albemarle -- 7, and
- Spotsylvania -- 6.

As with the interstate and primary systems, secondary roads in each county have their own unique critical accident rate. Of the six counties listed above, the critical rates ranged from 826 in Buchanan to 1,790 in Chesterfield. Appendix D contains additional data concerning critical accident rates for the secondary highway system.

Intersections. VDOT calculates critical accident rates for intersections separately from those for roadway sections. This is due to the recognition that intersections pose challenges for traffic operations and safety that are unique from those found on normal sections of highway. There were more than 1,900 intersections in the State with crash rates above the critical rate for the 12 months ending December 31, 1995 (Figure 4). As can be seen from the figure, the Northern Virginia district had the most such intersections, while the Suffolk district had the least. Nearly 80 percent of the intersections in the State that exceed the critical accident rate are unsignalized.

Figure 3

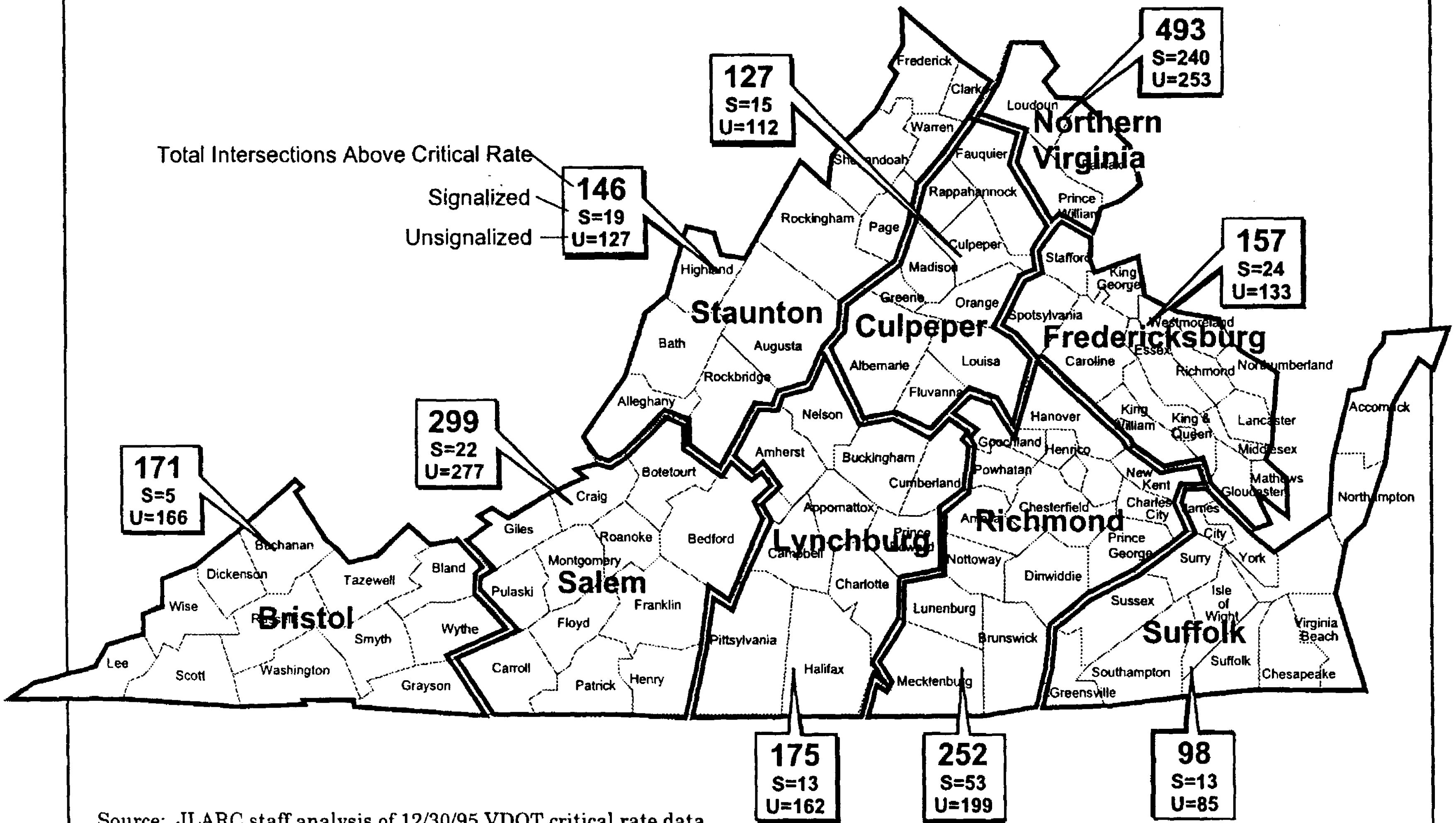
Interstate and Primary Highway Sections With Accident Rates Greater Than the Critical Rate (Shown by District)



Source: JLARC staff analysis of 6/30/96 VDOT critical rate data.

Figure 4

Number of Intersections with Accident Rates Greater Than the Critical Rate (Shown by District)



Source: JLARC staff analysis of 12/30/95 VDOT critical rate data.

In determining critical rates for intersections, VDOT takes into account whether or not there is a traffic signal at the intersection, and also the number of approaches to the intersection. Signalized intersections have critical rates that are substantially higher than unsignalized intersections. For example, an unsignalized four-approach intersection in Chesterfield County has a critical rate of 0.462 accidents per 1 million vehicles entering the intersection. However, a signalized four-approach intersection has a critical rate of 0.745. As explained by VDOT staff, while installation of a traffic signal may reduce the number of severe "angle" accidents associated with turning movements, it also increases the total number of accidents at the location as a result of "rear-end" accidents resulting from driver error. In addition, the greater the number of approaches to an intersection, the higher the critical rate. For example, a signalized three-approach intersection in Henry County has a critical rate of 0.524, while a signalized four-approach intersection has a critical rate of 0.607. This is because, as the number of approaches increases, so does the amount of potential conflict points in the intersection.

Use of the Critical Rate Data by VDOT

As previously stated, staff in the VDOT districts use the critical rate data as a means of identifying the universe of locations that potentially may have safety-related deficiencies. In many cases for which actual safety-related deficiencies are identified at a location, district staff consider applying for HES funding to support improvements at the site. In other words, the critical rate data is used as a means of identifying sites for annual HES applications. The HES program is reviewed in detail in Chapter III.

JLARC staff determined that at least one VDOT district also strives to incorporate the critical rate data into its daily operations so that areas of concern can be addressed on a proactive basis as they are identified by the central office.

The Culpeper district's highway safety improvement program is centered around the critical rate listing. The district's objective is to review all locations on the list at least once during a three-year period. However, the district states that it has been unable to meet this schedule as a result of staffing limitations.

During the comment phase of the preliminary scoping process for design of new construction projects, the district's policy is to review the critical rate list to determine whether any intersections or sections on the list are located within or near the boundaries of the new project. If there are, every effort is to be made through the project design to mitigate the accidents occurring at that site.

During reviews of private land development proposals, the critical rate listing is to be consulted to determine whether any intersections or sections on the list are located within or near the proposed develop-

ment. If at all possible, improvements to mitigate the accident history should be included within the road improvement requirements of the entrance permit so long as the developer is either willing to mitigate the situation or is compounding the situation.

When the proposed listing of the following season's repaving schedule becomes available, the critical rate list should be reviewed to determine whether any locations are located within or near the repaving schedule. If at all feasible, improvements such as pavement widening and shoulder paving should be considered in conjunction with surface repaving in order to mitigate accidents occurring at a specific location.

None of the other VDOT districts, either during interviews with VDOT staff or in their response to the JLARC survey, indicated this type of utilization of the critical rate data. However, it is possible that some other districts utilize the data in a manner similar to that of the Culpeper district or in other innovative ways. To the extent that the critical rate data is being used creatively by some districts, those techniques could be replicated throughout the agency.

Recommendation (2). **The Virginia Department of Transportation should identify best practices by its districts concerning use of the critical rate data on a daily operational basis and implement those practices in other districts and divisions.**

Accident Rates Are Useful But Not Definitive in Identifying Hazardous Sites

The use of critical rate data is a necessary, but not singular, step in the hazardous roadway site identification process. Perhaps more than anything else, sites with accident rates greater than the critical rate are noted as locations that require further study and investigation to determine the actual cause and extent of any hazard, as well as any appropriate countermeasures. As previously stated, professional engineering judgment and public input also figure prominently in the identification process. The lack of sufficiency in relying on accident rates alone is confirmed by substantial variations in perspective among VDOT district administrators concerning the significance of accident rates in identifying hazardous locations.

District Verification of State's Highest-Accident Rate Locations. At the request of JLARC staff, VDOT staff generated data which rank-ordered every roadway section and intersection in each VDOT district by total accident rate. The resulting list was stratified by traffic volume. Relatively high volume locations, greater than 10,000 vehicles per day, were analyzed separately from relative low traffic volume locations. The data were generated as of two distinct points in time, December 31, 1993 and December 31, 1996. For each district, JLARC selected a sample of eight roadway sections and two intersections as follows:

- one signalized intersection,
- one unsignalized intersection,
- four high-volume sections, and
- four low-volume sections.

To the extent possible, the eight roadway sections were comprised of four secondary, two primary, and two interstate sections.

As part of a survey, JLARC staff asked each district administrator to indicate whether the ten sites contained in the sample constituted the ten most hazardous locations in the district. Among interstate routes, the accident rates ranged from 200 on I-95 in Spotsylvania County to 680 on I-264 in Norfolk. Among the primary routes, accidents rates varied from 487 on Route 522 in Frederick County to 2,590 on Route 125 in Suffolk. Among secondary routes, the accident rates for the roadway samples ranged from 126 on Route 622 in Campbell County to 63,224 on Route 636 in Buchanan County.

In most cases, VDOT district administrators did not agree that the identified sites constituted the most hazardous sites. This is reflective of the fact that, as previously stated, accident rates are useful but not definitive in identifying hazardous locations. Moreover, one district displayed a unique perspective in that it did not agree that any of the sites were hazardous:

> At this time, it is emphasized that the Culpeper District does not consider any of these sections/intersections as "hazardous." The list represents those sections/intersections with the highest statistical accident rate within the district for their respective classification in the State highway system.

However, excluding Culpeper, the districts did agree that approximately 19 percent of the roadway sections and 28 percent of the intersections in the sample of highest-accident rate locations were among the ten most hazardous locations in their district. Even in the Culpeper district, four of the eight roadway sections, and one of the two intersections are located on corridors where the district is concentrating its efforts. A complete list of the sites in the JLARC sample, including their accident rates and whether or not VDOT district administrators agreed that these were among the most hazardous locations in their districts, is found in Appendix E.

Accident Rates Compared to Number of Accidents. Another difficulty involved in determining, for purposes of improvement prioritization, the location of truly hazardous locations is the relative importance which should be assigned to accident rates as opposed to the actual number of accidents. Typically, the highest accident rates are found on roads or in localities with relatively low traffic volumes. Conversely, the highest numbers of accidents are often found on roads or in localities with relatively high traffic volumes. One district traffic engineer succinctly summarized the issue facing VDOT:

> Should a low-volume roadway with one or two accidents, thus a high accident rate, be reconstructed before another location that has a higher volume of traffic with 15 or 20 accidents but perhaps a lower accident rate?

Performance measures that are being developed as part of VDOT's strategic planning process place explicit priority on State highway system accident rates, as opposed to the number of accidents. Nevertheless, to a certain extent, it appears that VDOT focuses on both actual numbers and rates of accidents. As stated by one district administrator:

> What grabs my attention is the number of fatal and injury accidents. I focus on the number of accidents. I want to know how many people got killed or injured. However, my district traffic engineer focuses on accident rates.

Another district administrator, while stating that the number of accidents and the accident rate were both important, indicated that the number of accidents is the focus of greater attention. "High volume routes are a priority. You get more bang for your buck."

Data Inaccuracy and Tardiness May Impede the Identification Process

During the course of this study, while examining VDOT's critical rate data for sections and intersections, and the data concerning State highway system crashes, traffic counts and roadway inventory, JLARC staff encountered numerous instances of inaccurate data. These inaccuracies, coupled with a lack of timeliness on the part of VDOT in publishing the data, raise questions concerning the integrity of State highway system data and its utility in identifying hazardous roadway sites.

Intersection Critical Rate Listing. JLARC staff reviewed the intersection critical rate listing for the 12 months ending December 31, 1995. This report was generated by the central office and sent to the districts in January 1997. Two of the data fields in the report are for the number of fatal accidents and the number of injury-only accidents. To the extent that more than one person is killed or injured in a crash, the number of fatalities or injuries will be greater than the count of fatal or injury-only accidents. However, in producing the report, VDOT staff reported the number of fatalities instead of the number of fatal accidents, and the number of injuries instead of the number of injury-only accidents. VDOT traffic engineering staff indicated that this problem will be corrected when the December 31, 1996 intersection critical rate report is provided to the districts.

The 1995 intersection critical rate report also provides data for Warwick County, which no longer exists. Warwick County became extinct in 1952 when it became Warwick City, which subsequently was consolidated with the City of Newport News in 1958. The continued use of an obsolete locality name does not aid the identification process.

VDOT 1994 Summary of Crash Data. JLARC staff reviewed the *1994 Summary of Crash Data*, published by VDOT, in order to obtain comparative crash data for Virginia localities and for other purposes. At the time of JLARC's review, from April to June 1997, this was the most recent published historical crash data available from VDOT. Numerous types of data discrepancies were observed during the course of this review, including:

- inconsistent roadway mileage data from one table to the next;
- accident data reported for roads which were shown to have zero traffic volume and zero mileage thereby preventing calculation of accident rates;
- total accident data for localities failing to reconcile with the component data for fatal, injury, and property damage accidents;
- injury rates for certain localities being obviously incorrect in relation to other localities with similar numbers of injury accidents; and
- property damage totals for certain localities being obviously incorrect in relation to other localities with similar numbers of property damage accidents.

Among the data problems found were:

> *The accident summary by district table lists total secondary system mileage in 1994 of 45,413.83. However, the accident summary by years table for the secondary system lists the total 1994 mileage as 46,222.83, a difference of 809 miles. Data subsequently provided by VDOT's traffic engineering staff, for 1995 and 1996, reported total secondary system mileage of 45,827.51 for each year.*

* * *

> *Accidents are shown for primary roads in the City of Harrisonburg despite the fact that vehicle miles traveled and length in miles for these facilities is shown to be zero.*

* * *

> *Lee County is shown as having 56 property damage accidents on its secondary roads, but with resulting property damage of only $1,400. This amount appears erroneous when compared to other counties in the Bristol district, such as Dickenson County which had 58 property damage accidents resulting in damage totaling $400,000.*

VDOT 1995 and 1996 Summary of Crash Data. In July 1997, VDOT traffic engineering staff provided JLARC staff with requested summary crash data for 1995 and 1996. This preliminary data, which has not yet been published by VDOT, was requested in order to determine if various trends identified from the 1994 data continued in 1995 and 1996. Unfortunately, many of the same types of problems encountered with the published 1994 data were also present in the unpublished 1995 and 1996 data. For example:

> *The accident summary by years table for the interstate system provided to JLARC staff showed total mileage of 2,209 for 1995 and 1996, which represents a doubling of the mileage data as published in 1994. In a subsequent telephone conversation, traffic engineering staff informed JLARC staff that the correct interstate mileage total was 1,103. However, this actually represents a slight decrease in interstate mileage from the 1994 data.*

Recommendation (3). **The Virginia Department of Transportation should take all necessary actions to ensure that data prepared for publication in the critical accident rate listings and the *Summary of Crash Data* publication is provided in an accurate and timely fashion.**

III. Improvement of Hazardous Roadway Sites

VDOT makes reasonable efforts to improve roadway sites that pose potential hazards to the traveling public. Some of the improvements that VDOT makes to roadways are small-scale "spot" projects which are relatively inexpensive and fairly quick to implement. "Corridor" improvements are much larger in scope, and consequently more expensive and time-consuming to construct. Spot improvements and corridor improvements both have important roles to play in addressing hazardous roadway sites.

Some roadway sites identified by VDOT as posing potential safety problems may not be improved for a variety of reasons, including a lack of sufficient funding. However, VDOT could improve the timeliness and efficiency with which funds previously allocated through the Hazard Elimination Safety Improvement Program (HES) and the State Traffic Operations and Safety Improvement Program (STOSIP) for spot improvements are actually put to work. The HES process appears too prolonged. Currently, it takes VDOT too long to begin construction of safety projects, but steps can be taken to make the process less time-consuming. There are numerous deficiencies with the STOSIP program, including the fact that much of the available money is not being spent on needed safety projects in a timely fashion. VDOT management is aware of these problems.

VDOT recognizes that physical improvements to the State highway system have their limitations in terms of mitigating hazardous locations. In order to continue making progress toward improving highway safety, more alternatives to expensive, major construction need to be developed where appropriate. These should focus on the behavior and performance of motorists who use the State highway system. This chapter assesses the adequacy of VDOT's improvement program in developing and implementing corrective measures at hazardous roadway sites on the State highway system

THE VDOT ROADWAY IMPROVEMENT DECISIONMAKING PROCESS APPEARS SOUND

Once VDOT has determined that a particular roadway site requires improvement in order to enhance the safety of motorists, it must determine what type of improvement is appropriate to mitigate the problem. A major aspect of the improvement decisionmaking process is VDOT's traffic engineering investigation, which includes a wide variety of data collection and analysis activities performed in accordance with established processes and standards. It appears that this process is generally sound and that, in most cases, VDOT attempts to address hazardous sites in a reasonable manner.

Occasionally, VDOT's processes and standards are not precisely followed during the course of making improvement decisions in order to accommodate community and public policy concerns. In these instances, VDOT attempts to be responsive to community needs and desires. However, in so doing, VDOT needs to be careful that the integrity of the overall decisionmaking process remains intact.

Traffic Engineering Studies Used In Improvement Decisionmaking Process

VDOT's process for identifying and improving hazardous roadway sites is illustrated in Figure 5. Following the review of the critical accident rate data, a traffic engineering study serves as a key input to the decisionmaking process. This type of study, which may be performed for a relatively small area or over an entire corridor, can include a wide variety of activities as outlined in Figure 5.

Improvement projects can range from major construction, designed to improve an entire corridor by constructing additional lanes or an interchange, to less extensive construction, such as installing a turn lane or widening the pavement of an existing lane. Furthermore, improvements can include installation of relatively expensive traffic control devices such as a traffic signal or a guardrail, or relatively minor control devices such as warning signs or pavement markings.

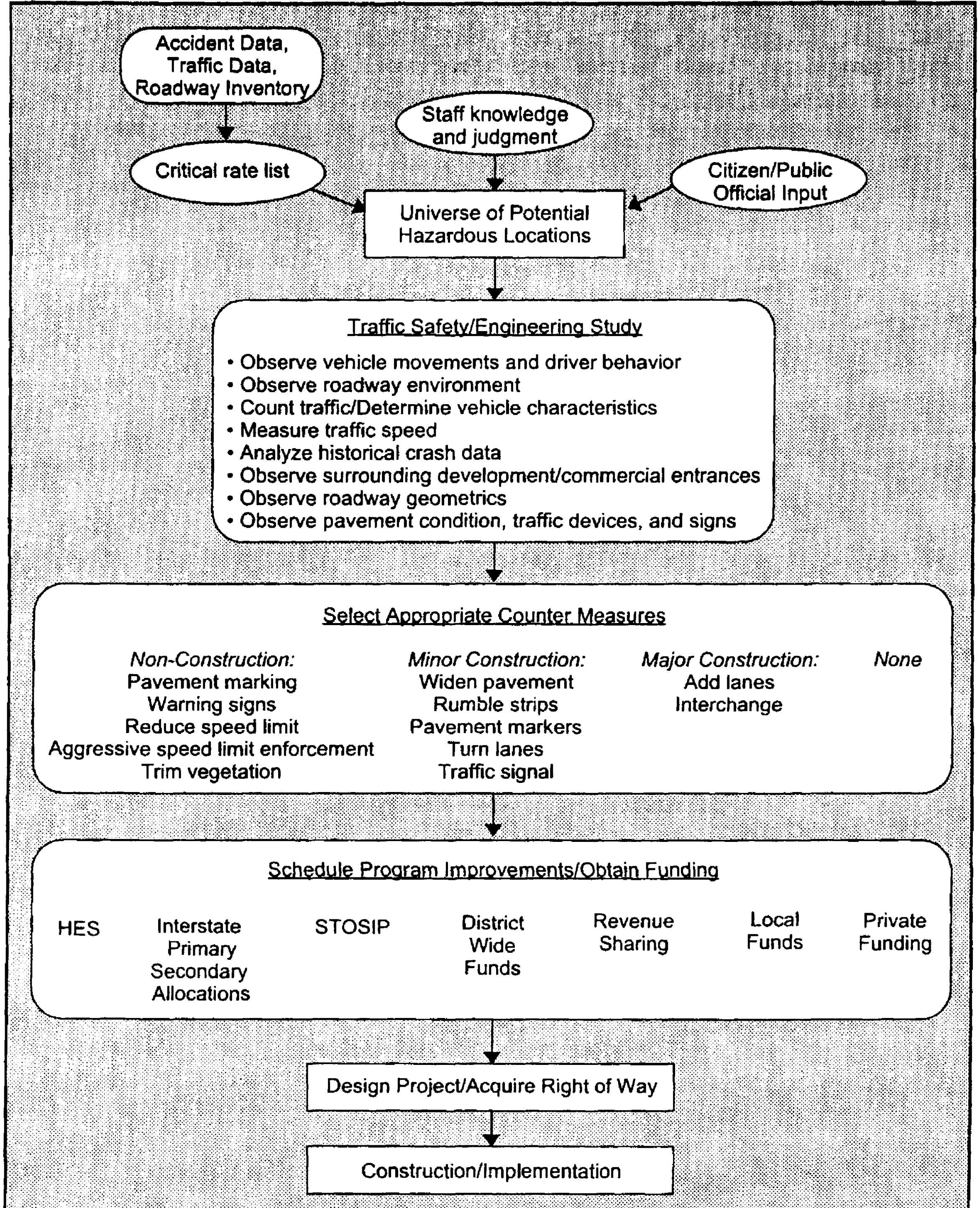
Highest-Accident Rate Sites Get Reasonable Improvement Consideration

JLARC staff analyzed the extent to which physical improvements, either actual or planned, had been made to the sample of 90 highest-accident rate roadway section and intersections previously discussed in Chapter II. JLARC staff, working with traffic engineering staff in VDOT's central office, collected improvement project data from each VDOT district for sites having the highest-accident rates for the 12 months ending December 31, 1993 (Appendix E). The accident rate for each of these sites was also greater than the applicable critical accident rate. The purpose of the analysis was to determine the extent of improvements from January 1, 1994 to the present. In addition, JLARC staff examined the extent to which the highest-accident rate sites from 1993, whether or not they received any improvements, remained among the highest accident rate locations for the 12 months ending December 31, 1996.

