FINAL REPORT

IMPACT OF THE 65 MPH SPEED LIMIT ON VIRGINIA'S RURAL INTERSTATE HIGHWAYS: 1989-1992

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Abstract

In April of 1987, Congress passed the Surface Transportation and Uniform Relocation Assistance Act (STURAA), which permitted states to raise their maximum speed limit on rural interstate highways to 65 mph. Virginia's 65 mph speed limit went into effect on July 1, 1988, for passenger vehicles and on July 1, 1989, for commercial buses. This is the final report in a series to examine the 65 mph speed limit in Virginia, and it summarizes Virginia's experience with the 65 mph speed limit from 1989 through 1992. Following the implementation of the 65 mph speed limit, average and 85th percentile speeds increased on Virginia's rural interstates, and fatal crashes and fatalities increased significantly. On Virginia's urban interstates, on which the speed limit remained at 55 mph, there was a smaller increase in average and 85th percentile speeds, but there was a slight, nonsignificant decrease in fatal crashes and fatalities. Absolute numbers of fatal crashes and fatalities were used in this analysis rather than rates because traffic volume increases on interstates are averaged for both rural and urban systems. Thus, if volumes increased more on rural interstates, comparisons of relative rates would be misleading. The data in this report clearly show that speeds, fatal crashes, and fatalities increased on Virginia's rural interstates after the implementation of the 65 mph speed limit. However, these increases appear to have plateaued in the last two years of the study. Reports from other states and from national studies reflect a general increase in travel speeds and fatal crashes on rural interstates, but there is conflicting evidence on whether the 65 mph speed limit is the cause. Likewise, there is conflicting evidence concerning whether differential speed limits for trucks and cars have had an impact on the frequency of crashes in states maintaining such differential limits.

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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

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EXECUTIVE SUMMARY

In 1974, Congress established the 55 mph national maximum speed limit (NMSL) for all roads as an energy conservation measure in response to the Arab oil embargo. Prior to the establishment of the NMSL, many of the nation's highways had speed limits in excess of 55 mph. One effect of the NMSL was a substantial reduction in traffic injuries and fatalities. Rural interstate highways had the lowest level of compliance with the NMSL, but they also had among the lowest fatality rates. Because of this, Congress included a provision in the Surface Transportation and Uniform Relocation Assistance Act of 1987 to allow states to raise their speed limit on interstates in rural areas to as high as 65 mph and still receive full federal-aid funding. On July 1, 1988, Virginia became the fortieth of 41 states to implement the 65 mph speed limit on at least a portion of their rural interstate highway system.

Although higher speeds are not necessarily related to a greater chance of being involved in a crash, they do increase the injury-producing potential of crashes that occur. Thus, there was a concern that allowing and even encouraging higher speeds would increase injuries and fatalities. Further, many believed that higher speeds and their negative consequences would spill over onto other roads, particularly urban interstates. Thus, since the implementation of the 65 mph speed limit on Virginia's rural interstates, the Virginia Transportation Research Council has been monitoring its impact in cooperation with the Virginia Departments of Transportation, Motor Vehicles, and State Police.

Since the implementation of the higher rural interstate speed limit, speeds have increased on both urban and rural interstates: 5.2 mph on rural interstates and 3.1 mph on urban interstates (see Figure ES-1.) The 85th percentile speeds also increased on both rural and urban interstates: 6.3 mph on rural interstates and 3.5 mph on urban interstates. (see Figure ES-2.)