About Half of the 90 Sites Received Improvements. Slightly more than half of the high accident rate locations as of December 31, 1993 had received some type of actual or scheduled improvement by the Spring of 1997. Eleven of the 18 intersections in the 1993 sample had received some type of roadway improvement, or were scheduled to receive improvements, as of 1997. Only one of the seven intersections that had not received actual or scheduled improvements — Routes 29 and 1021 in Fairfax County — still appeared among the highest- accident rate intersections for the year ending December 31, 1996. However, even in this case the accident rate was substantially reduced from 4.423 to 0.454. A five-approach, signalized intersection, VDOT reviewed the location in 1994 and 1996 to assess the need for a left-turn arrow on the traffic signal, but determined it was not necessary.

Figure 5

VDOT Process for Identifying and Improving Hazardous Roadway Sites



Source: JLARC staff analysis of VDOT documentation, and interviews with VDOT staff.

In only one case, the intersection of Routes 174 and 609 in Henry County, did an intersection with actual or scheduled improvements fail to experience a substantially decreased accident rate from 1993 to 1996. The accident rate at this signalized intersection remained virtually the same from 1993 to 1996. VDOT plans to rebuild the signal by replacing the span wires with mast arms, and installing protected left turn arrows on the signal.

Thirty-five of the 72 highest accident rate roadway sections in the 1993 sample had received some type of highway improvement, or were scheduled to receive improvements, as of 1997. Only seven of the 37 sections that had not received actual or scheduled improvements still appeared among the highest-accident rate roadway sections for the year ending December 31, 1996. These seven sections were located in Caroline, Isle of Wight, James City, Pittsylvania, Spotsylvania, Stafford, and Washington Counties (Table 5). However, the accident rates for five of these locations declined substantially from 1993 to 1996. For only two of these locations, I-95 northbound in Spotsylvania County and Route 258 in Isle of Wight County, did the accident rate fail to decrease from 1993 to 1996.

Table 5

Roadway Sections from 1993 Sample of Highest-Accident Rate Locations Which Did Not Receive Improvements and Which Continue to Experience High Accident Rates

County	Route	From Route	To Route	1993 Rate	1996 Rate
Caroline	207	95	652	1,328	946
Isle of Wight	258	652	620	1,141	1,227
James City	658	612	1517	920	541
Pittsylvania	40	1320	29	1,819	1,151
Spotsylvania	95 Northbound	606	1	189	200
Stafford	1	631	1590	724	219
Washington	19	1533	1501	879	403

Note: Rates refer to number of accidents per 100 million vehicle miles traveled.

Source: JLARC staff analysis of VDOT accident rate, highway inventory, and improvement program data.

One district traffic engineer noted that the 1993 accident rates for locations at which no improvements had been initiated were "statistical outliers."

> In other words, the location's accident history "spiked" for a year for unknown reasons. Generally, these are isolated locations where accidents randomly occur with no repeated patterns and/or frequency. Such could be due to unforeseen circumstances related to roadway

and/or land development construction activities where local traffic has voluntarily diverted to alternate routes to avoid delays. Other times, there is no clear cut reasoning for a spike in the accident frequency. In these cases, it is difficult to mitigate accidents without a defined factor to address and are consequently more difficult to justify limited funding for a project.... Such locations often appear in one year and never show significant accident frequencies again. It takes several years [critical rate] listings to adequately establish a consistent program which emphasizes priority locations rather than the outliers.

Few of the Improved Sites Still Have High Accident Rates. Only five of the sampled roadway sections that received actual or scheduled improvements subsequent to 1993 continued to be among the State's highest-accident rate roadway sites during the 12 months ending December 31, 1996 (Table 6). These roadway sections are located in Albemarle, Hanover, Henrico, Prince William, and York counties. Conversely, the crash rates for most of the roadway sections in the sample that did actually receive some type of improvement were much lower for the 12 months ending December 31, 1996 than they were for the 12 months ending December 31, 1993 (Table 7).

Table 6

Roadway Sections from 1993 Sample of Highest Accident Rate Locations Which Received Improvements But Which Continue to Experience High Accident Rates

County	Route	From Route	To Route	1993 Rate	1996 Rate	Improvement
Albemarle	Rt. 64 East	Ramp to Rt. 637	Ramp to Rt. 29	638	515	Rumblestrips (planned)
Hanover	Rt. 656	Rt. 623	Ramp to I-95	1,203	1,322	Traffic signal
Henrico	Rt. 5	School Road	Buffin Road	1,380	1,786	Left turn lanes, traffic signal
Prince William	Rt. 253	Rt. 1	Rt. 9344	1,892	2,413	Upgrade traffic signal, improve intersection geometrics
York	Rt. 60	James City County Line	Road to Kingsmill Development	537	942	New interchange at I-64 to alleviate traffic on Route 60 trying to access Busch Gardens and Kingsmill (planned)

Note: Rates refer to number of accidents per 100 million vehicle miles traveled.

Source: JLARC staff analysis of VDOT accident rate and improvement project data.

Table 7

Roadway Sections from 1993 Sample of Highest Accident Rate Locations Where Accident Rate Decreased Subsequent to Improvement Project

County	Route	From Route	To Route
Albemarle	743	29	1315
Botetourt	81 Northbound	640	11
Campbell	712	831	711
Campbell	460 Business	877	1520
Carroll	221	984	669
Fauquier	15	Vicinity of 17 and 687	
Fluvanna	6	675	Scottsville East Corporate Limits
Franklin	122	Vicinity of 616	
Henry	220	Vicinity of Route 902	
James City	31	727	706
Louisa	522	88	663
Prince George	95 Northbound	Vicinity of Route 301 Interchange	
Shenandoah	678	769	803
Stafford	610	648	1264
York	64 Eastbound	Vicinity of Route 17	

Source: JLARC staff analysis of VDOT highway crash data.

Improvement of Most Hazardous Roadway Locations Varies by District

JLARC's survey of VDOT district administrators requested identification of the five most hazardous roadway sites in their districts, and to describe any actual or planned improvements to the sites. Seven of the nine VDOT districts responded to the JLARC survey by identifying five specific locations within their jurisdiction, as requested. The only exceptions were the Culpeper and Northern Virginia districts. The results of the district administrators' self-assessment indicated that, in each district, particular counties account for many of the five worst sites. These counties are:

- Albemarle,
- Augusta,
- Chesterfield,
- Fauquier,
- Henrico,
- Henry,
- Orange,
- Pittsylvania,
- Sussex,
- Spotsylvania, and
- Washington

In addition to the following discussion, more detailed information concerning the location of the five most hazardous roadway locations in each district, as reported by VDOT's district administrators, is presented in Appendix F.

Response of Culpeper District to the JLARC Survey. In its response to the JLARC survey, the Culpeper district stated:

> There are no locations that the district considers "hazardous." However, in order to give an idea of what priorities have been established, this district has concentrated much of its efforts on a corridor basis rather than addressing locations at site-specific locations. There are corridors throughout the district within which a number of certain sections/intersections are cited in the critical rate listing as experiencing higher accident rates than the statewide average for their respective classification. Although the specific intersections cited may be in the critical rate listing individually, attempting to treat each intersection in an isolated manner has, in many cases, not proven to be practical or in the best interests of the traveling public. Consequently, this district has attempted to examine many of the locations within the critical rate listing by carefully considering the surrounding affected corridors in order to determine the best method in which to address each situation.

The Culpeper district identified 11 highway corridors on which it reports to be concentrating its efforts. Two of the corridors are on interstate routes, six on primary routes, and three on secondary routes:

- Interstate 64 in Albemarle, Fluvanna, and Louisa counties;
- Interstate 66 in Fauquier County;
- Route 29 in Albemarle, Greene, Madison, Culpeper and Fauquier counties;
- Route 250 in Albemarle, Fluvanna, and Louisa counties;
- Route 28 in Fauquier County;
- Route 17 in Fauquier County;
- Route 20 in Fluvanna, Albemarle, and Orange counties;
- Route 15 in Fluvanna, Louisa, Orange, Madison, and Culpeper counties;
- Route 631 in Albemarle County;
- Route 743 in Albemarle County; and
- Route 729 in Culpeper and Rappahanock counties.

Within these eleven corridors, the Culpeper district also identified 11 specific roadway sections as having particularly high accident rates.

Most of the locations identified by the Culpeper district have had some type of improvement either completed or currently programmed. For example, 10 of the 11 corridors have received some type of improvement on at least one section of the corridor. In addition, seven of the 11 high-accident rate sections have received some type of improvement. Safety concerns and improvement considerations on one of the corridors appear to have arisen from just two isolated crashes in which reckless driver behavior played a major role.

Response of Northern Virginia District to the JLARC Survey. The Northern Virginia district declined to identify its five most hazardous roadway sites. During a subsequent telephone interview with JLARC staff, the district traffic engineer stated that he could not make that kind of determination based on accident rates alone. Upon receiving an explanation from JLARC staff that the survey did not require the determination to be based on accident rates alone, the district traffic engineer stated that "I don't really have that kind of a list." The Northern Virginia district did provide JLARC staff with a list of roadway locations for which it had recently submitted HES applications, as well as other locations that it was currently evaluating.

Extent of Improvements to the Most Hazardous Sites. Less than half of the most hazardous locations identified by the VDOT districts, including those in the Culpeper district, have either received actual improvements or have scheduled projects currently funded through the improvement program. The extent to which these hazardous roadways have received improvements varies from district to district. For example, none of the locations identified by the Lynchburg and Richmond districts, and only one location cited by the Fredericksburg district, have received either actual improvements or have scheduled, funded improvements. However, this variation may indicate less about the adequacy of VDOT's improvement program than it does about how staff in the various VDOT districts deal with identifying hazardous locations.

For about one-third of the locations identified, exclusive of the Culpeper and Northern Virginia districts, VDOT district staff indicated that roadway improvements have already been made, or are included in the current improvement program. However, in about two-thirds of the cases exclusive of the Culpeper and Northern Virginia districts, VDOT district staff described improvements that they would like to make, provided that the proposed projects are treated with sufficient priority to be included in future six-year improvement programs subsequent to FY 1998. In a few cases, VDOT staff said that no improvements were planned, or feasible, for a location:

> *No improvements are planned for the section of Route 419 between Routes 220 and 904 in Roanoke County due to the nature of the roadway. This is an urban principal arterial with 100 percent commercial development. However, the road also serves as a major collector due to development in surrounding areas. Possible improvements include*

building a new road or building service roads to reduce roadside congestion.

* * *

No improvements are planned for the intersection of Routes 301 and 139 in Sussex County. VDOT evaluated this location for the possible installation of a traffic signal, but determined that it was not justified. VDOT believes that hazard beacons are the only improvement which may reduce accidents.

In other cases, VDOT staff said that funding limitations, or the need to first determine the most appropriate improvements, had precluded actual improvements to this point in time:

There is no funding available for improvements at the intersection of Routes 125 and 129 in Suffolk at this time. VDOT believes that improving sight distance, and adding turn lanes, would reduce the accidents that are occurring. VDOT staff in the Suffolk district plan to submit an application for HES funding to make these improvements.

* * *

The intersection of Interstate 81 and Route 33 in Augusta County is included in the Interstate 81 corridor study that is currently underway. Needed improvements at this intersection will be determined as part of that broader study.

One VDOT district reported being unable to determine the accident rates or injury rates for some of the roadway locations that it considered to be the most hazardous:

Staff in the Lynchburg district reported that they were unable to furnish JLARC with any current accident rate or injury rate data for locations in Appomattox, Charlotte, and Nelson counties that they consider to be the most hazardous. In addition, the district staff were unable to provide JLARC staff with injury rate data for two locations in Pittsylvania County that are considered to be hazardous. The district traffic engineer told JLARC staff that neither he nor his staff were able to obtain these data from VDOT's HTRIS computer system.

Improvements Must Balance Engineering Standards and Human Factors

One of the difficulties that VDOT encounters in using the improvement program to address hazardous locations is that, as previously discussed, what is considered hazardous by certain members of a community may not be considered hazardous by VDOT. A roadway site that, based on VDOT's professional engineering judgment and established standards is not deficient, may nevertheless receive improvements in response to public pressure. In these cases, VDOT's accident data and engineering standards are not always compatible, in practice, with human factors that exist within what can be very emotional situations in the aftermath of severe motor vehicle crashes. Two district administrators stated the issue as follows:

> When accidents involve trucks, children, schoolbuses, or prominent individuals, everything gets blown out of proportion. In those situations, look out, improvements will be made regardless of the cost.
>
> * * *
>
> I am always amazed at the number of people who say that roadway problems are caused by driver error, but who still insist on the need to find an engineering solution.

Human factors arising in connection with automobile crashes, particularly numerous fatal crashes occurring within a short period of time, can and do influence improvement projects. This is true even in cases in which, from an engineering viewpoint, the need for major construction is somewhat questionable, or where other less expensive alternatives might be available and prove to be cost-effective.

> *A 20-mile section of Route 28 from the southern corporate limits of Manassas to the intersection of Routes 15 and 29 in Fauquier County is a two-lane undivided highway passing mostly through rural countryside. In recent years, the route has seen an substantial increase in traffic volume, primarily due to commuter traffic headed to Northern Virginia.*
>
> *During a six-week period in early 1997, there were three multiple-fatality accidents on this highway in which eight people were killed. It is believed that aggressive, reckless driving in which one vehicle crossed the centerline caused at least two of these accidents.*
>
> *Prior to 1997, this section of roadway had been allocated $120,000 for corridor studies to determine the most appropriate methods of improving the corridor. An additional $1.7 million had been allocated for the straightening of a curve in Fauquier county, although only $50,000 had actually been funded. A preliminary widening plan for the entire corridor had been developed in March, 1995.*
>
> *The first fatal accident in 1997 apparently did not provoke any significant reaction by VDOT. Following the second fatal accident, VDOT took action to expedite work on the $1.7 million curve straightening*

project. Following the third fatal accident, VDOT reduced the speed limit on the entire corridor to 45 mph. Virginia State Police and local law enforcement began to aggressively enforce the reduced speed limit. At the same time, in response to requests from the local governing bodies, VDOT also made the corridor a much higher priority. The FY 1998 six-year improvement program allocates nearly $15 million in new improvement funding for this corridor, most of which was for the widening of the road to four lanes beginning with the section near Manassas.

The Culpeper district traffic engineer told JLARC staff the reduced speed limit and aggressive law enforcement effort appears to have been very successful. Although VDOT has not yet done a formal evaluation, average vehicle speeds have declined from 62 mph to about 40 to 45 mph. Traffic volume has also declined. Some motorists are probably avoiding Rt. 28 because of its hazardous reputation. On the other hand, many habitual speeders are probably taking alternate routes that have less aggressive law enforcement. The State Traffic Engineer believes that the aggressive law enforcement effort won't continue much longer, that traffic volumes will inevitably increase, and that the speed limit will likely revert back to 55 mph following certain improvements

* * *

Route 220 near the intersection of Route 902 in Henry County is a four-lane divided highway which was constructed in 1966. Classified by VDOT as a rural principal arterial, there is substantial commercial development on both sides of this roadway. The only controls to this commercial development, which has taken place without local zoning ordinances, were the issuance of VDOT commercial entrance permits. Extensive commercial access to 220 in this area generates considerable congestion for local residents and a significant amount of crossover traffic. Turn lanes are not provided at all of the existing crossovers in the vicinity. There is also a large volume of truck traffic which uses the roadway as an arterial route. The intersection of Routes 220 and 902 is unsignalized with three approaches.

In 1994, in response to a request from the Henry County Board of Supervisors, VDOT performed a traffic engineering and safety improvement analysis for the entire 220 corridor from the North Carolina state line to I-581 in Roanoke. The study, completed in September 1994, found that the section of 220 in the vicinity of 902 had the highest accident rate - 1,138 accidents per 100 million vehicle miles traveled — of any section on the entire corridor. The subsequent 1995 intersection critical rate analysis by VDOT indicated that 19 other unsignalized, three-approach intersections in Henry County had higher *total accident rates than 220/902. However only one other intersection in the county had more accidents and this was the only one with a fatality.*

The 1994 VDOT corridor study noted that a reduction in the speed limit coupled with enforcement might be required. In addition, the study said that consideration of a right-turn lane near a school in the vicinity may be required for school bus safety. Along the length of the entire corridor, the study cited a need for several improvements, including crossover delineators, traversable end treatments on drainage pipes, trimming vegetation to improve sight distance, improving edgeline delineators, removing trees to meet clear zone requirements, and reducing existing commercial entrance widths to a maximum of 50 feet for better control of access.

On January 29, 1995, while VDOT was still in the process of considering options for short and long-term improvements at the site, a teenage driver was killed in a collision at the intersection. Following this fatality, at the request of the Henry County Board of Supervisors, VDOT studied the site in greater detail, including the need for a traffic signal. Based on the study results, VDOT reduced the speed limit to 50 mph, installed intersection warning signs with flashing yellow lights, marked centerlines in the crossover with tape (the tape was subsequently destroyed by truck traffic), and prohibited U-turns at the crossover (this decision was later rescinded since it was determined to create more traffic problems than it solved.) VDOT also determined that a traffic signal was not justified.

In June 1996, VDOT's resident engineer presented a proposal for a construction project to realign the intersection. This proposal involved closing some existing commercial entrances. The proposal was met with some resistance by local officials. The resident engineer presented a revised proposal in August 1996, which included relocation of a road to create a new, unsignalized intersection.

On September 21, 1996, the basketball coach of the local high school was killed in a crash at the intersection. Following this fatality, the Henry County Board of Supervisors requested further reductions in the speed limit, that intersection improvement plans be expedited, and that the new intersection include a traffic signal.

During the month of October 1996, VDOT was the subject of increased local criticism concerning the pace of improvements, and came under intense pressure to do something at the location. In response, rumble strips were installed and, following another study that showed 85 percent of the traffic traveling at 57 mph, the speed limit was reduced to 45 mph. The Henry County sheriff's department informed VDOT that *it was willing and able to aggressively enforce that speed limit, although the State Police had apparently informed VDOT that it would not be able to do so.*

The FY1998 six-year improvement program for this site allocates $775,000 for the intersection of Routes 220 and 902. The fund sources include primary and secondary allocations, the HES program including the required ten percent local match, and the district signal fund. Most of the allocation is to acquire necessary right-of-way. Plans include a new signalized intersection, new turn lanes, and the closing of certain existing crossovers and commercial entrances. Construction could begin in early 1998.

Installation of Traffic Signals. VDOT's traffic engineers are generally reluctant to install additional traffic signals. However, traffic signals are often in heavy demand by the public for intersections that are perceived as having safety problems. VDOT staff explain that while much of the public views traffic signals as a safety device, whose presence will automatically make an intersection less hazardous, signals are nothing more than a device to control the flow of traffic through an intersection. Furthermore, while new signals may reduce the number of severe angle accidents at an intersection, the total number of accidents will probably increase as a result of an increase in the number of rear-end collisions. As previously discussed in Chapter II, VDOT fully expects a higher accident rate at signalized intersections than at unsignalized ones.

VDOT staff regularly perform studies of locations in order to determine if installation of a traffic signal is justified. The results of the study are applied against criteria, or "warrants," contained in the Manual of Uniform Traffic Control Devices (MUTCD) published by the FHWA. The MUTCD provides guidance for all traffic engineers to use in selecting the proper traffic control device for use in particular situations. Virginia, and all other states, have adopted the MUTCD standards to provide uniformity. The "warrants" primarily relate to traffic volume and accident experience.

Compliance with any one of the 11 traffic "warrants" in the MUTCD indicate that a traffic signal can be "justified." This does not mean that a signal is required, only that installation can be justified based on certain traffic conditions. The MUTCD states that a signal should not be installed unless an engineering study indicates that such would improve the overall safety or operation of the intersection. Furthermore, according to at least one district traffic engineer, the use of less restrictive remedies should be considered prior to installation of a signal.

VDOT policy provides various conditions under which developers are responsible for the costs of installing traffic signals necessitated by their developments:

- where the proposed development will warrant sufficient traffic to generate signalization, the total cost shall be borne by the developer;

- where the development and existing highway traffic must be combined to justify signalization, the developer shall bear 50 percent of the cost.

Traffic signals are a frequent source of contention between VDOT and the public. This occurs in situations in which certain citizens want a signal but where, according to VDOT, a signal is either not justifiable or not necessary at the present time. Several examples illustrate this point:

Staff from VDOT's traffic engineering division and the Richmond district told JLARC staff that a signal installed at the intersection of Route 5 and Laburnum Avenue in Henrico County was not justified by any of VDOT's traffic engineering studies. This signal, installed about nine years ago, resulted from community outrage concerning perceived hazards at the intersection. According to VDOT staff, local demands for improvements were precipitated by a single crash. A vehicle carrying four teenagers ran through a stop sign and was hit by an oncoming truck. All of the teenagers were killed.

* * *

In the Summer of 1995, a resort in the Culpeper district requested installation of a traffic signal at an intersection near its entrance. VDOT responded that a signal would be installed but that traffic impacts on the entire primary route must first be analyzed. In the Spring of 1996, local public officials requested VDOT to provide a time frame for installation of the signal. Shortly thereafter, VDOT again indicated that a signal would be installed in conjunction with other improvements on the primary corridor. This commitment was made despite the fact that VDOT's traffic studies indicated that a signal was not warranted. In July 1996, VDOT again stated that a signal would be installed after a traffic investigation had been completed. This was done despite the fact that a June 1996 VDOT traffic study found that a signal was not warranted.

In July of 1996, VDOT raised the issue of the resort paying the full cost of the signal installation. VDOT's former Chief Engineer had made a verbal agreement with the resort that VDOT would pay 50 percent of the cost if the signal was justified, and that the resort would pay 100 percent of the cost <u>if the signal was not justified</u>. In August of 1996, a local public official told VDOT that the resort had expressed a willingness to contribute to the cost of a signal but not to pay the full amount, estimated to be $74,000. VDOT stated that the resort would have to pay the full amount.

A signal has not yet been installed at this location. An additional study was made in April 1997, during a special event at the resort *which generated higher than normal traffic counts. VDOT's plans to conduct yet another study at this location in the near future.*

Installation of Roadway Signs. Another source of contention between VDOT engineering standards and the demands of certain citizens and businesses pertains to the installation of road signs, particularly those referred to as supplemental guide signs. These types of signs are primarily intended to direct motorists to those destinations "that are of major interest to travelers from outside the immediate area that generate relatively large volumes of non-repetitive traffic." The signs are not intended to provide advertising or promotion of the facilities for which signs are installed.

VDOT has guidelines for the installation of supplemental guide signs on State highways. The guidelines identify 37 different types of facilities, not intended to be all inclusive, for which supplemental signs are permitted provided that stated criteria are met. These include historic districts, amusement/theme parks with a minimum annual attendance of 300,000, institutions of higher education with a minimum enrollment of 1,000, public television stations and wineries. The guidelines also specify 48 types of facilities for which such signs are not allowed, which apparently is intended to be all inclusive, regardless of the amount of traffic they generate. These include industrial parks, shopping centers, camps, country clubs, and subdivisions.

VDOT's traffic engineers are concerned that there are already too many signs on the State highway system. Finding suitable locations for additional signs is increasingly difficult. As a result, VDOT's traffic engineers believe Virginia's highway roadsides are too distracting for motorists. According to the State Traffic Engineer, there are so many road signs providing so much information that "people can't process it." The State Traffic Engineer told JLARC staff that a motorist traveling at 65 mph has six seconds to make a decision concerning information provided on a road sign. Furthermore, these signs add to the number of fixed objects in the right-of-way thereby reducing the available clear zone.

VDOT staff report being subject to considerable pressure to install supplemental signs in certain instances despite the fact that established criteria are not satisfied. This can lead to inconsistency across the State by VDOT staff in how the supplemental sign criteria are applied and enforced. At VDOT's semi-annual traffic engineer's meeting in May 1997, one traffic engineer — indicating that some shopping malls are starting to request signs — said that "our credibility is hurt by pressure-sensitive inconsistency." Another traffic engineer said that he thought this inconsistency was a function of VDOT's district traffic engineers reporting to the district administrator rather than to the State Traffic Engineer.

VDOT MANAGEMENT OF SAFETY PROGRAMS COULD BE IMPROVED

In correcting the roadway deficiencies at hazardous locations, VDOT needs to achieve an appropriate balance between spot improvements and corridor improvements.

Two of VDOT's major means of funding spot improvements, HES and STOSIP, have certain weaknesses which reduce their effectiveness. Addressing the issues discussed in this section concerning the HES and STOSIP programs should assist VDOT in achieving and maintaining the proper balance between spot improvement and corridor improvement strategies.

HES Program Has Improved, But Process Needs to Be More Timely

The intent of the Hazard Elimination Safety (HES) program is to provide funding for relatively low-cost improvements, at locations with abnormally-high accident rates, which are expected to produce substantial benefits in terms of accident reduction. HES projects are expected to be relatively quick to complete compared to other types of highway improvement projects.

Following a competitive statewide process, VDOT's Traffic Engineering Division selects those projects that have the highest benefit/cost ratios. Proposed projects that are determined to have benefit/cost ratios greater than one qualify for funding. Qualified projects are prioritized from high to low in terms of their benefit/cost ratio. Funds are then allocated to each project in turn until all available funds are distributed. Projects at locations with no accident history are not supposed to be considered for funding. VDOT also advises prospective program applicants that projects with estimated costs of more than $500,000 should be considered for submission through the normal pre-allocation process. Exhibit 3 describes the formula that is used to calculate the benefit/cost ratio of proposed hazard elimination projects.

Over the three most recent fiscal years, from FY 1996 to FY 1998, 364 applications for HES funding, requesting more than $76 million, were submitted to the Traffic Engineering Division. Among the total applications submitted, approximately:

- 20 percent were found qualified and received funding;
- 22 percent were qualified, but were not of high enough priority to receive funding;
- 56 percent were not qualified; and
- 1 percent were withdrawn prior to a decision being made.

VDOT district staff credit the Traffic Engineering Division in the central office with being proactive through the implementation of numerous improvements to the HES program over the past three years. Communication between the central office and the districts concerning HES has improved, and the districts have a higher level of understanding concerning the program. In addition, the traffic engineering division recently provided each district with computer software enabling the districts to perform their own cost benefit analysis on potential HES projects prior to actually submit-

Exhibit 3

Hazard Elimination Safety Improvement Program - Benefit/Cost Formula

$$BC = \frac{\Sigma((NFI \times Qdollars \times PFI) + (NPD \times AAPD \times PPD))}{(PECost + RWCost + UtilCost + ConstCost) \times CRF}$$

where:

NFI: Average number of fatal and injury accidents per year over previous three calendar years

Qdollars: Average of cost and fatal injury accidents at all similar locations, weighted by frequency of fatal and injury accidents along various roadway types

PFI: Percent reduction in fatal and injury accidents.

NPD: Average number of related property damage-only accidents per year during past three calendar years

AAPD: Annual average cost of property damage-only accidents

PPD: Percent reduction in property damage only-accidents

PECost: Estimated preliminary engineering costs

RWCost: Estimated right-of-way cost

UtilCost: Estimated utility relocation cost

ConstCost: Estimated construction cost

CRF: Capital recovery factor uses an assumed average interest rate of 10 percent over the life of the project, and average service life to convert the project's one-time initial costs to an equivalent annual cost over the life span of the project

Source: VDOT Hazard Elimination Safety Improvement Program Documentation.

ting an application for funding. This should help make the HES application process more efficient for the districts in future years.

A Few Localities Account for Most HES Applications. Eleven localities accounted for 60 percent of all HES funding applications submitted for fiscal year 1996 through 1998 (Table 8). This relatively small circle of participants may indicate that many localities do not adequately understand the program, or that they do understand

Table 8

Localities Submitting Most HES Funding Applications, FY 1996 - FY 1998

Political Subdivision	Number of Applications	Number Funded
Richmond City	39	13
Newport News	35	5
Augusta County	32	5
Halifax County	25	4
Chesterfield County	15	3
Frederick County	15	4
Loudon County	12	1
Henrico County	12	1
Prince Edward County	11	2
Charlotte County	10	1
Lynchburg	10	6

Note: Fiscal year refers to year for which funding is sought.

Source: JLARC staff analysis of VDOT HES application data.

the program but do not consider it to be worth the time and effort involved in submitting applications.

The number of applications submitted, and the funding approval rates, varied greatly among localities comprising the various VDOT districts. For example, localities in the Richmond District submitted 83 applications, of which 22 percent were approved and funded. Localities in the Fredericksburg district submitted only two applications, both of which were approved and funded.

Changes in Project Scope Increase Costs and Delay Implementation. While HES was originally intended for spot improvements to reduce accidents, the program on occasion runs the risk of evolving into a major roadway reconstruction program. This appears to be a function of VDOT's highway design review process changing and expanding the scope of HES projects beyond the spot improvement intended by the applicant. As stated by one district traffic engineer:

> If we could adjust the program to allow improvements to be made quickly and at low cost but somewhat below our ultimate standard, we could perhaps fix a lot more locations with the available funds thus preventing property loss and personal injury. For example, sometimes we look at an intersection where sight distance is the major contributing factor to the accidents and it is determined that the intersection can be improved with a small allocation of funds. How-

ever, once it gets into the system and falls under the scrutiny of the individuals in the review and approval process, it often balloons into a project that far exceeds the funding capabilities and, in most cases, never gets fixed or is delayed beyond what is reasonable. We need to realize that the HES program is more of a first-aid type program and we should not attempt to do major surgery under this program.

Examples from the Lynchburg district illustrate how the tendency to expand relatively small projects can have an adverse effect on completion of safety improvements:

Two of the five most hazardous roadway sites identified by the Lynchburg district were at locations where, according to district staff, HES applications had previously been submitted and approved. However, during internal review by VDOT prior to the design, the scope of both projects was expanded substantially, and the estimated cost increased to the point that the projects were never actually implemented. One of the locations, in Pittsylvania County near the intersection of Routes 58 and 62 was previously submitted as a $35,000 HES application. The project was approved but, subsequently, the scope of the project was expanded and the estimated cost increased to $800,000. The original $35,000 project was not implemented. This location remains on the critical rate list. District staff report that another HES application will be submitted in 1997.

The State Traffic Engineer and staff in the traffic engineering division acknowledge the problem that "scope creep" poses for the HES program, and said that some projects wind up getting "priced out of the market." In fact, cost overruns on previously-approved safety projects have served to decrease the amount of new projects that can be funded through this program. Over the past several years, HES project costs have increased by as much as 300 percent from the original estimates. Beginning in FY 1996, VDOT began the practice of increasing the budgets of approved projects by 10 percent in order to adjust for relatively minor cost overruns. Despite this, VDOT traffic engineering division staff indicate that the costs of as many as 70 percent of safety projects currently underway exceed their initial estimates.

The relatively small number of new projects that can be undertaken with annual HES allocations is a problem. If an HES application is not approved for funding, the chance of that project being implemented with another funding source is remote. JLARC staff reviewed 56 HES applications submitted during 1995 and 1996 which were either found not qualified or else did not receive funding. Forty-one of these projects were never initiated by VDOT.

HES Projects Can Take Too Long to Implement. It typically takes at least two years from the submission of an HES funding application to the start of construction. While there is no time limit criterion for implementation of HES projects, this timeframe appears contrary to the program's intent. Some district staff interviewed by JLARC staff also believe that the HES process simply takes too long at the present time to adequately satisfy its stated objective to quickly implement low-cost, high-benefit roadway improvements designed to reduce accidents. One district reported that:

> The length of time from program approval to actual construction is too long. Safety projects should be treated as such and should be given a higher priority than normal construction projects. We suggest that this time could be shortened if preliminary engineering funds were made available as soon as a location was approved for inclusion in the program. Plans could be prepared for right-of-way purchase or construction where no right-of-way was required, as soon as construction funds were available.

The time frame for the HES program is heavily influenced by the fact that 90 percent of the funding is provided by the federal government. The way the program is currently administered by VDOT, construction can not begin until after the FHWA has approved the list of projects selected by the traffic engineering division, and until after the start of the next federal fiscal year. For HES project applications submitted in 1997, for funding in State fiscal year 1999, the following time frame currently applies:

- spring/summer 1997 -- identify problem locations, prepare and submit application;
- summer/fall 1997 -- traffic engineering division evaluates applications;
- fall 1997 -- traffic engineering division releases list of selected projects and submits list to FHWA for its approval;
- June 1998 -- Commonwealth Transportation Board includes improved projects in FY 1999 Six-Year Improvement Plan;
- October 1, 1998 -- 90 percent federal funding authorized for the approved projects;
- spring 1999 (typically) -- project construction begins.

VDOT could accelerate the typical start of construction for HES projects by about one year, and perhaps allow less time for "scope creep" to set in, by using the federal HES funds as reimbursement for appropriated State funds. According to the State Traffic Engineer, approval by the FHWA of the list of projects selected by the traffic engineering division is purely a formality. FHWA defers to VDOT's judgment, and does not disapprove projects. Therefore, it would appear prudent to assume that the full amount of federal money for all projects selected by VDOT staff will be provided in due course. These funds can be used to reimburse the State for funds that VDOT would make available to localities at the time that the traffic engineering releases its list of selected HES projects.

It is conceivable that this type of reimbursement approach would require only a one-time appropriation of State funds. For example, funds advanced by the State in the Fall of any given year would be reimbursed by the Federal government in October of the following year. Those federal funds, in turn, could be used upon receipt to fund initial activities for new projects selected by the VDOT traffic engineering division. VDOT should examine the feasibility of this approach with the FHWA.

Recommendation (4). **The Commonwealth Transportation Board and the Virginia Department of Transportation should work with the U.S. Federal Highway Administration to develop a plan to use available federal funds to reimburse appropriated State funds for the Hazard Elimination Safety Improvement Program, in order to expedite the design and construction of approved safety projects. The Virginia Department of Transportation should submit the plan for approval by the 1999 General Assembly.**

HES Program Is Not Always Purely Competitive

The HES program is funded through a mandatory ten percent set-aside of the federal Surface Transportation Program (STP) allocation to Virginia. Item 496.3 of the Appropriation Act states that ten percent of the STP allocation "shall be set aside for a statewide safety program, with grants made on a competitive basis." As administered by the traffic engineering division, and publicized to localities, the competitive basis officially includes:

- statewide competition open to counties, cities, and towns;
- reliance on accident histories over the past three calendar years;
- use of a cost-benefit methodology in selecting projects for funding; and
- requirement that each project be submitted on a separate application.

During the course of this review, JLARC staff identified instances in the past few years in which the HES application evaluation process, due to a number of factors, was not purely competitive. These factors include:

- economic development considerations;
- highly publicized fatal accidents in certain localities; and
- lack of automated traffic count data for cities.

Economic Development Considerations. JLARC staff identified one highway improvement project which received HES funding due to economic development considerations. This was despite the fact that the location did not have an accident history which would have produced a sufficiently-high cost benefit ratio to warrant project funding on a competitive statewide basis. In response to economic development interests, this project was provided with opportunities to receive funding that were not made available to other HES applicants. Operating outside of its normal procedures, VDOT justified the use of HES funds for this project based on its potential for reducing future accidents.

A manufacturing plant with access off of a two-lane primary highway was planning to expand the size of its facility. The owner of the plant wanted some roadway improvements at the plant entrance, including left and right turn lanes, to accompany the expansion. The entrance to the plant is unusual in that railroad tracks run parallel to the primary route within a few feet of the road. Passing trains block the entrance and exit of trucks, which must remain in the travel lane thereby blocking through traffic. Another complicating factor is a narrow bridge 25 feet from the plant entrance.

In 1992, VDOT analyzed the company's request for improvements and concurred that turn lanes would be beneficial, but determined that the widening of the nearby bridge would be required to make the turn lane installation feasible. At the time, no VDOT funds were available for these improvements.

By 1995, the plant's expansion plans had progressed. The State was assisting in the effort by trying to assemble a package of financial assistance. The roadway improvements had become more of a priority within VDOT, and funding sources had been identified including the use of revenue sharing funds. However, in June 1995, VDOT determined that the amount of revenue sharing funds available for this project would be less than originally estimated. The amount of available funding was at least $100,000 less than the total project cost as estimated by VDOT in November 1994. Shortly thereafter, VDOT management directed staff in the traffic engineering division to somehow justify the use of HES funds for this project.

On August 30, 1995, VDOT staff visited the site, observed traffic patterns and vehicle turning movements, and obtained traffic count data. A relatively high number of traffic conflicts or "close calls" were observed. The nearby narrow bridge was identified as a major hazard. Two days later, on September 1, the decision was made to allocate $200,000 in HES funds to support construction of a continuous third turning lane and replacement of the bridge. The total allocation for the project was $1.2 million. Although HES funds were used, the required application for HES funds was never made for this project.

The file maintained by VDOT's traffic engineering division for this project contained staff workpapers, but did not contain any documentation summarizing the rationale for the decision to fund this project using the HES program. Only after JLARC staff asked about the project did VDOT staff indicate that such a summary should have been, and would be, prepared.

The use of a more proactive basis for the allocation of HES funds, such as a methodology that seeks to reduce the potential of future accidents at particular locations as in the example above, is an entirely reasonable concept. As stated by one district traffic engineer in response to the JLARC survey:

> We need to change our procedure to allow more weight to be given to potential high accident locations rather than just using accident rates alone. Certainly we need to include every intersection with a high accident rate but those with a high potential need to be given equal consideration. Factors that often cause an intersection to be less than desirable and/or safe include limited sight distance, poor alignment, and other geometric factors. When these conditions occur, eventually these locations will show up on the critical rate list and perhaps this could be avoided by fixing the problem early on.

However, if VDOT intends to use this type of approach for allocating HES funds, then it should be done using a consistent, well-documented approach on a statewide basis. Otherwise, the integrity of the statewide competitive process will be harmed and VDOT's compliance with the provisions of the Appropriation Act will be called into question.

Effect of Highly-Publicized Fatal Accidents on HES Decisions. The cost benefit methodology is the focal point of the HES application evaluation process. However, this highly structured process is not always applied in exactly the same manner in all cases. In some cases, certain projects at certain locations receive special treatment and consideration that are not provided to other HES funding applicants. For example, the cost benefit analysis may be redone in order to incorporate more recent accident history that is favorable to the application.

> *Route 8 in Patrick County was the site of a triple-fatality accident in February 1995. A vehicle carrying three men plunged 120 feet off a cliff. The driver of the vehicle had been drinking, and the incident was described as alcohol-related. This accident led to requests by family members of the victims and other local citizens for installation of a guardrail along the section of road. An HES application was submitted in June 1995 requesting $49,000 for FY 1997. At the time, VDOT staff were aware that the cost estimate was low due to a problem with a lack of a sufficient shoulder on which to install the guardrail according to current VDOT standards.*
>
> *The cost benefit analysis of the HES application was done on July 14. The analysis was based on accident data for the period January 1, 1992 through December 31, 1994, in accordance with VDOT policy for the HES program. Therefore, the triple fatality in February 1995 was excluded. The benefit cost ratio was calculated to be zero. In October 1995, following a trip to Patrick County by the Governor and a letter to the Commissioner by a local public official, VDOT management expressed to traffic engineering staff its desire to include the guardrail project in the FY 1997 HES program by including the February 1995 triple fatality in the cost benefit analysis. Furthermore, manage-*

ment stated that $49,000 was all the funding that would be provided: "If the project increases in scope, we will tell them that they will have to seek the difference from Primary funds."

This project was approved for FY 1997 HES funding. The project file maintained by the traffic engineering division contains the results of a subsequent cost benefit analysis, done on November 15, 1996. This analysis calculated a cost benefit ratio of 2.5, based on accidents occurring from January 1, 1993 to December 31, 1995. According to traffic engineering staff, the project cost $100,000 in order to stabilize the shoulders prior to installing the guardrail. This project appears in the HES application database maintained by the traffic engineering division as "unqualified."

* * *

The intersection of Route 17 and Route 2 in Spotsylvania County was the scene of a double-fatality crash in March 1994. A husband and wife ran a stop sign and were killed when their vehicle was struck by another. The State Police report attributed the fatal accident to reckless driving. At the time of the accident, the intersection was unusual in that it was much wider than the approaching roadways. This was a result of a decision by VDOT 20 to 30 years ago to widen an intersection prior to an anticipated widening of the roadways. However, the roadway widening never occurred. The resulting difference in the width of the intersection was a potential source of confusion to motorists. Nevertheless, no particular safety problems were noted by VDOT until the fatal accident. Sight distance was not a problem at this intersection. Following the fatality, a relative of one of the victims began pressuring VDOT for improvements at the intersection. VDOT made several quick improvements, including reducing the speed limit to 45 mph.

In the summer of 1994, VDOT prepared a cost benefit analysis for the use of HES funds to improve the intersection to better delineate proper vehicle movements. The traffic engineering division's project file contains two different cost benefit analysis worksheets. Both utilized 3.5 years of historical accident data, rather than the standard three years, thereby including the double fatality from March 1994. However, one cost benefit worksheet calculated a benefit cost ratio of 2.5, while the other calculated a benefit cost ratio of 1.5. HES funding in the amount of $230,000 was allocated for this project.

Following these improvements, a traffic signal was installed despite the fact that VDOT's study indicated that none of the signal warrants were actually satisfied. VDOT staff did state that their recommendation for a signal was on firm ground since "three of the four conditions listed under warrant #6 are met and the angle accident frequency is *so critically high for an intersection with relatively low volumes of approach traffic."*

Lack of Automated Traffic Count Data for Cities. Since the passage of ISTEA in 1991, cities have been able to apply for HES funds on a competitive basis with counties. However, VDOT does not have automated traffic count data for cities. Consequently, VDOT is not able to calculate critical accident rates for cities. In applying for HES funds, cities compute accident rates and prioritize high accident rate locations using their own methodologies. This could place VDOT's traffic engineering division staff at a disadvantage in their evaluation and verification of HES applications submitted by cities. This could also potentially create some inequity within the statewide competitive process of prioritizing the cost benefit ratios of all submitted HES applications. As previously discussed, Virginia's cities are among the largest and most successful sources of HES applications.

VDOT is in the process of implementing a new traffic count program for urban streets, under which traffic on every urban street will be counted every six years. According to VDOT traffic engineering staff, they currently have manual traffic count data for most roads in cities and towns. However, since it is not automated in HTRIS, it can not be used to calculate critical accident rates.

Recommendation (5). **The Virginia Department of Transportation should develop plans for the automation of currently available traffic count data for streets in Virginia's cities and towns. The department should use that automated data, in conjunction with other automated traffic count data obtained through its new urban traffic count program, to calculate critical accident rates for Virginia's cities and towns in order to better evaluate applications for hazard elimination safety program funding.**

STOSIP Program Requires Improved Management and Oversight

The State Traffic Operations and Safety Improvement Program (STOSIP) has been part of VDOT's overall highway improvement program since 1987. In FY 1997, the total allocation for the program was $1.4 million. The program is intended to quickly implement improvements in response to unanticipated operational or safety problems which may suddenly develop at some roadway sites. Typical types of improvements can include adding turn lanes, and lengthening acceleration and deceleration lanes. District administrators have considerable discretion in when and how these funds are used. Unlike HES funds, STOSIP funds do not require a history of accidents at a site to justify their use. VDOT staff cite STOSIP's administrative flexibility as one of it main attributes.

There are two primary issues concerning STOSIP that require attention and review by VDOT. The first relates to the basis and justification of each district's STOSIP allocation. The second relates to VDOT policies and procedures governing expenditure of STOSIP funds.

STOSIP Allocations to Each District. Each district's STOSIP allocation is a line item in its larger primary system allocation. Consequently, STOSIP funds can not be spent on the secondary highway system. The amount of STOSIP allocations to each district varies, ranging from $200,000 in the Richmond and Salem districts to $100,000 in the Fredericksburg district. FY 1998 STOSIP allocations for the other six districts are as follows:

- Staunton -- $175,000;
- Bristol -- $170,000;
- Suffolk -- $160,000;
- Culpeper -- $150,000;
- Lynchburg -- $150,000; and
- Northern Virginia -- $100,000.

The relative percentage of total STOSIP funds allocated to each district has remained relatively constant since FY 1994. The districts that receive the most in FY 1998 — Richmond and Salem — and the districts that receive the least — Fredericksburg and Northern Virginia — also received the most and least respectively in FY 1994. The two biggest changes were significant increases that Culpeper received in FY 1995, and that Lynchburg received in FY 1996. Otherwise, STOSIP allocations to districts have remained essentially the same since FY 1995. Each district's allocation had been doubled for FY 1995.

The rationale for the varying allocations among districts is not clear. During interviews with JLARC staff, most VDOT district staff expressed little knowledge of how the STOSIP allocation decision is made, and many were surprised to learn that their district received less than another, or that not all districts received the same amount. In 1993, VDOT management considered an allocation model based on the percentage of State primary system vehicle miles traveled within the district. Under that model, the Northern Virginia district would have received the largest percentage of STOSIP funds while Staunton would have received the least. That model was not implemented.

STOSIP Project Authorizations and Expenditures. STOSIP funds are meant to expedite low-cost projects that can be constructed by VDOT employees rather than private contractors. According to VDOT, this reduces the amount of paperwork and, in turn, speeds up the process to construct a project. VDOT believes that it is imperative that STOSIP projects be authorized and constructed within the same fiscal year that funds are allocated. For that reason, VDOT policy does not permit STOSIP funds to be carried over by a district from one fiscal year to the next.

In the spring of 1997, staff in VDOT's Programming and Scheduling Division detected some discrepancies in STOSIP financial data which led them to believe that the agency policy prohibiting the carry-over of STOSIP funds was not being followed in all cases. According to VDOT staff, there was some concern that a few districts might not be using all of their STOSIP allocation, and were instead holding money in reserve to spend on projects larger in scope than originally intended for the program. This led the central office to officially re-notify each district of the VDOT policy prohibiting the carry-over of funds. Any unexpended balance greater than $2,500 of a STOSIP project is required to revert to the district's general fund for redistribution during the update of the Six-Year Improvement Program to fund primary road needs.

Analysis of VDOT's data concerning allocation, authorization, and expenditure of STOSIP funds indicates substantial difficulties within VDOT in actually implementing projects using this fund source. JLARC staff examined financial data covering the period FY 1994 through FY 1997. In most cases, there were substantial differences between the amount allocated to the district and the amount expended during the fiscal year. There were also substantial differences in the amount of STOSIP project expenditures authorized by the district administrator and the amount actually spent during the fiscal year. In three cases, the Culpeper district in FY 1994, the Fredericksburg district in FY 1995, and the Suffolk district in FY 1997, VDOT data shows that the districts did not spend any STOSIP funds during the fiscal year. In another case, Northern Virginia in FY 1997, the district apparently did not authorize any new STOSIP expenditures during the fiscal year. Figure 6 summarizes the percent of allocations obligated and expended by each district over the past several years. VDOT policy documentation concerning STOSIP states, "It is intended that preliminary engineering and right-of-way costs be held to a minimum…." However, at least one VDOT district administrator believes that there is a total ban on the use of STOSIP to acquire right-of-way.

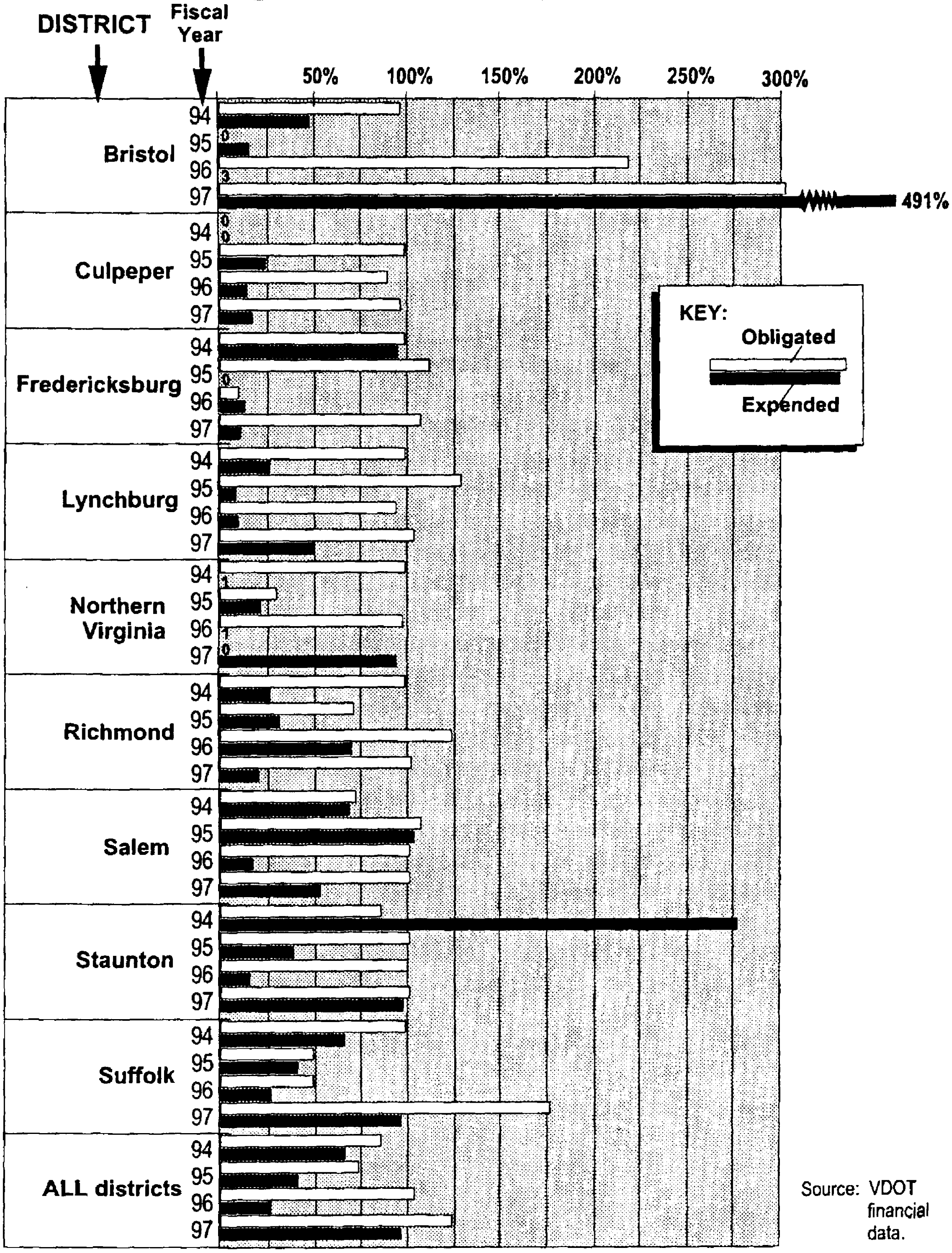
The Suffolk District planned to use STOSIP funds to install a left turn lane at the entrance to a vocational-technical school located just outside Suffolk. Part of the project plan involved a donation of right-of-way by the school. According to the district administrator, the school had originally agreed to the donation, but never actually donated the land. The planned use of STOSIP funds was put on hold throughout FY 1997 pending resolution of the right-of-way issue. As a result, the district did not spend any of its STOSIP allocation during FY 1997. The district administrator told JLARC staff that it is his understanding that STOSIP cannot be used to purchase right of way. In the case of the vocational-technical school, however, the district administrator did not believe that the right-of-way would have been costly.

JLARC staff also identified cases of districts spending well in excess of their STOSIP allocations. During FY 1997, one district had STOSIP expenditures 491 percent greater than its STOSIP allocation.

The Bristol District, which had a $170,000 STOSIP allocation for FY 1997, installed a raised median barrier along a section of Route 460 in Tazewell County. The roadway section passed through a large rock cut. Due to the large shadow created by the rock cut, the roadway tended to ice over quickly in the winter, which contributed to motorists losing control of their vehicles, running across the median and into oncoming traffic. A portion of the roadway section was located on a

Figure 6

Percent of STOSIP Allocations Obligated and Expended per Fiscal Year, by District



Source: VDOT financial data.

> *bridge, which complicated the process of installing the barrier. Since the bridge was located on a curve, the median barrier had to be extended off both ends of the bridge. Both of these factors made the project much more expensive than originally estimated.*
>
> *In June 1996, the district administrator obtained written authorization from VDOT's Chief Engineer to proceed with the project using STOSIP funds despite the fact that the cost would be more than originally estimated. In authorizing the project, the chief engineer envisioned a minor increase in project cost, from $40,000 to $60,000. However, project costs apparently increased much more than that. According to VDOT's data, the Bristol district's STOSIP authorizations for FY 1997 were $514,000 and its expenditures were $835,000.*

Recommendation (6). **The Virginia Department of Transportation should develop an updated policy statement governing the State Traffic Operations and Safety Improvement Program. The policy statement should (a) state a clear rationale for the amount of the annual allocation to be received by each district, (b) state to what extent allocations can be used to purchase right-of-way, and (c) provide clear guidance on situations in which allocations may be carried over or exceeded. The Virginia Department of Transportation should also determine whether the current STOSIP allocation levels remain appropriate, and consider the benefits and costs of making STOSIP funds available to the secondary highway system.**

Recommendation (7). **The Virginia Department of Transportation should more aggressively and proactively monitor the State Traffic Operations and Safety Improvement Program in order to ensure that allocated funds are expended during the fiscal year for which they are allocated, and that project authorizations and expenditures are in made in accordance with allocation policy.**

Risk Management Project Aims to Improve Decisionmaking Process

While VDOT states that every highway improvement project enhances safety in some way, there are those who believe that the risk of crashes and crash risk mitigation is not given enough consideration compared to capacity increases in VDOT's improvement decisionmaking process. In a collarborative effort with the Virginia Transportation Research Council (VTRC) and the University of Virginia, VDOT is in the process of developing a computer model which could serve as a means of effectively comparing the tradeoffs among crash risk reduction, performance gain, and the costs of proposed highway improvement projects. The project's feasibility study states that:

> Presumably, when decisionmakers judge a highway element to be safe, they are weighing the crash risk against other system characteristics and concluding that, all things considered, the risk is acceptable.

According to the VTRC study team, the goal of highway safety can be better served through quantitatively including the assessment and consideration of crash risks, along with capacity increases, travel time reductions, costs, and other factors. The objective of this effort is to provide decisionmakers with a tool that aids in, but does not dictate, project selection.

ALTERNATIVE HIGHWAY IMPROVEMENT METHODS WOULD BE BENEFICIAL

It is extremely unlikely that there will ever be sufficient public funds available to make all of the physical highway improvements that VDOT and others would like to implement in order to improve safety. Even if funding limitations did not exist, other factors such as environmental protection, historical preservation, business access, driver behavior, and the ability of VDOT to actually implement safety improvement projects in a timely fashion would serve to limit the potential scope and reach of such improvements. VDOT recognizes this and has taken steps to develop some new approaches in order to complement highway construction and further improve safety on the State highway system. This section discusses four such new approaches recently taken or currently under review. These include Smart Travel Virginia, the Safety Management System, the Corridor Safety Improvement Program, and Access Management.

Smart Travel Virginia Focuses on Intelligent Transportation Systems

Smart Travel Virginia evolved from VDOT's 1993 strategic plan for the development of Intelligent Transportation Systems (ITS). ITS refers to a wide array of technological innovations intended to ease congestion, improve safety, and increase the reliability of highways without constructing additional travel lanes. According to VDOT, the essence of the Smart Travel Program (Smart Travel) is to "unify the transportation technology efforts" of all the State's transportation-related agencies, and even local governments, under one umbrella concept. An emphasis on safety, through a reduction in the number and severity of crashes, is one of the six guiding principles of Smart Travel.

VDOT's "vision" for the development of ITS is based on four key areas: system management, personal travel, commercial vehicle operations, and vehicle control and safety. The system management goals include operating the transportation system efficiently and effectively. One envisioned method of accomplishing this is to minimize delays due to traffic signals by improving existing signal timing plans, and by incorporating adaptive traffic signal systems. Another goal of system management is to enhance public safety by enhancing enforcement of safety regulations and reducing accidents. The vehicle control and safety goals of Smart Travel include facilitating the development of automated vehicles and highways through the development of the Virginia Smart Road. As part of vehicle control and safety, VDOT envisions that collision avoidance systems will be installed in vehicles in order to reduce the number of crashes, injuries, and fatalities on Virginia's transportation system.

One of the limitations of the Smart Travel program, at least in its current form, is that little of its focus is on the State's secondary highway system. As previously discussed in this report, the secondary system has by far the worst safety record of the State's highway system components. Even if Smart Travel accomplishes all of its goals and objectives, most of the 56,000 mile State highway system will not directly benefit.

Safety Management System Is Based on Cooperative Inter-Agency Efforts

The 1991 federal ISTEA legislation required each State to develop, establish, and implement systems for managing highway safety, commonly referred to as a Safety Management System (SMS). The FHWA defines a SMS as a systematic process that has the goal of reducing the number and severity of traffic crashes by:

> Ensuring that all opportunities to improve highway safety are identified, considered, and implemented as appropriate, and evaluated in all phases of highway planning, design, construction, maintenance, and operation, and by providing information for selecting and implementing effective highway safety strategies and projects.

In 1993, Virginia began to formalize the interagency relationships and organizational structure of its SMS. This effort culminated in October 1994 with the publication, by the Virginia Transportation Research Council, of a strategic plan for Virginia's SMS. Representatives from five State agencies serve on a steering committee to oversee the operation of the SMS, including VDOT, DMV, the State Police, the Office of Emergency Medical Services of the Virginia Department of Health, and the Commission on the Virginia Alcohol Safety Action program (VASAP). The designated lead official for Virginia's SMS is VDOT's Assistant Commissioner for Operations. There are also SMS agency liaisons from the Department of Education, Department of Criminal Justice Services, FHWA, and the National Highway Traffic Safety Administration (NHTSA). Staff from the VTRC are also invited to attend SMS meetings.

The federal National Highway Designation Act of 1995 removed the SMS mandate from federal law. However, Virginia decided to voluntarily continue its SMS efforts. The intent of Virginia's SMS is to address safety factors which relate to the roadway, the vehicle, and the motorist. At the request of the SMS steering committee, the VTRC prepared a series of options for improving the operations of the SMS. This report, which presented a number of recommendations, was released in February 1996.

SMS Strategic Plan. Staff from the VTRC identified five issues that the SMS would need to fully address in order to operate in an effective manner. These were:

- Coordinate and integrate Virginia's safety efforts more fully;

- Provide guidelines for the replacement and upgrade of safety hardware, highway elements, and operational features;

- Increase data sharing and integration of data systems that support transportation safety;

- Provide for more rigorous evaluation of transportation safety efforts; and

- Target injury reduction.

Options for Enhancing the Effectiveness of the SMS. The report prepared by the VTRC recommended that the steering committee consider several options. These included:

- Establish an SMS Coordinator position to facilitate the daily operation of the SMS;

- Formalize a strategic planning process for the SMS;

- Use the SMS to vitalize local traffic safety commissions to identify solutions and propose solutions to those problems;

- Encourage the use of a holistic, multidisciplinary corridor approach to community traffic safety problems;

- Provide for more integral involvement of the public health community in the SMS;

- Determine whether electronic communication alternatives available through the Internet would further Virginia's transportation safety goals; and

- Provide for the implementation of improved traffic records, including data linkage, electronic data transfer, and geographic information systems.

In an interview with JLARC staff, VDOT's Assistant Commissioner for Operations stated that the SMS has not yet been completed, and that the steering committee is continuing to consider many issues. The Assistant Commissioner for Operations also mentioned the possibility that, in the future, HES funds could be used in Virginia to support alternative methods of highway improvements.

Corridor Safety Improvement Program Utilizes Multi-Disciplinary Approach

In 1990, the FHWA began emphasizing the use of corridor safety improvement programs (CSIPs) as a prudent use of limited highway safety improvement funds.

CSIPs take an approach to highway safety that emphasizes multi-disciplinary cooperation as a means of identifying and targeting traffic safety problems and implementing appropriate countermeasures. In 1991, FHWA published guidelines for CSIP implementation by the states.

VDOT's experience with the use of CSIPs as part of its overall highway safety improvement efforts has been limited to a single pilot project that focused on two corridors. The results of the pilot project were decidedly mixed. Staff from the VTRC evaluated VDOT's use of CSIP, and made several recommendations for more effective use of this strategy in the future.

VDOT's Use of CSIP. VDOT decided to establish a CSIP as a pilot project in early 1992. A major program objective was to reduce crash-severity on a corridor-wide basis by simultaneously focusing on the roadway, vehicle, and motorist. The problem-solving approach was intended to encompass a variety of disciplines, including traffic engineering, public information, law enforcement, education, licensing, and emergency medical services. A key component of the CSIP structure was the use of local task forces. The task forces were fairly large and consisted of representatives from DMV, VDOT, VASAP, the Alcoholic Beverage Control Commission, local fire and EMS units, State and local police, and numerous local officials.

The traffic engineering division served as the focal point to implement and coordinate the project. VDOT made an arbitrary decision to select an urban corridor in the Richmond District, and a rural corridor in the Salem District. The specific roadway section along each corridor was selected based on 1990 VDOT crash summary data. The two corridors ultimately selected were a five-mile section of Route 144 in Chesterfield County, and a 17-mile section of Route 24 in Bedford County. Route 144 is a two-lane road. Route 24 is partly two-lane, and partly four-lane divided. The CSIP approach proved to be much more successful in Bedford County than in Chesterfield County.

Results of the CSIP Pilot Project in Bedford County. The local task force developed a set of short and long-term improvements for the Route 24 corridor. Short-term improvements included elimination of passing zones; speed limit reductions; installation of rumble strips and warning signs; and establishment of a juvenile driver improvement program by VASAP, the State Police and Bedford County. Longer-term improvement plans were also developed. The FY 1998 six-year highway improvement program allocates $430,000 for the construction of a left turn and pavement widening near Route 755, and an additional $190,000 for slight pavement widening from Route 755 to Route 122.

Results of the CSIP Pilot Project in Chesterfield County. Seven task force meetings were held between February 1994 and March 1995. Initially, attendance was fairly high in that 14 of 21 members were present. However, attendance soon became very poor, to the point where only 5 of the members attended the meetings. Shortly after the seventh meeting, the project was canceled by the State Traffic

Engineer because of a lack of interest by the task force. Subsequently, VDOT did widen the pavement slightly along the corridor.

Evaluation of the CSIP Process by VTRC Staff. The disappointing result of the CSIP pilot project in Chesterfield County was attributed to VDOT's initial decision to place more responsibility for identifying problems and developing countermeasures on local multidisciplinary task forces than recommended by the FHWA guidelines. The VTRC identified three specific guidelines that were not followed:

- Determine what existing agencies are doing, what resources are required, and what resources are available to implement the CSIP;

- Develop a completed action plan which includes a list of problems on the corridor and possible safety initiatives; and

- Establish a multi-disciplinary safety team of 10 to 15 members to gain further insight into the problems and solutions to be implemented, revise the action plan with the team's support, and present a final draft action plan at the second team meeting.

The 1997 VTRC report, *Lessons Learned From Virginia's Pilot Corridor Safety Improvement Program*, discussed the consequences of VDOT's decision not to follow all of the FHWA guidelines:

- No information was gathered from any agency other than DMV or VDOT before the initial meetings of the task forces. Requests for agency-specific data, staff support, and funding were made only after the initial meetings. Other than the $500,000 secured for highway improvements on each corridor, $10,000 in Section 402 funds for nonhighway improvements on each corridor was the only source of funds identified.

- Although the crash data were reviewed and cross tabulated to reveal the types and locations of crashes on the corridors, the identification of problems and specific countermeasures were left to the task forces.

- The teams were formed, but they had more than the 10 to 15 members suggested by the guidelines. Rather than reacting to a specific plan and making modifications, the task forces were charged with analyzing the data, proposing solutions, and determining the top priorities. This resulted in a lengthy process. Further, because specific potential solutions had not been fully investigated before the initial meeting of the task force, the prioritization of potential countermeasures was delayed until VDOT could develop reliable cost estimates.

The VTRC report recommended that VDOT not continue the CSIP process unless FHWA guidelines and the recommendations listed below, are followed to establish a new pilot project:

- Select corridor candidates as quickly as possible;

- Base the selection of corridor candidates on both crash data and existing public interest in improving a corridor;

- Limit task force membership to 10 to 15 representatives;

- At the first meeting of the task force, give members a detailed list of problems on the corridor and the possible countermeasures and their costs;

- Make developing cost estimates a high priority; and

- Secure a significant amount of money to fund nonhighway countermeasures.

Access Management Strategies Are Being Studied by VDOT

As previously discussed in Chapter II, property owners in Virginia are permitted access to abutting streets or highways. However, as noted by AASHTO, the location, number and geometrics of access points may be governed by regulations. As envisioned by staff in VDOT's traffic engineering division, access management refers to regulation of the spacing and design of commercial entrances, residential driveways, median crossovers, traffic signals, and interchanges. Recognizing the need to balance the interests of through traffic with local access, the goals of access management include:

- limiting and separating the number of traffic conflict points,
- reducing interference with through traffic due to turning movements,
- providing sufficient spacing between at-grade intersections,
- maintaining vehicle speeds along arterial highways, and
- providing adequate on-site vehicle storage areas.

VDOT anticipates that several types of benefits would result from access management strategies, including: improved safety through decreased accident rates, reduced congestion through more efficient use of the existing roadway network, and reduced travel times through increased mobility. The effects of failing to address access management issues, according to VDOT, include:

- detrimental impact on economic development due to traffic congestion;

- compromising of public safety;

- construction of bypass routes which usually become as congested as the roads they were built to relieve; and

- damage to established residential neighborhoods adjacent to overburdened arterial routes.

To the extent that public safety is compromised, the failure to properly manage access also raises issues of potential liability in situations where known hazardous locations remain uncorrected despite the fact that VDOT has budgeted funds for their improvement.

> *In 1993 and 1996 the Fredericksburg district submitted applications, and received VDOT approval, for HES funding to install raised median barriers along different sections of Route 1 in Spotsylvania County. Both projects were included in VDOT's six-year improvement program. However, on both occasions, the Fredericksburg Metropolitan Planning Organization (MPO), established by ISTEA, declined to include the project in its Transportation Improvement Plan. The MPO's actions were apparently prompted by concerns of local businesses that the median projects would restrict access to their establishments. The 1993 project was later partially implemented as part of a commercial entrance permit at an adjacent development. The status of the 1996 project remains unclear as VDOT remains in negotiations with affected business owners.*

VDOT is still in the preliminary stages of its study of access management techniques and how they could potentially be applied to the State highway system. However, VDOT traffic engineering staff do have an initial sense of how the issue should be approached. The first step would be to upgrade and modify existing standards governing access for commercial entrances and residential subdivisions. Next, standards for the spacing of traffic signals, median crossovers, and interchanges would be developed. The ultimate goal is development and adoption, through a cooperative process involving VDOT staff and political subdivisions, of spacing and design regulations. Access management could potentially be implemented by VDOT through modifications to its existing construction and permitting activities.

VDOT Should Continue to Develop Alternative Improvement Methods

As previously discussed, VDOT staff have frequently mentioned the aggressive, reckless, inattentive driver phenomenon as being a constant factor affecting VDOT operations. This study has documented numerous improvement projects undertaken or expedited in the immediate aftermath of highly publicized fatal accidents where driver error, inattention, or violations were clear contributing factors. One district traffic engineer described this situation, and its consequences, at length:

> With the migration of the population into outlying areas, commuter traffic has increased significantly over the past 10 to 15 years. These drivers have evolved through a fast-paced society which emphasizes time savings rather than human safety. Motorists are now observed performing many activities as they drive to/from work in order to save time in their daily routines (shaving, dressing, reading the newspaper, reading books, using cellular telephones and laptop comput-

> ers, etc.) all of which detract their attention from their primary responsibility of driving the car safely.
>
> In their impatience, the further trait of aggression has developed where motorists are taking frustrations out by driving offensively often resorting to physical retaliation to settle minor traffic infractions.
>
> Modern cars are now high performance machines which out perform their predecessors and give the sense of power to the driver which in itself has created aggression, even towards the dwindling manpower of law enforcement agencies.
>
> All of these conjunctively have created incidents on the highways which have been unprecedented in recent years. There needs to be a re-emphasis on the Defensive Driver concept and on driver responsibility where motorists realize that driving is not a constitutional right but a privilege which can be revoked.

Improving the attention, behavior, and legal compliance of Virginia's motorists poses a significant challenge for the public sector. However, given the consequences that poor driving behavior pose for Virginia's highway improvement program, VDOT will be a clear beneficiary of any improvements in this area.

Recommendation (8). **The Virginia Department of Transportation should work cooperatively with other State and local agencies in order to identify effective methods and strategies that are available to enhance safety on the State highway system with a focus on improving the compliance of motorists with Virginia's highway safety laws and regulations.**

Appendixes

Appendix A
Study Mandate

House Joint Resolution No. 579
1997 Session

Directing the Joint Legislative Audit and Review Commission to study the procedures for identifying and funding the improvement of hazardous roadway sites.

WHEREAS, the highways of the Commonwealth are intended to provide safe and efficient motor vehicle transit for the citizens of this state; and

WHEREAS, the majority of the highways in the Commonwealth are well designed, constructed and maintained; and

WHEREAS, certain highways in the Commonwealth are hazardous to motorists due to poor design, deterioration, lack of maintenance, or difficult terrain; and

WHEREAS, such hazardous roadway sites include, for example, excessively sharp curves, improperly marked or controlled intersections, improper signage, unsafe bridges, absence of traffic signals, and other similar roadway hazards; and

WHEREAS, hazardous roadway sites lead to a disproportionate number of motor vehicle accidents resulting in injury and death to motor vehicle drivers and passengers; and

WHEREAS, hazardous roadway sites located near the intersection of Virginia Secondary Route 605 and U.S. Route 220 in Franklin County and near the intersection of Virginia Secondary Route 902 and U.S. Route 220 near Ridgeway have contributed to several motor vehicle accidents resulting in death or injury; and

WHEREAS, a system for the identification, correction, and funding of hazardous roadway sites throughout the Commonwealth needs to be established to prevent needless deaths and injuries due to motor vehicle accidents at such sites; now, therefore, be it

RESOLVED by the House of Delegates, the Senate concurring, That the Joint Legislative Audit and Review Commission be directed to study the procedures for identifying and funding the improvement of hazardous roadway sites.

All agencies of the Commonwealth shall provide assistance for this study, upon request.

The Joint Legislative Audit and Review Commission shall complete its work in time to submit its findings and recommendations to the Governor and the 1998 Session of the General Assembly as provided in the procedures of the Division of Legislative Automated Systems for the processing of legislative documents.

Appendix B

1994 Motor Vehicle Crash Data by Locality

Interstate Highway System						
District	City/County	Length (miles)	Number of Fatal Crashes	Number of Injury Crashes	Injury Crash Rate	Fatal Crash Rate
Bristol	Wythe	37.44	5	114	51	1.31
Bristol	Bland	21.19	2	32	22	1.54
Bristol	Bristol	9.17	2	21	37	1.87
Bristol	Washington	25.6	1	54	29	0.34
Bristol	Smyth	21.63	1	28	21	0.52
Culpeper	Fauquier	21.93	4	30	19	1.9
Culpeper	Louisa	19.65	1	37	43	0.66
Culpeper	Albemarle	29.67	0	78	49	0
Fredericksburg	Stafford	15.74	3	86	25	0.52
Fredericksburg	Spotsylvania	12.39	3	47	22	1.22
Fredericksburg	Caroline	15.54	3	45	21	0.77
Fredericksburg	Fredericksburg	3.18	0	19	29	0
NOVA	Fairfax	51.36	8	899	42	0.37
NOVA	Prince William	24.74	2	241	42	0.26
NOVA	Arlington	10.96	0	244	58	0
NOVA	Alexandria	4.48	0	104	63	0
Richmond	Henrico	54.68	8	245	31	0.81
Richmond	Hanover	25	4	144	38	0.65
Richmond	Petersburg	9.67	3	56	55	2.49
Richmond	New Kent	20.07	2	75	41	0.63
Richmond	Prince George	22.32	2	46	30	0.91
Richmond	Richmond	12.33	1	184	58	0.2
Richmond	Richmond	5.38	0	42	33	0
Richmond	Brunswick	20.77	2	35	49	1.51
Richmond	Chesterfield	16.62	1	106	36	0.25
Richmond	Mecklenburg	16.21	1	35	57	0.9
Richmond	Dinwiddie	24.68	0	65	64	0
Richmond	Goochland	23.38	0	56	42	0
Richmond	Hopewell	3.3	0	4	24	0
Richmond	Colonial Heights	3.57	0	1	1	0
Salem	Montgomery	20.94	3	76	39	1.11
Salem	Botetourt	26.86	2	74	9	0.65
Salem	Carroll	24.29	2	45	32	0.79
Salem	Roanoke City	17.57	1	62	35	0.37
Salem	Pulaski	17.54	1	49	39	0.52
Salem	Roanoke Co.	5.51	0	28	30	0
Salem	Salem	0.42	0	1	15	0
Staunton	Rockbridge	47.97	7	99	39	1.96
Staunton	Alleghany	38.04	3	49	45	2
Staunton	Rockingham	20.66	2	43	28	0.87

District	City/County	Length (miles)	Number of Fatal Crashes	Number of Injury Crashes	Injury Crash Rate	Fatal Crash Rate
Staunton	Augusta	41.41	1	116	33	0.2
Staunton	Shenandoah	32.47	1	59	26	0.3
Staunton	Frederick	23.74	1	41	20	0.32
Staunton	Warren	15.95	1	16	21	1.8
Staunton	Waynesboro	2.88	1	5	32	3.97
Staunton	Harrisonburg	6.44	0	20	35	0
Staunton	Covington	1.4	0	1	14	0
Staunton	Winchester	0.07	0	0	0	0
Suffolk	Newport News	18.33	5	201	82	1.11
Suffolk	Norfolk	23.34	4	407	65	0.45
Suffolk	Greensville	15.47	4	45	56	2.32
Suffolk	Chesapeake	23.68	2	172	57	0.49
Suffolk	Sussex	17.51	2	35	35	1.02
Suffolk	Nansemond	0	2	0	No Rate	No Rate
Suffolk	Portsmouth	5.71	1	83	98	0.86
Suffolk	Virginia Beach	2.92	1	34	40	0.98
Suffolk	York	11.23	0	75	63	0
Suffolk	James City	11.04	0	29	28	0
Suffolk	Suffolk	5.63	0	9	15	0
Suffolk	Emporia	1.67	0	8	85	0
Suffolk	Hampton	15.62	0	1	1	0
Suffolk	Williamsburg	0	0	0	No Rate	No Rate
Suffolk	Suffolk	5.63	0	0	0	0

Note: No Rate indicates missing data in 1994 Summary of Crash data. City of Richmond appears twice because mileage is divided between two residences.

Primary Highway System						
District	City/County	Length (miles)	Number of Fatal Crashes	Number of Injury Crashes	Injury Crash Rate	Fatal Crash Rate
Bristol	Tazewell	120.35	5	182	127	2.1
Bristol	Washington	105.34	2	146	143	1.2
Bristol	Buchanan	66.76	2	165	167	1.3
Bristol	Russell	96.89	4	135	94	1.5
Bristol	Scott	103.62	2	112	102	2.9
Bristol	Wise	92.79	4	105	95	2.6
Bristol	Lee	100.59	2	114	122	1.3
Bristol	Wythe	68.62	1	71	165	7.52
Bristol	Grayson	93.25	4	58	115	5.9
Bristol	Smyth	75.83	2	62	118	2.2
Bristol	Dickenson	74.84	4	71	114	5.4
Bristol	Bland	77.69	1	21	109	3.3
Bristol	Norton	2.64	0	6	68	0
Bristol	Norton	2.64	0	1	10	0
Bristol	Bristol	1.55	0	8	263	0
Culpeper	Albemarle	127.51	7	342	118	1.9
Culpeper	Fauquier	112.36	6	150	52	1.3
Culpeper	Culpeper	77.85	1	126	105	1
Culpeper	Greene	26.18	1	74	138	1.4
Culpeper	Madison	61.67	2	64	78	1.6
Culpeper	Fluvanna	68.28	2	52		2.4
Culpeper	Rappahannock	52.93	0	36	76	0
Culpeper	Orange	80.55	3	82	80	1.9
Culpeper	Louisa	115.36	3	124	116	1.7
Culpeper	Charlottesville	2.31	0	4	21	0
Fredericksburg	Spotsylvania	67.23	6	247	130	1.9
Fredericksburg	Stafford	44.66	4	184	117	2.4
Fredericksburg	Gloucester	55.6	4	165	118	2.2
Fredericksburg	King George	75.41	4	108	84	2.1
Fredericksburg	Caroline	94.82	7	87	87	4.5
Fredericksburg	Westmoreland	59.68	2	66	138	2.5
Fredericksburg	Essex	47.3	2	39	47	1.5
Fredericksburg	Middlesex	46.23	2	38	61	4.5
Fredericksburg	Lancaster	50.03	1	37	88	1.6
Fredericksburg	King William	42.9	2	31	48	1.9
Fredericksburg	Mathews	33.65	3	32	101	4.5
Fredericksburg	Richmond Co.	28.29	0	19	40	0
Fredericksburg	Northumberland	44.49	1	24	45	1.2
Fredericksburg	King & Queen	51.99	2	23	65	2.8
Lynchburg	Campbell	98.53	3	215	112	1
Lynchburg	Pittsylvania	142.78	8	159	96	3.5
Lynchburg	Charlotte	101.45	1	62	88	1
Lynchburg	Halifax	141.59	2	166	120	0.9
Lynchburg	Prince Edward	67.14	1	69	76	0.7
Lynchburg	Danville	7.44	0	11	132	0

District	City/County	Length (miles)	Number of Fatal Crashes	Number of Injury Crashes	Injury Crash Rate	Fatal Crash Rate
Lynchburg	Amherst	84.82	0	142	100	0
Lynchburg	Nelson	114.39	2	79	83	1.3
Lynchburg	Buckingham	95.24	4	45	70	4.1
Lynchburg	Cumberland	50.69	2	35	105	5.9
Lynchburg	Appomattox	45.97	2	33	62	2
Lynchburg	Danville	16.92	1	4	33	5.46
Lynchburg	Lynchburg	6.51	2	16	46	4.2
NOVA	Fairfax	149.86	21	1702	132	1.1
NOVA	Arlington	37.41	3	756	223	0.7
NOVA	Prince William	83.09	10	575	175	1.9
NOVA	Loudoun	100.25	4	267	72	0.7
NOVA	Alexandria	0.79	0	17	811	0
Richmond	Chesterfield	127.16	6	798	104	0.5
Richmond	Henrico	98.09	7	626	162	1.2
Richmond	Hanover	86.55	5	191	109	1.7
Richmond	Prince George	76.18	3	110	110	2.2
Richmond	Powhatan	47.89	0	46	57	0
Richmond	Goochland	54.07	2	61	119	2.7
Richmond	Mecklenburg	138.13	9	105	95	4.6
Richmond	New Kent	68.11	1	51	84	1
Richmond	Brunswick	82.19	6	62	109	5.4
Richmond	Amelia	39.36	2	46	79	2.9
Richmond	Richmond	1.87	0	28	95	0
Richmond	Richmond	5.85	0	19	25	0
Richmond	Nottoway	73.5	1	35	51	0.9
Richmond	Dinwiddie	80.8	1	75	81	0.7
Richmond	Lunenburg	56.11	0	15	56	0
Richmond	Charles City	50.95	2	29	69	5.7
Salem	Henry	103.33	3	339	141	0.8
Salem	Bedford Co.	149.25	1	195	88	1.1
Salem	Roanoke Co.	62.02	4	194	87	0.9
Salem	Franklin	93.5	8	193	92	2.8
Salem	Carroll	85.94	4	105	137	3.2
Salem	Botetourt	77.54	4	112	79	1.9
Salem	Montgomery	40.33	2	131	143	1.3
Salem	Pulaski	31.83	0	95	143	0
Salem	Patrick	90.12	1	64	84	1.8
Salem	Giles	64.31	4	39	40	2.9
Salem	Roanoke City	5.35	0	33	46	1.2
Salem	Floyd	53.29	1	34	90	1.8
Salem	Craig	58.87	0	19	106	0
Salem	Bedford City	3.3	0	7	98	0
Staunton	Frederick	97.96	6	153	71	2.3
Staunton	Rockingham	145.4	10	161	86	3.2
Staunton	Rockbridge	107.79	3	192	96	2.2
Staunton	Shenandoah	77.01	1	52	71	0.9
Staunton	Page	49.97	0	48	83	0
Staunton	Clarke	45.56	0	61	60	0

District	City/County	Length (miles)	Number of Fatal Crashes	Number of Injury Crashes	Injury Crash Rate	Fatal Crash Rate
Staunton	Warren	32.87	0	45	96	0
Staunton	Alleghany	73.52	1	50	152	1.8
Staunton	Bath	74.8	1	28	114	2.9
Staunton	Highland	70.08	0	9	47	0
Staunton	Harrisonburg	0	0	3		
Staunton	Staunton	5.15	0	3	31	0
Staunton	Covington	0.72	0	2	59	0
Staunton	Augusta	157.7	2	168	104	0.7
Staunton	Winchester	0.29	0	7	482	0
Suffolk	Suffolk	112.94	12	370	131	0
Suffolk	York	48.36	3	221	90	1
Suffolk	Virginia Beach	11.2	0	135	47	0
Suffolk	Emporia	3.64	0	4	27	0
Suffolk	Isle of Wight	71.3	4	123	105	1.8
Suffolk	Accomack	84.88	11	152	111	4.4
Suffolk	James City	39.95	1	102	90	0.5
Suffolk	Southampton	89.64	8	71	76	5.7
Suffolk	Northampton	40.56	4	72	123	4.8
Suffolk	Sussex	80.16	3	60	117	3.9
Suffolk	Norfolk	2.65	0	35	67	0
Suffolk	Surry	45.39	1	25	97	4.7
Suffolk	Greensville	21.24	0	22	91	0
Suffolk	Portsmouth	6.9	3	23	52	6.7
Suffolk	Chesapeake	3.59	0	23	52	0
Suffolk	Newport News	0.41	0	4	61	0

Note: Cities of Richmond and Norton appear twice because primary mileage is divided between two residences.

Secondary Highway System						
District	City/County	Length (miles)	Number of Fatal Crashes	Number of Injury Crashes	Injury Crash Rate	Fatal Crash Rate
Bristol	Russell	521.31	0	67	175	0
Bristol	Buchanan	450.35	3	209	276	3.2
Bristol	Wise	361.12	2	99	149	5.3
Bristol	Smyth	431.65	2	96	192	2.9
Bristol	Dickenson	380.77	0	63	186	0
Bristol	Grayson	653.13	0	39	131	0
Bristol	Wythe	440.44	1	60	185	2.1
Bristol	Tazewell	436.45	2	106	206	2.6
Bristol	Lee	540.48	3	50	161	6.1
Bristol	Bland	205.59	2	24	193	15.3
Bristol	Washington	729.4	1	162	182	0.8
Bristol	Scott	656.51	0	83	171	0
Culpeper	Fauquier	790.82	7	155	110	3.7
Culpeper	Orange	329.93	1	51	155	2.3
Culpeper	Albemarle	778.14	4	303	165	1.5
Culpeper	Louisa	478.69	4	85	150	5.3
Culpeper	Culpeper	444.3	0	75	159	0
Culpeper	Fluvanna	283.61	0	36	140	0
Culpeper	Greene	177.49	0	53	251	0
Culpeper	Rappahannock	220.31	0	16	117	0
Culpeper	Madison	304.96	0	28	139	0
Fredericksburg	Spotsylvania	462.9	6	262	199	3.1
Fredericksburg	Westmoreland	306.19	2	45	152	4.9
Fredericksburg	Stafford	356.79	0	212	171	0
Fredericksburg	Caroline	472.53	2	69	152	3
Fredericksburg	Essex	257.04	0	44	237	0
Fredericksburg	Northumberland	321.22	0	28	80	3
Fredericksburg	Gloucester	278.94	2	103	235	0
Fredericksburg	Middlesex	150.72	2	26	216	8.8
Fredericksburg	Richmond Co.	199.41	0	15	102	0
Fredericksburg	King & Queen	300.43	1	36	168	0
Fredericksburg	King William	240.66	0	25	127	0
Fredericksburg	King George	156.03	1	19	123	4.9
Fredericksburg	Mathews	138.57	0	14	179	6.4
Fredericksburg	Lancaster	187.71	1	24	137	0
Lynchburg	Pittsylvania	1415.62	6	292	181	2.4
Lynchburg	Campbell	660.33	2	183	148	1.2
Lynchburg	Halifax	864.81	7	157	181	6.4
Lynchburg	Amherst	545.53	1	66	129	1.3
Lynchburg	Buckingham	569.45	1	37	122	2.4
Lynchburg	Cumberland	293.65	2	32	167	13.2
Lynchburg	Charlotte	454.02	5	42	215	14.1
Lynchburg	Prince Edward	405.98	1	66	258	2.6

District	City/County	Length (miles)	Number of Fatal Crashes	Number of Injury Crashes	Injury Crash Rate	Fatal Crash Rate
Lynchburg	Appomattox	403.38	3	42	122	9
Lynchburg	Nelson	468.23	2	35	137	6
NOVA	Fairfax	2030.59	27	2342	120	1.1
NOVA	Prince William	725.08	8	983	179	1.2
NOVA	Loudoun	749.52	7	293	145	2.4
Richmond	Chesterfield	1195.69	10	806	173	1.4
Richmond	Hanover	700.38	2	228	137	0.9
Richmond	Brunswick	571.52	5	87	208	7.7
Richmond	Mecklenburg	692.15	3	107	257	4.7
Richmond	Prince George	272.18	2	80	173	4.6
Richmond	Powhatan	235.98	2	54	120	3.3
Richmond	Amelia	359.34	0	46	166	0
Richmond	Lunenburg	473.58	0	48	199	0
Richmond	Nottoway	280.13	1	28	127	3.3
Richmond	Dinwiddie	529.56	2	69	142	5.4
Richmond	Goochland	281.31	1	50	115	1.6
Richmond	Charles City	134.38	2	16	93	8
Richmond	New Kent	190.42	0	16	130	0
Salem	Franklin	1012.54	4	175	158	3.7
Salem	Carroll	825.07	1	75	119	1.2
Salem	Henry	661.27	8	225	160	4.9
Salem	Montgomery	421.96	5	154	216	7.2
Salem	Patrick	626.22	1	53	122	1.6
Salem	Roanoke County	512.9	1	131	125	0.7
Salem	Botetourt	511.45	2	68	165	3.3
Salem	Pulaski	352.95	2	104	218	2.6
Salem	Floyd	626.87	0	56	157	0
Salem	Giles	321.88	0	32	217	0
Salem	Craig	163.83	0	22	259	8
Salem	Bedford County	932.03	2	183	142	1.2
Staunton	Augusta	978.39	3	201	166	1.7
Staunton	Rockingham	843.37	7	146	149	4.6
Staunton	Clarke	199.26	0	25	147	0
Staunton	Shenandoah	613.1	1	58	130	1.5
Staunton	Rockbridge	594.68	3	77	198	5
Staunton	Alleghany	261.91	1	46	192	2.8
Staunton	Frederick	529.28	2	107	128	1.7
Staunton	Page	295.81	1	46	180	2.5
Staunton	Warren	194.86	1	39	145	2.7
Staunton	Bath	242.43	1	11	105	5.5
Staunton	Highland	211.61	0	12	251	0
Suffolk	Southampton	661.16	3	93	177	3.7
Suffolk	Accomack	512.98	1	101	192	1.3
Suffolk	Isle of Wight	411.39	3	80	174	5.6
Suffolk	Greensville	279.98	2	55	239	5.3
Suffolk	Northampton	208.06	0	20	141	0

District	City/County	Length (miles)	Number of Fatal Crashes	Number of Injury Crashes	Injury Crash Rate	Fatal Crash Rate
Suffolk	Suffolk	481.3	1	160	235	0
Suffolk	York	225.09	1	97	167	1.1
Suffolk	James City	209.43	3	91	169	3.4
Suffolk	Sussex	436.46	6	37	209	19.9
Suffolk	Surry	236.28	0	26	131	0

Source: VDOT 1994 Summary of Crash Data.

Appendix C

Driver-Related Crash Factors

Table C-1

Percent of Drivers Involved in Crashes Who Were Impaired - 1996

Alcohol-Related Impairment	Number of Drivers	Percent of Drivers
Driver Condition		
Not Impaired	219841	95.2
Drinking-Impaired	6878	3
Drinking-Not Impaired	1872	0.8
Drinking-Impairment Unknown	2353	1
TOTAL	230944	
NOT STATED	10263	
GRAND TOTAL	241207	
Physical Impairment	Number of Drivers	Percent of Drivers
Driver Condition		
Not Impaired	224861	97.5
Physical Defect	1304	0.6
Sick	520	0.2
Fatigued	783	0.3
Apparently Asleep	2233	1
Other	869	0.4
TOTAL	230570	100
Not Stated	10637	
GRAND TOTAL	241207	

Source: Virginia Traffic Crash Facts, published by DMV.

Table C-2

Percent of Crashes in Which Involved Excessive Vehicle Speed - 1996

Speeding	All Crashes	%Total	%Grand Total
Speed Limit Exceeded	13273	11.54	10.13
Safe Speed Exceeded	16391	14.25	12.50
No Violation	85346	74.21	65.11
TOTAL	115010		
Not Stated	16078		
GRAND TOTAL	131088		

Source: JLARC staff analysis of DMV Traffic Crash Fact data.

Appendix D

Critical Accident Rates in Virginia

Table D-1

Number of Intersections with Accident Rates Greater than Critical Rate - Twelve Months Ending December 31, 1995

County	District	Signalized?	Number of Approaches	Critical Rate	Number of Intersections Above Critical Rate
Accomack	*Suffolk*	*No*	*3*	*0.202*	*18*
Accomack	Suffolk	No	4	0.374	10
Accomack	Suffolk	No	5	2.145	1
Accomack	Suffolk	Yes	3	0.546	2
Accomack	Suffolk	Yes	4	0.759	0
Albemarle	Culpeper	No	3	0.243	14
Albemarle	Culpeper	No	4	0.37	3
Albemarle	Culpeper	No	5	0.992	1
Albemarle	Culpeper	Yes	3	0.863	3
Albemarle	Culpeper	Yes	4	1.174	5
Alleghaney	Staunton	No	3	0.183	8
Alleghaney	Staunton	Yes	3	0.488	1
Amelia	Richmond	No	3	0.233	10
Amelia	Richmond	No	4	0.462	4
Amherst	Lynchburg	No	3	0.216	12
Amherst	Lynchburg	No	4	0.418	7
Amherst	Lynchburg	Yes	3	0.909	2
Amherst	Lynchburg	Yes	4	0.937	1
Appomattox	Lynchburg	No	3	0.216	3
Appomattox	Lynchburg	No	4	0.418	2
Appomattox	Lynchburg	No	40	0.418	2
Arlington	Northern Virginia	No	3	0.214	20
Arlington	Northern Virginia	No	4	0.283	5
Arlington	Northern Virginia	Yes	3	0.613	6
Arlington	Northern Virginia	Yes	4	0.749	10
Augusta	*Staunton*	*No*	*3*	*0.183*	*28*
Augusta	Staunton	No	4	0.353	11
Augusta	Staunton	Yes	3	0.488	4
Augusta	Staunton	Yes	4	0.67	3
Bedford	Salem	No	3	0.196	34
Bedford	Salem	No	4	0.313	6
Bedford	Salem	Yes	3	0.524	1

Table D-1 (continued)

Number of Intersections with Accident Rates Greater than Critical Rate - Twelve Months Ending December 31, 1995

County	District	Signalized?	Number of Approaches	Critical Rate	Number of Intersections Above Critical Rate
Bedford	Salem	Yes	4	0.607	2
Bland	Bristol	No	3	0.255	3
Bland	Bristol	No	4	0.38	1
Botetourt	Salem	No	3	0.196	12
Botetourt	Salem	No	4	0.313	1
Botetourt	Salem	Yes	3	0.524	0
Botetourt	Salem	Yes	4	0.607	1
Brunswick	Richmond	No	3	0.233	2
Brunswick	Richmond	No	4	0.462	5
Buchanan	*Bristol*	*No*	*3*	*0.255*	*26*
Buchanan	Bristol	Yes	3	0.711	1
Buckingham	Lynchburg	No	3	0.216	1
Buckingham	Lynchburg	No	4	0.418	3
Campbell	Lynchburg	No	3	0.216	17
Campbell	Lynchburg	No	4	0.418	11
Campbell	Lynchburg	Yes	3	0.909	4
Campbell	Lynchburg	Yes	4	0.937	2
Caroline	Fredericksburg	No	3	0.221	9
Caroline	Fredericksburg	No	4	0.374	5
Caroline	Fredericksburg	Yes	4	0.737	4
Carroll	Salem	No	3	0.196	10
Carroll	Salem	No	4	0.313	4
Carroll	Salem	Yes	4	0.607	0
Charles City	Richmond	No	3	0.233	2
Charles City	Richmond	No	4	0.462	1
Charlotte	Lynchburg	No	3	0.216	2
Charlotte	Lynchburg	No	4	0.418	3
Chesterfield	*Richmond*	*No*	*3*	*0.233*	*59*
Chesterfield	Richmond	No	4	0.462	20
Chesterfield	Richmond	Yes	3	0.723	18
Chesterfield	Richmond	Yes	4	0.745	16
Chesterfield	Richmond	Yes	5	1.798	0
Clarke	Staunton	No	3	0.183	5
Clarke	Staunton	No	4	0.353	2
Clarke	Staunton	Yes	3	0.488	1
Clarke	Staunton	Yes	4	0.67	1
Craig	Salem	No	3	0.196	1
Craig	Salem	No	4	0.313	1
Culpeper	Culpeper	No	3	0.243	5
Cumberland	Lynchburg	No	3	0.216	7
Dickenson	Bristol	No	3	0.255	2

Table D-1 (continued)

Number of Intersections with Accident Rates Greater than Critical Rate - Twelve Months Ending December 31, 1995

County	District	Signalized?	Number of Approaches	Critical Rate	Number of Intersections Above Critical Rate
Dickenson	Bristol	No	4	0.38	2
Dinwiddie	Richmond	No	3	0.233	6
Dinwiddie	Richmond	No	4	0.462	2
Dinwiddie	Richmond	Yes	3	0.723	1
Dinwiddie	Richmond	Yes	4	0.745	1
Essex	Fredericksburg	No	4	0.374	4
Essex	Fredericksburg	Yes	3	0.594	0
Fairfax	*Northern Virginia*	*No*	*3*	*0.214*	*112*
Fairfax	Northern Virginia	No	4	0.283	52
Fairfax	Northern Virginia	No	5	0.191	3
Fairfax	Northern Virginia	No	6	0.1	1
Fairfax	Northern Virginia	Yes	3	0.613	76
Fairfax	Northern Virginia	Yes	4	0.749	77
Fairfax	Northern Virginia	Yes	5	0.511	6
Fairfax	Northern Virginia	Yes	6	0.517	1
Fauquier	*Culpeper*	*No*	*3*	*0.243*	*35*
Fauquier	Culpeper	No	4	0.37	12
Fauquier	Culpeper	Yes	3	0.863	2
Fauquier	Culpeper	Yes	4	1.174	2
Floyd	Salem	No	4	0.313	1
Fluvanna	Culpeper	No	3	0.243	6
Fluvanna	Culpeper	No	4	0.37	1
Fluvanna	Culpeper	Yes	4	1.174	1
Franklin	Salem	No	3	0.196	27
Franklin	Salem	No	4	0.313	4
Franklin	Salem	Yes	3	0.524	2
Frederick	Staunton	No	3	0.183	22
Frederick	Staunton	No	4	0.353	8
Frederick	Staunton	Yes	3	0.488	4
Frederick	Staunton	Yes	4	0.67	1
Giles	Salem	No	3	0.196	5
Giles	Salem	No	4	0.313	2
Gloucester	*Fredericksburg*	*No*	*3*	*0.221*	*23*

Table D-1 (continued)

Number of Intersections with Accident Rates Greater than Critical Rate - Twelve Months Ending December 31, 1995

County	District	Signalized?	Number of Approaches	Critical Rate	Number of Intersections Above Critical Rate
Gloucester	Fredericksburg	No	4	0.374	7
Gloucester	Fredericksburg	Yes	3	0.594	2
Gloucester	Fredericksburg	Yes	4	0.737	2
Goochland	Richmond	No	3	0.233	10
Goochland	Richmond	No	4	0.462	4
Goochland	Richmond	Yes	3	0.723	1
Grayson	Bristol	No	3	0.255	6
Grayson	Bristol	No	4	0.38	1
Greene	Culpeper	No	3	0.243	5
Greene	Culpeper	No	4	0.37	2
Greene	Culpeper	Yes	4	1.174	0
Greensville	Suffolk	No	3	0.202	4
Greensville	Suffolk	No	4	0.374	1
Halifax	Lynchburg	No	3	0.216	17
Halifax	Lynchburg	No	4	0.418	6
Halifax	Lynchburg	Yes	3	0.909	1
Halifax	Lynchburg	Yes	4	0.937	3
Hanover	Richmond	No	3	0.233	20
Hanover	Richmond	No	4	0.462	7
Hanover	Richmond	Yes	3	0.723	5
Hanover	Richmond	Yes	4	0.745	7
Hanover	Richmond	Yes	5	1.798	0
Henrico	Richmond	No	3	0.233	1
Henrico	Richmond	Yes	3	0.723	1
Henrico	Richmond	Yes	4	0.745	2
Henry	*Salem*	*No*	*3*	*0.196*	*58*
Henry	Salem	No	4	0.313	15
Henry	Salem	Yes	3	0.524	6
Henry	Salem	Yes	4	0.607	2
Isle of Wight	Suffolk	No	3	0.202	6
Isle of Wight	Suffolk	No	4	0.374	5
Isle of Wight	Suffolk	Yes	3	0.546	2
James City	Suffolk	No	4	0.374	2
James City	Suffolk	Yes	3	0.546	1
James City	Suffolk	Yes	4	0.759	2
King & Queen	Fredericksburg	No	3	0.221	3
King & Queen	Fredericksburg	No	4	0.374	2
King George	Fredericksburg	No	3	0.221	6
King George	Fredericksburg	No	4	0.374	4
King George	Fredericksburg	Yes	4	0.737	1
King William	Fredericksburg	No	3	0.221	1

Table D-1 (continued)

Number of Intersections with Accident Rates Greater than Critical Rate - Twelve Months Ending December 31, 1995

County	District	Signalized?	Number of Approaches	Critical Rate	Number of Intersections Above Critical Rate
King William	Fredericksburg	Yes	4	0.737	0
Lancaster	Fredericksburg	No	3	0.221	4
Lee	Bristol	No	3	0.255	11
Lee	Bristol	No	4	0.38	2
Loudon	Northern Virginia	No	3	0.214	3
Loudon	Northern Virginia	No	4	0.283	11
Loudon	Northern Virginia	Yes	3	0.613	4
Loudon	Northern Virginia	Yes	4	0.749	3
Louisa	Culpeper	No	3	0.243	7
Louisa	Culpeper	No	4	0.37	3
Louisa	Culpeper	Yes	3	0.863	1
Lunenburg	Richmond	No	3	0.233	1
Madison	Culpeper	No	3	0.243	3
Madison	Culpeper	No	4	0.37	1
Madison	Culpeper	Yes	4	1.174	0
Mathews	Fredericksburg	No	3	0.221	9
Mecklenburg	Richmond	No	3	0.233	9
Mecklenburg	Richmond	No	4	0.462	3
Middlesex	Fredericksburg	No	3	0.221	5
Middlesex	Fredericksburg	No	4	0.374	2
Montgomery	Salem	No	3	0.196	16
Montgomery	Salem	No	4	0.313	4
Montgomery	Salem	Yes	4	0.607	0
Nelson	Lynchburg	No	3	0.216	5
Nelson	Lynchburg	No	4	0.418	3
New Kent	Richmond	No	3	0.233	5
New Kent	Richmond	No	4	0.462	3
New Kent	Richmond	Yes	3	0.723	0
Norfolk	Suffolk	No	3	0.202	1
Northampton	Suffolk	No	3	0.202	2
Northampton	Suffolk	No	4	0.374	6
Northampton	Suffolk	Yes	4	0.759	1
Northumberland	Fredericksburg	No	3	0.221	3
Northumberland	Fredericksburg	No	4	0.374	2
Nottoway	Richmond	No	3	0.233	1
Nottoway	Richmond	No	4	0.462	1
Orange	Culpeper	No	3	0.243	9

Table D-1 (continued)

Number of Intersections with Accident Rates Greater than Critical Rate - Twelve Months Ending December 31, 1995

County	District	Signalized?	Number of Approaches	Critical Rate	Number of Intersections Above Critical Rate
Orange	Culpeper	No	4	0.37	4
Orange	Culpeper	Yes	3	0.863	1
Orange	Culpeper	Yes	4	1.174	0
Page	Staunton	No	3	0.183	4
Patrick	Salem	No	3	0.196	4
Patrick	Salem	No	4	0.313	4
Pittsylvania	*Lynchburg*	*No*	*3*	*0.216*	*36*
Pittsylvania	Lynchburg	No	4	0.418	15
Pittsylvania	Lynchburg	No	5	0.311	0
Pittsylvania	Lynchburg	Yes	4	0.937	0
Powhatan	Richmond	No	3	0.233	4
Powhatan	Richmond	No	4	0.462	3
Prince Edward	Lynchburg	No	3	0.216	9
Prince Edward	Lynchburg	No	4	0.418	1
Prince Edward	Lynchburg	Yes	3	0.909	0
Prince Edward	Lynchburg	Yes	4	0.937	0
Prince George	Richmond	No	3	0.233	12
Prince George	Richmond	No	4	0.462	4
Prince George	Richmond	Yes	4	0.745	1
Prince William	Northern Virginia	No	3	0.214	32
Prince William	Northern Virginia	No	4	0.283	14
Prince William	Northern Virginia	Yes	3	0.613	26
Prince William	Northern Virginia	Yes	4	0.749	31
Pulaski	Salem	No	3	0.196	10
Pulaski	Salem	No	4	0.313	2
Pulaski	Salem	Yes	3	0.524	1
Pulaski	Salem	Yes	4	0.607	1
Rappahanock	Culpeper	No	3	0.243	1
Richmond	Fredericksburg	No	3	0.221	4
Richmond	Fredericksburg	No	4	0.374	1
Roanoke	Salem	No	3	0.196	43
Roanoke	Salem	No	4	0.313	11
Roanoke	Salem	Yes	3	0.524	7
Roanoke	Salem	Yes	4	0.607	1
Roanoke	Salem	Yes	5	0	0
Rockbridge	Staunton	No	3	0.183	5
Rockbridge	Staunton	No	4	0.353	1

Table D-1 (continued)

Number of Intersections with Accident Rates Greater than Critical Rate - Twelve Months Ending December 31, 1995

County	District	Signalized?	Number of Approaches	Critical Rate	Number of Intersections Above Critical Rate
Rockbridge	Staunton	No	5	1.265	0
Rockbridge	Staunton	Yes	3	0.488	1
Rockbridge	Staunton	Yes	4	0.67	0
Rockingham	Staunton	No	3	0.183	21
Rockingham	Staunton	No	4	0.353	7
Rockingham	Staunton	Yes	3	0.488	1
Rockingham	Staunton	Yes	4	0.67	1
Russell	Bristol	No	3	0.255	17
Scott	Bristol	No	3	0.255	10
Scott	Bristol	No	5	0.35	1
Shenandoah	Staunton	No	3	0.183	4
Shenandoah	Staunton	No	4	0.353	1
Smyth	Bristol	No	3	0.255	6
Smyth	Bristol	No	4	0.38	4
Southhampton	Suffolk	No	3	0.202	9
Southhampton	Suffolk	No	4	0.374	4
Southhampton	Suffolk	Yes	4	0.759	1
Spotsylvania	Fredericksburg	No	3	0.221	16
Spotsylvania	Fredericksburg	No	4	0.374	3
Spotsylvania	Fredericksburg	Yes	3	0.594	4
Spotsylvania	Fredericksburg	Yes	4	0.737	9
Stafford	Fredericksburg	No	3	0.221	14
Stafford	Fredericksburg	No	4	0.374	2
Stafford	Fredericksburg	Yes	3	0.594	0
Stafford	Fredericksburg	Yes	4	0.737	2
Surry	Suffolk	No	3	0.202	2
Surry	Suffolk	No	4	0.374	2
Sussex	Suffolk	No	3	0.202	1
Sussex	Suffolk	No	4	0.374	4
Tazewell	Bristol	No	3	0.255	22
Tazewell	Bristol	No	4	0.38	1
Tazewell	Bristol	Yes	3	0.711	2
Tazewell	Bristol	Yes	4	1.226	1
Warren	Staunton	Yes	3	0.488	1
Warwick	Suffolk	No	4	0.374	1
Warwick	Suffolk	Yes	3	0.546	1
Warwick	Suffolk	Yes	4	0.759	1
Washington	Bristol	No	3	0.255	21
Washington	Bristol	No	4	0.38	5
Washington	Bristol	Yes	3	0.711	1
Washington	Bristol	Yes	4	1.226	0

Table D-1 (continued)

Number of Intersections with Accident Rates Greater than Critical Rate - Twelve Months Ending December 31, 1995

County	District	Signalized?	Number of Approaches	Critical Rate	Number of Intersections Above Critical Rate
Westmoreland	Fredericksburg	No	3	0.221	2
Westmoreland	Fredericksburg	No	4	0.374	2
Wise	Bristol	No	3	0.255	9
Wise	Bristol	No	4	0.38	4
Wise	Bristol	Yes	4	1.226	0
Wythe	Bristol	No	3	0.255	7
Wythe	Bristol	No	4	0.38	5
York	Suffolk	No	0	0.202	6
York	Suffolk	Yes	3	0.546	2

Note: County having the greatest number of intersections above the critical rate in each district is marked with *italics*.

Source: JLARC staff analysis of VDOT intersection critical rate data for 12 months ending 12/31/95.

Table D-2

Interstate and Primary Highway Sections with Accident Rates Greater than Critical Rate

District	Functional Classification	Number of Lanes	Divided Highway?	Access Control	Critical Rate	Number of Sections
Bristol	Rural Interstate	2	Yes	Full	59	4
Bristol	Rural Minor Arterial	2	transition	None	315	1
Bristol	Rural Minor Arterial	2	No	None	231	12
Bristol	Rural Minor Arterial	4	Yes	None	297	1
Bristol	Rural Minor Collector	2	No	None	245	13
Bristol	*Rural Principal Arterial*	*4*	*Yes*	*None*	*150*	*21*
Bristol	Rural Principal Arterial	4	No	None	310	0
Bristol	Rural Principal Arterial	2	No	None	212	4
Bristol	Urban Interstate	2	Yes	Full	99	5
Bristol	Urban Minor Arterial	2	No	None	302	1
Bristol	Urban Principal Arterial	4	Yes	None	217	1
Bristol	Urban Principal Arterial	4	No	None	256	1
Bristol	Urban Principal Arterial	2	No	None	208	2
Culpeper	Rural Interstate	2	Yes	Full	90	7
Culpeper	Rural Minor Arterial	4	Yes	None	198	1
Culpeper	*Rural Minor Arterial*	*2*	*No*	*None*	*183*	*19*
Culpeper	Rural Minor Collector	2	No	None	232	6
Culpeper	Rural Principal Arterial	4	Yes	None	102	10
Culpeper	Rural Principal Arterial	4	Yes	Full	99	3
Culpeper	Rural Principal Arterial	4	Yes	Partial	82	2
Culpeper	Rural Principal Arterial	2	No	None	304	2
Culpeper	Urban Freeway/Expressway	4	Yes	Partial	313	1
Fredericksburg	Rural Interstate	4	Yes	Full	73	0
Fredericksburg	*Rural Interstate*	*3*	*Yes*	*Full*	*49*	*33*
Fredericksburg	Rural Minor Arterial	4	Yes	None	109	6
Fredericksburg	Rural Minor Arterial	3	No	None	299	1
Fredericksburg	Rural Minor Arterial	2	No	None	155	8
Fredericksburg	Rural Minor Collector	4	No	None	157	1
Fredericksburg	Rural Minor Collector	2	No	None	255	1
Fredericksburg	Rural Principal Arterial	4	Yes	None	105	6
Fredericksburg	Rural Principal Arterial	2	No	None	229	2
Fredericksburg	Urban Collector	2	No	None	342	2
Fredericksburg	Urban Interstate	3	Yes	Full	52	2
Fredericksburg	Urban Minor Arterial	4	Yes	None	235	0
Fredericksburg	Urban Minor Arterial	4	No	None	324	2
Fredericksburg	Urban Minor Arterial	2	No	None	673	0
Fredericksburg	Urban Principal Arterial	4	Yes	None	258	6
Fredericksburg	Urban Principal Arterial	4	Yes	Partial	785	1
Fredericksburg	Urban Principal Arterial	4	No	None	160	2

Table D-2 (continued)

Interstate and Primary Highway Sections with Accident Rates Greater than Critical Rate

District	Functional Classification	Number of Lanes	Divided Highway?	Access Control	Critical Rate	Number of Sections
Lynchburg	Rural Minor Arterial	4	Yes	None	267	3
Lynchburg	Rural Minor Arterial	4	No	None	553	0
Lynchburg	Rural Minor Arterial	2	No	None	204	5
Lynchburg	Rural Minor Collector	4	No	None	835	0
Lynchburg	Rural Minor Collector	2	No	None	222	3
Lynchburg	*Rural Principal Arterial*	*4*	*Yes*	*None*	*111*	*16*
Lynchburg	Rural Principal Arterial	4	Yes	Full	68	1
Lynchburg	Urban Principal Arterial	4	Yes	None	497	1
Lynchburg	Urban Principal Arterial	4	No	None	1432	0
Lynchburg	Urban Principal Arterial	2	No	None	439	0
Northern Virginia	Rural Interstate	3	Yes	Full	109	8
Northern Virginia	Rural Interstate	2	Yes	Full	89	3
Northern Virginia	Rural Minor Arterial	4	Yes	None	313	1
Northern Virginia	Rural Minor Arterial	4	No	None	205	1
Northern Virginia	Rural Minor Arterial	2	No	None	165	9
Northern Virginia	Rural Minor Collector	2	No	None	251	7
Northern Virginia	Rural Principal Arterial	5	Yes	None	251	1
Northern Virginia	Rural Principal Arterial	4	Yes	None	244	5
Northern Virginia	Rural Principal Arterial	4	Yes	Partial	83	1
Northern Virginia	Rural Principal Arterial	2	No	None	180	8
Northern Virginia	Urban Freeway/Expressway	6	Yes	Partial	146	3
Northern Virginia	Urban Freeway/Expressway	4	Yes	Full	206	1
Northern Virginia	Urban Freeway/Expressway	2	Yes	Full	207	2
Northern Virginia	Urban Interstate	5	Yes	Full	61	4
Northern Virginia	*Urban Interstate*	*4*	*Yes*	*Full*	*89*	*14*
Northern Virginia	Urban Interstate	3	Yes	Full	153	9
Northern Virginia	Urban Interstate	2	Yes	Full	86	8

Table D-2 (continued)

Interstate and Primary Highway Sections with Accident Rates Greater than Critical Rate

District	Functional Classification	Number of Lanes	Divided Highway?	Access Control	Critical Rate	Number of Sections
Northern Virginia	Urban Minor Arterial	6	Yes	None	508	0
Northern Virginia	Urban Minor Arterial	4	Yes	Full	892	0
Northern Virginia	Urban Minor Arterial	4	Yes	None	583	0
Northern Virginia	Urban Minor Arterial	4	No	None	617	1
Northern Virginia	Urban Minor Arterial	2	No	None	190	7
Northern Virginia	Urban Principal Arterial	8	Yes	None	708	0
Northern Virginia	Urban Principal Arterial	7	Yes	None	625	1
Northern Virginia	Urban Principal Arterial	7	Yes	Full	128	0
Northern Virginia	Urban Principal Arterial	6	Yes	None	515	4
Northern Virginia	Urban Freeway/Expressway	3	Yes	Full	87	4
Culpeper	Urban Interstate	2	Yes	Full	115	1
Culpeper	Urban Principal Arterial	4	Yes	None	483	2
Lynchburg	Urban Freeway/Expressway	4	Yes	Full	170	2
Northern Virginia	Urban Principal Arterial	6	Yes	Partial	173	4
Northern Virginia	Urban Principal Arterial	6	Yes	Full	223	0
Northern Virginia	Urban Principal Arterial	6	No	None	346	1
Northern Virginia	Urban Principal Arterial	5	Yes	None	517	0
Northern Virginia	Urban Principal Arterial	5	Yes	Partial	471	0
Northern Virginia	Urban Principal Arterial	4	Yes	None	346	12
Northern Virginia	Urban Principal Arterial	4	Yes	Partial	260	3
Northern Virginia	Urban Principal Arterial	4	No	None	570	9
Northern Virginia	Urban Principal Arterial	2	No	None	200	4
Richmond	Rural Interstate	3	Yes	Full	83	10
Richmond	Rural Interstate	2	Yes	Full	78	18
Richmond	Rural Minor Arterial	4	Yes	None	110	2
Richmond	Rural Minor Arterial	4	No	None	649	0

Table D-2 (continued)

Interstate and Primary Highway Sections with Accident Rates Greater than Critical Rate

District	Functional Classification	Number of Lanes	Divided Highway?	Access Control	Critical Rate	Number of Sections
Richmond	Rural Minor Arterial	2	No	None	169	4
Richmond	Rural Minor Collector	4	No	None	253	0
Richmond	Rural Minor Collector	2	No	None	209	5
Richmond	Rural Principal Arterial	4	Yes	None	110	3
Richmond	Rural Principal Arterial	4	No	None	177	3
Richmond	Rural Principal Arterial	2	No	None	185	2
Richmond	Urban Collector	4	Yes	None	326	0
Richmond	Urban Collector	2	No	None	484	1
Richmond	Urban Freeway/Expressway	6	Yes	Full	65	2
Richmond	Urban Freeway/Expressway	4	Yes	Full	77	4
Richmond	Urban Freeway/Expressway	3	Yes	Full	88	1
Richmond	Urban Interstate	4	Yes	Full	62	2
Richmond	*Urban Interstate*	*3*	*Yes*	*Full*	*98*	*40*
Richmond	Urban Interstate	2	Yes	Full	130	5
Richmond	Urban Minor Arterial	6	Yes	None	366	2
Richmond	Urban Minor Arterial	4	Yes	Partial	266	1
Richmond	Urban Minor Arterial	4	Yes	None	314	1
Richmond	Urban Minor Arterial	4	No	None	390	1
Richmond	Urban Minor Arterial	3	No	None	511	0
Richmond	Urban Minor Arterial	2	No	None	299	19
Richmond	Urban Principal Arterial	6	Yes	None	442	4
Richmond	Urban Principal Arterial	4	Yes	None	244	14
Richmond	Urban Principal Arterial	4	Yes	Full	153	1
Richmond	Urban Principal Arterial	4	Yes	Partial	524	0
Richmond	Urban Principal Arterial	4	No	None	332	4
Salem	Rural Interstate	2	Yes	Full	63	13
Salem	Rural Minor Arterial	4	Yes	None	179	3
Salem	Rural Minor Arterial	4	No	None	707	0
Salem	Rural Minor Arterial	3	No	None	167	2
Salem	*Rural Minor Arterial*	*2*	*No*	*None*	*221*	*28*
Salem	Rural Minor Collector	4	No	None	178	1
Salem	Rural Minor Collector	2	No	None	227	9
Salem	Rural Principal Arterial	4	Yes	None	101	18
Salem	Rural Principal Arterial	4	Yes	Full	56	1
Salem	Rural Principal Arterial	4	No	None	384	1
Salem	Urban Freeway/Expressway	4	Yes	Full	210	0
Salem	Urban Interstate	2	Yes	Full	92	6
Salem	Urban Minor Arterial	4	Yes	None	635	0

Table D-2 (continued)

Interstate and Primary Highway Sections with Accident Rates Greater than Critical Rate

District	Functional Classification	Number of Lanes	Divided Highway?	Access Control	Critical Rate	Number of Sections
Salem	Urban Minor Arterial	4	No	None	275	1
Salem	Urban Minor Arterial	2	No	None	318	1
Salem	Urban Principal Arterial	4	Yes	None	317	4
Salem	Urban Principal Arterial	4	No	None	264	0
Salem	Urban Principal Arterial	2	No	None	318	2
Staunton	*Rural Interstate*	*2*	*Yes*	*Full*	*67*	*23*
Staunton	Rural Minor Arterial	4	Yes	None	157	7
Staunton	Rural Minor Arterial	4	No	None	236	2
Staunton	Rural Minor Arterial	3	No	None	181	1
Staunton	Rural Minor Arterial	2	No	None	206	14
Staunton	Rural Minor Collector	4	No	None	520	0
Staunton	Rural Minor Collector	3	No	None	176	1
Staunton	Rural Minor Collector	2	No	None	227	8
Staunton	Rural Principal Arterial	4	Yes	None	135	5
Staunton	Rural Principal Arterial	4	Yes	Full	98	1
Staunton	Urban Interstate	2	Yes	Full	89	3
Suffolk	Rural Interstate	2	Yes	Full	71	15
Suffolk	Rural Minor Arterial	4	Yes	None	170	1
Suffolk	Rural Minor Arterial	4	No	None	328	1
Suffolk	Rural Minor Arterial	2	No	None	202	4
Suffolk	Rural Minor Collector	4	Yes	None	220	1
Suffolk	Rural Minor Collector	2	No	None	250	3
Suffolk	Rural Principal Arterial	4	Yes	None	137	16
Suffolk	Rural Principal Arterial	4	Yes	Full	114	4
Suffolk	Rural Principal Arterial	4	No	None	116	2
Suffolk	Rural Principal Arterial	2	No	None	263	1
Suffolk	Urban Collector	2	No	None	276	1
Suffolk	Urban Freeway/Expressway	8	Yes	Full	86	2
Suffolk	Urban Freeway/Expressway	6	Yes	Full	116	3
Suffolk	Urban Freeway/Expressway	4	Yes	Full	75	2
Suffolk	Urban Freeway/Expressway	4	Yes	Partial	210	0
Suffolk	Urban Freeway/Expressway	2	No	None	147	1
Suffolk	Urban Interstate	5	Yes	Full	279	0
Suffolk	Urban Interstate	4	Yes	Full	273	0
Suffolk	*Urban Interstate*	*3*	*Yes*	*Full*	*168*	*26*
Suffolk	Urban Interstate	2	Yes	Full	142	23
Suffolk	Urban Minor Arterial	6	Yes	None	1175	1

Table D-2 (continued)

Interstate and Primary Highway Sections with Accident Rates Greater than Critical Rate

District	Functional Classification	Number of Lanes	Divided Highway?	Access Control	Critical Rate	Number of Sections
Suffolk	Urban Minor Arterial	4	Yes	None	302	1
Suffolk	Urban Minor Arterial	4	No	None	87	1
Suffolk	Urban Minor Arterial	2	No	None	430	3
Suffolk	Urban Principal Arterial	4	Yes	None	154	11
Suffolk	Urban Principal Arterial	2	No	None	51	4
Suffolk	Urban Principal Arterial	2	No	None	274	0

Note: Type of highway facility in each district with most number of sections greater than critical rate are marked with *italics*.
Source: JLARC staff analysis of VDOT critical rate data for 12 months ending 6/30/96.

Table D-3

Secondary Highway Sections with Accident Rates Greater than Critical Accident Rate

County	District	Number of Sections	Critical Rate	Secondary Highway Mileage
Albemarle	*Culpeper*	*7*	*1131*	*778.14*
Augusta	*Staunton*	*3*	*1364*	*978.39*
Buchanan	*Bristol*	*9*	*826*	*450.35*
Buckingham	Lynchburg	1	1268	569.45
Campbell	*Lynchburg*	*2*	*970*	*660.33*
Chesterfield	*Richmond*	*9*	*1790*	*1195.69*
Dickenson	Bristol	1	1147	380.77
Essex	Fredericksburg	1	1178	257.04
Fairfax	*Northern Virginia*	*16*	*1109*	*2030.59*
Fauquier	Culpeper	3	991	790.82
Franklin	Salem	1	1048	1012.54
Gloucester	Fredericksburg	2	1287	278.94
Halifax	Lynchburg	2	951	864.81
Hanover	Richmond	1	1312	700.38
Henry	*Salem*	*2*	*988*	*661.27*
Isle of Wight	Suffolk	1	1102	411.39
James City	*Suffolk*	*1*	*1194*	*209.43*
King William	Fredericksburg	1	1433	240.66
Lancaster	Fredericksburg	1	1764	187.71
Lee	Bristol	1	1600	540.48
Loudon	Northern Virginia	2	1162	725.08
Montgomery	Salem	1	1001	421.96
Pittsylvania	Lynchburg	2	955	1415.62
Powhatan	Richmond	2	1139	235.98
Prince George	Richmond	2	1207	272.18
Prince William	Northern Virginia	13	979	749.52
Pulaski	Salem	1	1290	352.95
Rappahanock	Culpeper	1	1867	220.31
Roanoke	Salem	1	1667	512.9
Shenandoah	Staunton	1	1577	613.1
Smyth	Bristol	1	979	431.65
Spotsylvania	*Fredericksburg*	*6*	*1099*	*462.9*
Stafford	Fredericksburg	3	1198	356.79
Surry	Suffolk	1	1515	236.28
Sussex	Suffolk	1	1675	436.46
Washington	Bristol	3	1234	729.4
Wise	Bristol	2	874	361.12

Note: Locality marked in *italics* has the most sections over critical rate among all localities in its district.
Source: JLARC staff analysis of 6/30/96 VDOT secondary highway section critical rate data.

Appendix E

Highest Accident Rate Sites

Table E-1

JLARC Sample of Highest Accident Rate Roadway Sections - 12 Months Ending 12/31/96
District Administrator Agreement/Disagreement That Site is One of Ten Most Hazardous in District

District	County	Route	From	To	Accident Rate	Agree?
Bristol	Washington	I-81 South	0.99 miles north of ramp from northbound 21	0.10 miles north of ramp to 11 and 19	266	No
Bristol	Tazewell	460	intersection of 719 and 1234	19	730	Yes
Bristol	Washington	75	intersection of 670 and 911	0.2 miles north of 670	1329	No
Bristol	Buchanan	80	0.88 miles north of private,un-named road	0.2 miles north of Route 600	1304	No
Bristol	Buchanan	636	0.04 miles north of 638	0.2 miles north of 613	63224	No
Bristol	Washington	614	2.4 miles east of 625	626	26513	No
Bristol	Wise	644	0.22 miles north of 903	0.21 miles north of 680	10404	No
Bristol	Washington	645	0.41 miles east of 781	0.30 miles east of 655	2312	No
Culpeper	Albemarle	I-64 East	3.33 miles east of 637	0.6 miles east of 29	515	No
Culpeper	Culpeper	29	1.64 miles north of 522 and 3	intersection of 666 and 667	593	No
Culpeper	Fauquier	55	0.21 miles east of 757	0.1 miles east of 757	2174	No
Culpeper	Culpeper	15 Bus	0.90 miles east of 666	1.10 miles east of 629	1074	No
Culpeper	Greene	633	0.90 miles east of 603	1.2 miles east of 603	4348	No
Culpeper	Orange	637	0.60 miles east of 688	1 mile east of 688	4130	No
Culpeper	Albemarle	631	0.35 miles north of 659	743	806	No
Culpeper	Albemarle	631	29	0.1 miles north of 659	760	No
Fredericksburg	Spotsylvania	I-95 North	6.78 miles east of 606	0.2 miles north of 1	200	No
Fredericksburg	Spotsylvania	1	0.40 miles north of 1246 and entrance to service road	729	668	No
Fredericksburg	Caroline	1	0.14 miles north of 757	0.20 miles north of 639	1180	Yes
Fredericksburg	King George	206	9951	0.23 miles east of private, un-named road	1151	No
Fredericksburg	Gloucester	615	0.6 miles east of 9164	629	6198	No
Fredericksburg	Stafford	670	0.71 miles east of 656	1.01 miles east of 656	4172	No
Fredericksburg	Spotsylvania	639	3	0.10 miles north of 1592	948	Yes
Fredericksburg	Stafford	630	0.38 miles east of 732	1336	711	No
Lynchburg	Halifax	501	0.14 miles north of un-named, private road	0.3 miles north of 58	657	No
Lynchburg	Halifax	501	0.13 miles north of 1306	654	609	Yes
Lynchburg	Cumberland	45	0.85 miles north of 633	0.10 miles north of 631	1997	No

Table E-1 (continued)

JLARC Sample of Highest Accident Rate Roadway Sections - 12 Months Ending 12/31/96
District Administrator Agreement/Disagreement That Site is One of Ten Most Hazardous in District

District	County	Route	From	To	Accident Rate	Agree ?
Lynchburg	Campbell	501	1.34 miles north of 686	0.1 miles north of 24	1643	Yes
Lynchburg	Campbell	622	1519	0.22 miles east of 1520	126	Yes
Lynchburg	Campbell	606	0.5 miles east of 615	0.9 miles east of 615	3368	No
Lynchburg	Campbell	626	0.2 miles east of 682	0.5 miles east of 682	2686	No
Lynchburg	Pittsylvania	832	0.88 miles east of 895	1.18 miles east of 895	2040	No
NOVA	Fairfax	I-95 North	I-395 North	0.1 miles north of I-495 south	404	No
NOVA	Arlington	27 East	Ramp to 244	0.5 miles east of ramp to I-395 south	1761	No
NOVA	Prince William	253	Intersection of 1 and 687	Route 741	2413	No
NOVA	Prince William	253	Vineyard Way	0.4 miles west of 9344	897	No
NOVA	Fairfax	5401	8351	29	4750	No
NOVA	Loudon	606	28	.10 miles east of 636	1418	No
NOVA	Fairfax	652	5251	.18 miles east of 1520	1024	No
NOVA	Loudon	731	.20 miles north of 734	.50 miles north of 734	10273	No
Richmond	Goochland	I-64 West	0.14 miles west of 617	0.34 miles west of 617	474	No
Richmond	Dinwiddie	I-85 North	3.32 miles north of 650	3.66 miles north of 650	663	No
Richmond	Henrico	157	0.9 miles north of St. Pages Lane	.10 miles north of the intersection of 7514 and 7526	1012	No
Richmond	Henrico	5	.04 miles east of Mill Rd.	.03 miles east of Strath Road	1786	No
Richmond	Chesterfield	668	.30 miles east of 4329	3699	8725	No
Richmond	Chesterfield	711	4193	3387	8677	No
Richmond	Hanover	656	623	0.19 miles north of I-95	1322	Yes
Richmond	Chesterfield	650	647	0.38 miles north of 647	1185	No
Salem	Botetourt	I-81 South	0.58 miles north of ramp to scales	.04 miles north of 220	427	No
Salem	Pulaski	114	11	0.5 miles east of 600	858	No
Salem	Carroll	52	0.15 miles north of 981	0.1 miles north of 686	1524	Yes
Salem	Pulaski	100	0.60 miles north of 822	0.9 miles north of 822	1304	No
Salem	Bedford	741	0.10 miles north of 812	0.40 miles north of 812	37359	No
Salem	Bedford	626	1.37 miles north of 627	1.67 miles north of 627	7827	No

Table E-1 (continued)

JLARC Sample of Highest Accident Rate Roadway Sections - 12 Months Ending 12/31/96
District Administrator Agreement/Disagreement That Site is One of Ten Most Hazardous in District

District	County	Route	From	To	Accident Rate	Agree?
Salem	Henry	657	1.7 miles east of 655	2 miles east of 655	5829	No
Salem	Carroll	682	0.30 miles east of 870	0.20 miles east of 674	5073	No
Staunton	Augusta	I-64 West	2.22 miles east of Waynesboro east city limits	250	598	Yes
Staunton	Warren	I-66 West	5.97 miles east of I-81	6.34 miles east of I-81	467	No
Staunton	Frederick	522	0.46 miles north of 673	0.18 miles north of 654	487	Yes
Staunton	Highland	250	0.8 miles east of 629	1.1 miles east of 629	2283	No
Staunton	Shenandoah	717	1.2 miles north of 263	George Washington National Forest boundary	15435	No
Staunton	Frederick	1054	1040	1061	8837	No
Staunton	Augusta	608	0.84 miles north of 898	1.14 miles north of 898	7305	No
Staunton	Augusta	612	1906	1907	347	Yes
Suffolk	Norfolk	I-264 East	337	0.9 miles east of 460	680	Yes
Suffolk	York	60	0.2 miles east of James City County line	0.13 miles east of private, un-named road	942	No
Suffolk	Suffolk	125	0.14 miles east of 627	337	2590	Yes
Suffolk	Surry	31	0.82 miles north of 620	0.30 miles north of 641	2454	No
Suffolk	York	637	1.77 miles east of Newport News City limits	2.17 miles east of Newport News City limits	14049	No
Suffolk	York	600	Big Bethel Reservoir	134	527	Yes
Suffolk	James City	612	0.39 miles east of 1570	0.3 miles east of 658	553	No
Suffolk	Suffolk	643	0.70 miles north of 759	1.04 miles north of 759	6849	No

Source: JLARC staff analysis of VDOT accident and road inventory data, and JLARC Staff Survey of VDOT District Administrators, June 1997.

Table E-2

JLARC Sample of Highest Accident Rate Intersections - 12 Months Ending 12/31/96
District Administrator Agreement/Disagreement That Site is One of Ten Most Hazardous in District

District	County	Route Intersection	Signalized	Accident Rate	Agree?
Bristol	Tazewell	19 and 460	Y	1.928	Yes
Bristol	Lee	58 and 724	N	3.936	No
Culpeper	Fluvanna	15 and 250	Y	2.912	No
Culpeper	Culpeper	644 and 715	N	7.631	No
Fredericksburg	Spotsylvania	2, 17 and 17 Business	Y	4.042	No
Fredericksburg	Spotsylvania	1140 and 1145	N	5.064	No
Lynchburg	Halifax	58 and 360	Y	2.144	No
Lynchburg	Appomatox	604 and 694	N	7.384	No
Northern Virginia	Fairfax	5401 and 8351	Y	13.121	No
Northern Virginia	Fairfax	3575 and 7680	N	54.794	No
Richmond	Hanover	156 and 643	Y	2.420	Yes
Richmond	Amelia	602 and 612	N	7.924	No
Salem	Henry	174 and 609	Y	2.175	Yes
Salem	Patrick	680 and 683	N	15.566	No
Staunton	Augusta	340 and 608	Y	1.463	Yes
Staunton	Augusta	778 and 865	N	13.978	No
Suffolk	James City	612, 658 and 1517	Y	2.083	Yes
Suffolk	Greensville	608 and 680	N	9.613	No

Source: JLARC staff analysis of VDOT accident and road inventory data, and JLARC staff survey of VDOT district administrators, June 1997.

Table E-3

Sample of Highest Accident Rate Roadway Sections for 12 Months Ending 12/31/93

District	County	Route	From	To	Accident Rate
Bristol	Buchanan	646	2.48 mi. E of 643	2.49 mi. E of 643	3106
Bristol	Grayson	604	0.6 mi. E of 644	0.9 mi. E of 644	7610
Bristol	Russell	80	0.73 mi. N of 656	1.13 mi. N of 656	2814
Bristol	Smyth	650	720	0.35 mi. N of 720	3727
Bristol	Smyth	660	0.54 mi. N of 659	0.7 mi. N of 1101 0.8	2029
Bristol	Smyth	81N	0.20 mi. N of 683	0.59 mi. N of 683	210
Bristol	Washington	19	1533	0.03 mi. N of 825	879
Bristol	Washington	81N	2.38 mi. N of 42 Service Road 2.39	0.03 mi. N of 52	387
Culpeper	Albemarle	641	0.13 mi. E of 606	29	2767
Culpeper	Albemarle	743	29	0.5 mi. N of 1315 0.6	771
Culpeper	Albemarle	631	1481	0.23 mi. N of 768	225
Culpeper	Albemarle	620	2.8 mi. N of 728	3.1 mi. N of 728	2818
Culpeper	Albemarle	64E	637	29	638
Culpeper	Fauquier	15	17/687	0.4 mi. N of 17/687 0.5	526
Culpeper	Fluvanna	6	675	0.6 mi. E of Scottsville ECL 0.7	1630
Culpeper	Louisa	522	2.09 mi. N of FR 88	0.1 mi. N of 663	1343
Fredericksburg	Caroline	207	0.01 mi. N of 95	0.2 mi. N of 652	1328
Fredericksburg	Spotsylvania	608	0.21 mi. N of 705	0.19 mi. N of 693	1494
Fredericksburg	Spotsylvania	605	0.2 mi. N of 647	646	1486
Fredericksburg	Spotsylvania	95N	6.78 mi. N of 606	0.01 mi. N of 1	189

Table E-3 (continued)

Sample of Highest Accident Rate Roadway Sections for 12 Months Ending 12/31/93

District	County	Route	From	To	Accident Rate
Fredericksburg	Stafford	630	0.1 mi. E of 95	0.04 mi. E of 1264	637
Fredericksburg	Stafford	610	648	0.6 mi. E of 1264	489
Fredericksburg	Stafford	1	0.3 mi. N of private unnamed road	0.1 mi. N of 631/687	724
Fredericksburg	Westmoreland	202	1.1 mi. E of 611	759	1985
Lynchburg	Campbell	622	1513	1520	273
Lynchburg	Campbell	712	831	711	4193
Lynchburg	Campbell	460	877	1520	682
Lynchburg	Halifax	678	0.1 mi. E of 681	0.1 mi. E of 781	6088
Lynchburg	Halifax	501	129/884	0.09 mi. N of 654	1288
Lynchburg	Nelson	56	844	0.3 mi. E of 844	1922
Lynchburg	Pittsylvania	743	1514	742	6764
Lynchburg	Pittsylvania	40	1320	29	1819
NOVA	Arlington	244	120	0.02 mi. E of South Orme St.	1178
NOVA	Fairfax	1720	0.05 mi. E of 2365	2335	1289
NOVA	Fairfax	613	0.35 mi. N of 618	0.02 mi. N of 8420	1282
NOVA	Fairfax	674	1.43 mi. N of 8188	1.89 mi. N of 8188	3591
NOVA	Fairfax	95N	Vicinity of interchange with 395 and 495		331
NOVA	Loudon	643	0.1 mi. N of 648	0.1 mi. n of 653	5452
NOVA	Loudon	287	1.13 mi. N of 717	1.43 mi. N of 717	1369
NOVA	Prince William	253	1	0.01 mi. N of 9344	1892
Richmond	Chesterfield	650	360	3830	1565
Richmond	Chesterfield	651	0.71 mi. E of FR-1026	0.25 mi. E of 653	3658

Table E-3 (continued)

Sample of Highest Accident Rate Roadway Sections for 12 Months Ending 12/31/93

District	County	Route	From	To	Accident Rate
Richmond	Dinwiddie	603	672	0.3 mi. E of 672	3623
Richmond	Hanover	656	623	0.1 mi. N of 95	1203
Richmond	Henrico	1	Lakeside Blvd.	Brookside Blvd.	785
Richmond	Henrico	5	0.08 mi. E of School Rd.	Buffin Rd.	1380
Richmond	Mecklenburg	85S	0.85 mi. N of South Hill NCL	1.15 mi. N of South Hill NCL	608
Richmond	Prince George	95N	0.58 mi. N of Collector Rd.	0.01 mi. N of 460/Collector Rd	407
Salem	Botetourt	81N	5.2 mi. N of 640	11	293
Salem	Carroll	740	0.2 mi. E of 745	0.6 mi. E of 745	6523
Salem	Carroll	683	0.6 mi. E of 904	0.3 mi. E of 725	5629
Salem	Carroll	221	0.03 mi. N of 9984	100/669	1461
Salem	Franklin	705	714	0.3 mi. N of 714	5798
Salem	Franklin	122	1.2 mi. N of 616	1.5 mi. N of 616	992
Salem	Henry	220	Vicinity of 902 and 1415		1138
Salem	Roanoke	720	419	0.2 mi. N of 1626	250
Staunton	Alleghany	64W	1.6 mi. E of 60	1.93 mi. E of 60	390
Staunton	Alleghany	60	0.63 mi. E of 651	0.2 mi. E of 772	1170
Staunton	Frederick	522	0.51 mi. N of 673	0.2 mi. N of 654	681
Staunton	Rockbridge	631	0.4 mi. E of 9516	0.1 mi. E. of 704	1597
Staunton	Rockbridge	81S	0.74 mi. N of 710	1.14 mi. N of 710	353
Staunton	Rockingham	637	0.4 mi. E of 602	0.9 mi. E of 602	5923
Staunton	Rockingham	644	0.3 mi. N of 646	0.6 mi. N of 646	1365
Staunton	Shenandoah	678	769	0.25 mi. N of 803	5860
Suffolk	Accomack	602	0.15 mi. N of Northampton County line	0.45 mi. N of Northampton County line	4280

Table E-3 (continued)

Sample of Highest Accident Rate Roadway Sections for 12 Months Ending 12/31/93

District	County	Route	From	To	Accident Rate
Suffolk	Greensville	611	0.3 mi. E of 658	0.67 mi. E of 658	2863
Suffolk	Isle of Wight	258	2.93 mi. E of 652	0.2 mi. E of 620	1141
Suffolk	James City	658	0.5 mi. E of 612	0.81 mi. E of 612	920
Suffolk	James City	31	727	706	1639
Suffolk	Suffolk	616	0.3 mi. E of 615	0.36 mi. E of 615	5407
Suffolk	York	64E	17	0.03 mi. E of 17	971
Suffolk	York	60	0.02 mi. E of James City County line	0.04 mi. E of Road to Kingsmill	537

Note: Accident rate defined as number of crashes per 100 million vehicle miles traveled.
Source: VDOT.

Table E-4

Sample of Highest Accident Rate Intersections for 12 Months Ending 12/31/93

District	County	Signal	Route 1	Route 2	Route 3	Accident Rate
Bristol	Tazewell	YES	460	783	N/A	2.599
Bristol	Tazewell	NO	655	680	N/A	8.615
Culpeper	Albemarle	YES	29	866	N/A	2.692
Culpeper	Fauquier	NO	626	807	N/A	6.866
Fredericksburg	Caroline	YES	207	652	N/A	2.141
Fredericksburg	Spotsylvania	NO	639	1110	N/A	37.53
Lynchburg	Halifax	YES	58	501	N/A	2.403
Lynchburg	Prince Edward	NO	628	630	637	13.833
NOVA	Fairfax	YES	29	1021	N/A	4.423
NOVA	Loudon	NO	662	663	N/A	9.831
Richmond	New Kent	YES	60	33	N/A	4.016
Richmond	Goochland	NO	634	702	N/A	19.025
Salem	Henry	YES	174	609	N/A	2.178
Salem	Pulaski	NO	626	798	N/A	6.074
Staunton	Augusta	YES	340	631	N/A	1.985
Staunton	Frederick	NO	640	737	N/A	25.604
Suffolk	Southampton	YES	35	58	N/A	2.421
Suffolk	Northampton	NO	183	614	N/A	6.601

Note: Accident rate defined as number of of crashes per million vehicle miles traveled.
Source: VDOT crash data for 12 months ending December 31, 1993.

Appendix F

Most Hazardous Roadway Sites Identified by VDOT District Administrators

District	County	Route	From	To	Avg. Daily Traffic	Accident Rate	Injury Rate	Actual or Programmed Improvements to Location	Type of Actual or Programmed Improvement *(Desired Improvements Not Yet Programmed or Funded are Shown in Italics)*
Bristol	Washington	647	140	Bristol NCL	5286	94	69	Yes	Widen shoulder to four foot minimum, improve horizontal alignment
Bristol	Scott	71	72	791	3000	75	60	Yes	Preliminary engineering for shoulder widening and safety enhancements. *Total upgrade of corridor is desired*
Bristol	Tazewell	460	19	637	11000	31	23	No	None
Bristol	Washington	19	Abingdon ECL	1533	11000	44	44	No	None
Bristol	Washington	81	Bristol ECL	Tennessee State Line	40000	43 NB / 94 SB	36 NB / 69 SB	Yes	Widen from four lanes to six
Culpeper	Fauquier	29	17	Prince William County Line	NP	1.34 - 2.71	NP	Yes	Preliminary Engineering Study to determine method of improvement along entire corridor.
Culpeper	Albemarle, Fluvanna, Louisa	64	Augusta County Line	Goochland County Line	NP	0.6	NP	Yes	Upgrade fog detection system on Afton Mountain
Culpeper	Fauquier	66	Warren County Line	Prince William County Line	NP	0.36	NP	No	None
Culpeper	Culpeper	29	633	685	NP	0.97 - 3.02	NP	Yes	Preliminary Engineering Study to determine method of improvement along entire corridor.
Culpeper	Fauquier	17	Stafford County Line	Loudon County Line	NP		NP	Yes	Warrenton bypass spur - four lanes on new location; Opal intersection of 15/29/17 - Strobe lights installed, Construction of left turn lane at four locations is underway, Grade separate interchange being designed, plans to extend northbound acceleration lane on Route 17
Culpeper	Albemarle	250	738	Charlottesville WCL	NP	1.61 - 1.92	NP	Yes	Realign east intersection with Route 809 in vicinity of Belair subdivision This is just a small spot on the overall corridor
Culpeper	Albemarle	250	Charlottesville ECL	Fluvanna County Line	NP	0.42 - 3.16	NP	No	None
Culpeper	Fauquier	28	15/29	Prince William County Line	NP	1.41 - 2.50	NP	Yes	Widen from two to four lanes, improve curve at Rt. 610 (Midland)
Culpeper	Culpeper, Rappahanock	729	229	211	NP	1.42 - 1.73	NP	Yes	Road edge reflectors, repaint centerline, trim back new vegetation, enlarge existing 40 mph safe speed advisory signs, reduce speed limit to 45 mph

District	County	Route	From	To	Avg. Daily Traffic	Accident Rate	Injury Rate	Actual or Programmed Improvements to Location	Type of Actual or Programmed Improvement *(Desired Improvements Not Yet Programmed or Funded are Shown in Italics)*
Culpeper	Orange,	15	Orange NCL	Culpeper SCL	NP	0.37 - 4.89	NP	No	None
Culpeper	Albemarle	631	Charlottesville NCL	743	NP	3.11	NP	Yes	Widen shoulders and install guardrail Improve horizontal/vertical alignment and install exclusive turn lanes if feasible
Culpeper	Fluvanna, Louisa, Orange	15	250	Orange SCL	NP	0.42 - 3.83	NP	Yes	Intersection improvements and widening at Rt. 250. Bridge replacement in Madison County. This location is just a small spot at southern terminus of corridor identified by district traffic engineer
Culpeper	Orange	20	Orange NCL	3	NP	0.65 - 1.13	NP	No	None
Culpeper	Albemarle	743	29	Greene County Line	NP	2.33 - 7.81	NP	Yes	Widen from two lanes to four from Rt 29 to Rt 631with continuous fifth left turn lane, signal modifications at several intersections to provide left turn arrow
Culpeper	Albemarle, Orange	20	250	Orange SCL	NP	0.27 - 2.58	NP	Yes	Will install "Watch for Turning Vehicles" warning signs. Considering continual left and right turn lanes at Rt. 769
Culpeper	Albemarle	20	712	64	NP	0.65 - 2.50	NP	Yes	Bridge replacement, preliminary engineering to widen to 1 mile section at Rt 53 to four lanes (just two small sections of entire corridor)
Culpeper	Fauquier	17	66	Loudon County Line	NP	0.5 - 0.54	NP	No	None
Culpeper	Albemarle, Greene	29	743	33	NP	0.81 - 3.69	NP	Yes	Preliminary Engineering Study to determine method of improvement along entire corridor. Also, 7 miles being widened from 4 to 6 lanes along 3 sections in Albemarle. Vertical alignment project along 0.6 km in Albemarle. 29 bypass project in Albemarle. Two bridge replacements in Albemarle.
Fredericksburg	Spotsylvania	610	150 feet west of 684	1226	42514	444	267	No	*Widen to 6 lane divided*
Fredericksburg	Spotsylvania	639	3	618	11655	948	371	Yes	Widen to multi-lane divided highway
Fredericksburg	Spotsylvania	1	17	686 feet north of 636	24500	385	214	No	*New facility - probably 6 lane divided*
Fredericksburg	Stafford	1	697	Ramp to I-95 North	18000	704	416	No	*Widen road to provide median divided access control*

District	County	Route	From	To	Avg. Daily Traffic	Accident Rate	Injury Rate	Actual or Programmed Improvements to Location	Type of Actual or Programmed Improvement *(Desired Improvements Not Yet Programmed or Funded are Shown in Italics)*
Fredericksburg	Spotsylvania	1 Business	1234	1227/1217	14000	491	238	No	*Widen to 4 lane median divided for 1.3 miles*
Lynchburg	Pittsylvania	29	0.6 miles north of 863	0.3 miles south of 864	15000	2163	missing	No	*Realign southbound lane to remove curve and improve sight distance.*
Lynchburg	Pittsylvania	58	0.5 miles west of 62	62	8800	895	missing	No	*Raise grade of EB 58 with eight inches of plant mix to improve sight distance at intersection*
Lynchburg	Appomatox	26	Intersections with 611/624, 663,608, and 659		2400	missing	missing	No	*Adjust grade along 26*
Lynchburg	Charlotte	15/360 ramp			5600	unknown	missing	No	*3 acceleration and 3 deceleration lanes at the ramps*
Lynchburg	Nelson	Intersection of 151 and 56			1900	unknown	missing	No	*Lower grade on 151 to improve sight distance, realign 56 to eliminate 'y' intersection*
Richmond	Henrico	Intersection of 33 and Laburnum Ave			45200	1.15	0.54	No	None
Richmond	Henrico	Intersection of 157 and Three Chopt Road			28000	1.76	0.58	No	None
Richmond	Chesterfield	Intersection of 1 and 613			46300	0.84	0.54	No	None
Richmond	Chesterfield	Intersection of 1 and 618			22400	1.32	0.53	No	None
Richmond	Henrico	Intersection of 1 and Wilmer Ave			26000	1.16	0.84	No	None
Salem	Franklin	Intersection of 220, 619, 816			18000	missing	missing	No	None
Salem	Carroll	52	0.64 miles north of NC line	1.24 miles north of NC line	6000	1953	1242	No	None
Salem	Henry	Intersection of 174 and 609			6000	16678	226209	Yes	Modify traffic signal by replacing span wires and installing protected left turn arrows
Salem	Henry	220	929	902	17000	452	905	Yes	Realign 902/220. Close and shift crossovers, consolidate commercial entrances, install turn lanes
Salem	Roanoke	419	220	904	48344	597	235	No	None
Staunton	Frederick	522	739 north	739 south	17000	679	594	No	Install turn lane, lengthen right turn lane, widen road to provide dual left turn lanes
Staunton	Augusta	Intersection of 11 and 340			9400	1.57	1.75	Yes	Reconstruct intersection to eliminate "y"

District	County	Route	From	To	Avg. Daily Traffic	Accident Rate	Injury Rate	Actual or Programmed Improvements to Location	Type of Actual or Programmed Improvement *(Desired Improvements Not Yet Programmed or Funded are Shown in Italics)*
Staunton	Rockingham	Intersection of I-81 and 33			41000	225 NB/ 325 SB	125 NB/ 175 SB	No	None
Staunton	Augusta	Intersection of 340 and 612			6397	2.3	2.71	Yes	left turn lanes, improve sight distance
Staunton	Warren	340	619	607	5400	190	178	Yes	Reconstruction of 1.2 mile section of two lane road at intersection with 619
Suffolk	York	600	Big Bethel	134	10897	527	276	Yes	Install left turn lane, right turn lane
Suffolk	James City	Intersection of 612, 658, and 1517			missing	2.083	missing	No	*Install left and right turn lanes*
Suffolk	Sussex	Intersection of 301 and 139			5800	4.31	4.85	No	*Hazard identification beacons*
Suffolk	Sussex	460	WCL Wakefield	31	6800	362	483	No	*Continuous left turn lane*
Suffolk	Suffolk	Intersection of 125 and 129			3844	2.92	2.09	No	*Improve sight distance, add turn lanes at intersection*

Note: The Northern Virginia district declined to identify any roadway locations as being the five most hazardous in the district. Average daily traffic and injury rate data not provided (NP) by Culpeper district. NB - northbound, SB - southbound, EB - eastbound, WB - westbound. Some accident rate data provided by VDOT staff as a range.

Source: JLARC survey of VDOT district administrators, June 1997.

Appendix G
Agency Response

As part of an extensive data validation process, State agencies involved in a JLARC evaluation are given the opportunity to comment on an exposure draft of the report. Appropriate technical corrections resulting from written comments have been made in this final report. Page references in the agency responses relate to the earlier exposure draft and may not correspond to the page numbers in this version.

This appendix contains the response from the Virginia Department of Transportation.

COMMONWEALTH *of* VIRGINIA

DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, 23219

DAVID R. GEHR
COMMISSIONER

September 5, 1997

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

Dear Mr. Leone: Phil

Thank you for the opportunity to review and comment on the exposure draft of the report entitled "Improvement of Hazardous Roadway Sites in Virginia".

Attached are our comments on the recommendations with suggestions and additional information that should help finalize this report. We agree with many of the findings and conclusions of the report. As you can see from our comments on each one of the recommendations, VDOT is either implementing or has planned enhanced procedures to meet the safety objectives of our strategic plan. Also, I appreciate the opportunity to meet with you and your staff to share additional comments on this report.

Please let me know if we can answer any further questions or provide additional assistance.

Very truly yours,

Dave

David R. Gehr
Commissioner

Attachment

copy: The Honorable Robert E. Martínez

VIRGINIA DEPARTMENT OF TRANSPORTATION COMMENTS ON THE JLARC REPORT ON THE SAFETY IMPROVEMENT PROGRAM

Recommendation #1: *The Virginia Department of Transportation should examine the adequacy of its procedures for administering and enforcing statutory provisions pertaining to commercial entrances to ensure that permitting requirements are enforced uniformly across the State. The Department should report the findings of its evaluation to the House and Senate Transportation committees.*

- VDOT agrees with this recommendation.
- VDOT has been continuously improving its procedures in the area of land development. Upgrades and enhancements to the Minimum Guidelines for Entrances to State Highways have recently been reviewed and approved by the Commonwealth Transportation Board. In June of this year, the Minimum Guidelines for Entrances to State Highways was officially adopted by the Commonwealth Transportation Board (CTB), and is currently being printed for statewide dissemination.
- VDOT is producing a Land Development Manual that is a procedural guide for site plan and subdivision review process that will provide consistency and uniformity of application across the state. The Land Development Manual is a resource document for VDOT staff, local jurisdictions as well as engineering consultants. In an effort to further enhance the consistency of application, a team of VDOT personnel from around the state developed a two and a half day training class on the procedures established in the Land Development Manual. VDOT personnel from each district involved at all levels of land development decision making attended these training sessions.

Recommendation #2: *The Virginia Department of Transportation should identify best practices by its districts concerning use of the critical rate data on a daily operational basis and implement those practices in other districts and divisions.*

- VDOT agrees with this recommendation.
- Central Office Traffic Engineering Division staff has been presenting information to district staffs over the last year in an effort to increase the awareness and understanding of the safety improvement program. The people who have attended these presentations are responsible for submitting applications and programming projects once they are approved for funding at both the district and residency levels. These presentations are intended to promote consistency statewide and to share the practices from different districts.
- Best practices are being shared across the state using forums such as the quarterly District Traffic Engineer's meeting and presentations conducted by the Central Office Traffic Engineering Division staff. A consistent and reliable procedure for identifying and investigating the high accident rate locations is being pursued.

Recommendation #3: *The Virginia Department of Transportation should take all necessary actions to ensure that data prepared for publication in the critical accident rate listings and the Summary of Crash Data publication is provided in an accurate and timely fashion.*

- VDOT agrees with this recommendation.
- There are several factors that affect the "timeliness" of the crash records. For example, the final 1996 crash data was not available until April 1997 due to the time lag between the crash occurring on the roadway and the report being processed into the database. For 1996, the police departments around the state were responsible for providing all reports to Department of Motor Vehicles (DMV) by February 28, 1997. If a crash occurred on December 31, 1996, one month is provided to the law enforcement agencies to ensure that all of the details for the crash are investigated. VDOT shares this crash data with several outside state agencies including the Department of State Police (DPT) and DMV.

- VDOT has greatly improved the lag time over the past three years, from a six to eight month reporting period to a three month reporting period, with the assistance of automated procedures and cooperative efforts between state and local police, DMV, and VDOT. VDOT is continuously working to reduce this time even further.
- The Traffic Engineering Division is presently working with the Information Technology Division (ITD) to fully automate the development of the Summary of Crash Data book. This procedure will significantly reduce the amount of time required to produce the crash summary books. Prior to publication of the Summary of Crash Data book, the data is always accessible from the database.
- The newly developed intersection critical accident rate program was designed so district engineers can access the data at any time of the year from the computers in their office, rather than relying on Central Office staff to provide the reports.

Recommendation #4: *The Virginia Department of Transportation should develop plans for the automation of currently available traffic count data for streets in Virginia's cities and towns. The Department should use that automated data, in conjunction with other automated traffic count data obtained through its new urban traffic count program, to calculate critical accident rates for Virginia's cities and towns in order to better evaluate applications for hazard elimination safety program funding.*

- VDOT agrees with this recommendation.
- Continuous count sites have been installed in cities and towns throughout the state. Since the traffic count program is on a three-year cycle, traffic will be available on roadways functionally classified as collector and above in all of the cities and towns in Virginia by the end of 1999. At that time, the critical rate program will be adjusted to compute accident rates in the cities and town. This information will assist the cities and towns in identifying the high accident rate locations.

Recommendation #5: *The Commonwealth Transportation Board and the Virginia Department of Transportation should work with the U.S. Federal Highway Administration to develop a plan to use available federal funds to reimburse appropriated State funds for the Hazard Elimination Safety Program, in order to expedite the design and construction of approved safety projects. The Department should submit its plan for approval by the 1998 General Assembly.*

- VDOT agrees with the intent of this recommendation with the following comments.
- Project approval may be a formality, but funding approval is strictly regulated. According to federal regulations, projects must be included in the appropriate Transportation Improvement Program (TIP) and Statewide Transportation Improvement Program (STIP) for the phase of work to be undertaken during the year. The TIP is developed by the Metropolitan Planning Organizations (MPO) in urbanized areas with population greater than 50,000 such as Charlottesville, Lynchburg, Hampton Roads, Fredericksburg, Danville, Roanoke, Northern Virginia, Richmond, Bristol-Kingsport and Tri-Cities. Areas with less than 50,000 population are included in the Planning District Commission (PDC) and are not required to have a TIP. However, these areas must be included in the STIP. Individual phase authorizations must be received in order to initiate preliminary engineering, right-of-way, and construction. Any work performed with state funds prior to receipt of federal authorization is not eligible for federal reimbursement.
- VDOT can and does accelerate the engineering starts using Advance Construction provisions of the federal process. While this does not shorten the time between preliminary engineering authorization and construction, it can reduce the time lag between project selection and the initiation of preliminary engineering. It is still necessary to ensure that each project is appropriately included in the TIP/STIP prior to the start of preliminary engineering. This procedure has been implemented for the safety improvement projects, and has allowed the authorization of preliminary engineering to be approved four to six months sooner than before the procedure was adopted. Since preliminary engineering work is initiated sooner on these smaller projects, the other phases of the project may be also moved forward.

- Due to the program and funding uncertainties of the federal authorization legislation, VDOT is unclear as to how the safety program will be modified. It may be more appropriate for VDOT to develop a plan of improvement for the General Assembly to review at the 1999 session.

Recommendation #6: *The Virginia Department of Transportation should develop an updated policy statement governing the State Traffic Operations and Safety Improvement Program (STOSIP). The policy statement should (1) state clear rationale for the amount of the annual allocation to be received by each district, (2) state to what extent allocations can be used to purchase right-of-way, and (3) provide clear guidance on situations in which allocations may be carried over or exceeded. The Virginia Department of Transportation should also determine whether the current STOSIP allocation levels remain appropriate, and consider the benefits and cost of making STOSIP funds available to the secondary highway system.*

- VDOT agrees with this recommendation.
- STOSIP is a discretionary allocation subject to annual commitment by the Commonwealth Transportation Board (CTB). At the annual update of the Six-Year Improvement Program, the CTB sets aside an amount of money to fund unanticipated safety and operational projects on the primary road system that may arise throughout the year.
- Right-of-way expenditures are permitted on STOSIP projects. According to the goals of the STOSIP program, "It is intended that preliminary engineering and right-of-way costs be held to a minimum…" The primary focus of the program is to allow the District Administrator to develop and implement, in an expedient manner, low cost projects to improve traffic operations and safety at locations that do not meet the criteria for Federal funds.
- State statute does not permit expending district primary funds for secondary system projects. Each county Board of Supervisors has the latitude to include a STOSIP-like program funded from their respective county secondary system allocation.

Recommendation #7: *The Virginia Department of Transportation should more aggressively and proactively monitor the State Traffic Operations and Safety Improvement Program (STOSIP) in order to ensure that allocated funds are expended during the fiscal year for which they are allocated, and that project authorizations and expenditures are made in accordance with allocation policy.*

- VDOT agrees with this recommendation.
- The Programming and Scheduling Division staff attends the monthly operational staff meeting which includes the District Administrators as well as the State Traffic Engineer. These meetings provide an excellent forum to communicate any revised guidelines adopted by VDOT management, the need to expend the money during the fiscal year for which it is allocated, and to encourage its usage in districts where the allocations are being under utilized.

Recommendation #8: *The Virginia Department of Transportation should work cooperatively with other State and local agencies in order to identify effective methods and strategies that are available to enhance safety on the State highway system with a focus on improving the compliance of motorists with Virginia's highway safety laws and regulations.*

- VDOT agrees with this recommendation.
- The Safety Management System has provided a forum for various state agencies to discuss safety-related issues such as work zone safety and access management. As stated in the report, there are many organizations involved including DMV, State Police, Emergency Medical Services, Department of Health, and local agencies.

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