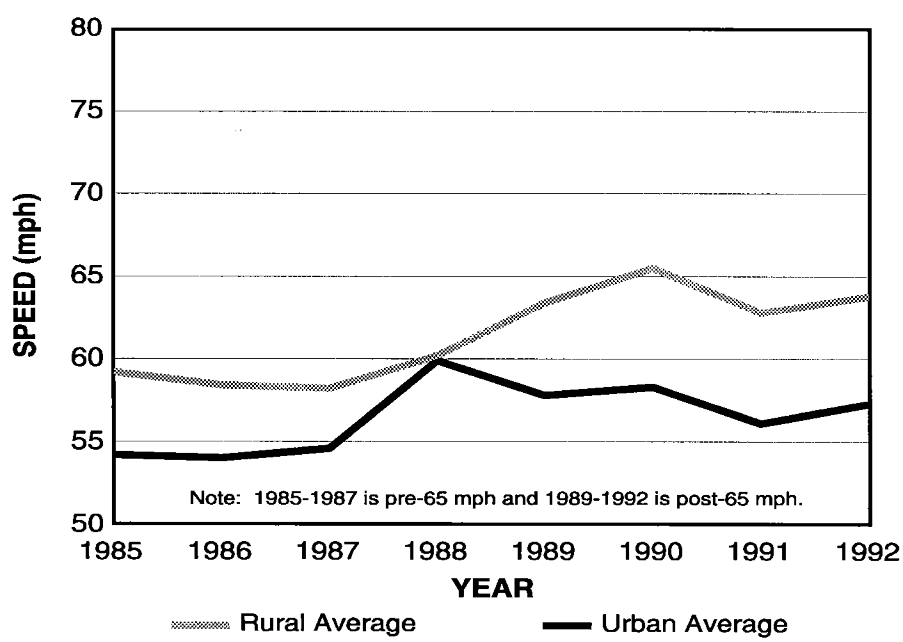

Figure ES-1. Average Speeds on Virginia's Rural and Urban Interstates, Pre- and Post-65 mph Limit.

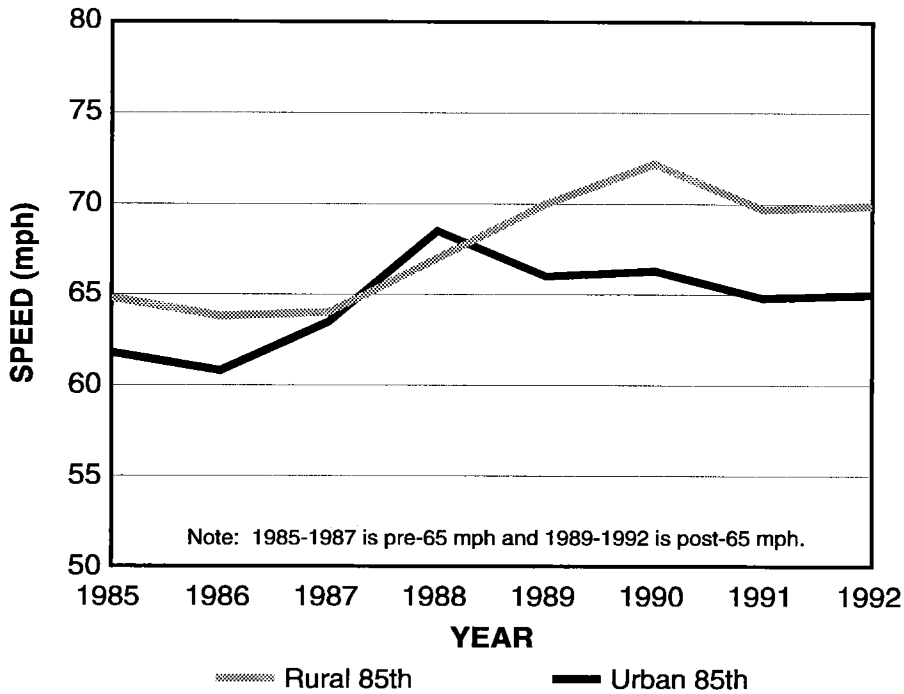

Figure ES-2. 85th Percentile Speeds on Virginia's Rural and Urban Interstates Pre- and Post-65 mph Limit.

Although urban interstate speeds increased, there was a slight, nonsignificant decrease in fatal crashes and fatalities (see Figures ES-3 and ES-4.) On rural interstates, there were significant increases in fatalities and fatal crashes: fatalities by 21.1 for an average of 70.8 per year and fatal crashes by 19.2 for an average of 62.5 per year. The greatest increases in fatal crashes included an increase of 7.0 per year for those involving trucks and 16.0 per year for those involving vehicles running off the road. Absolute numbers of fatal crashes and fatalities were used in this analysis rather than rates because traffic volume increases on interstates are averaged for both rural and urban systems. Thus, if volumes increased more on rural interstates, comparisons of relative rates would be misleading.

Analysis of yearly post-65 data indicated that the increases in speed, fatal crashes, and fatalities on rural interstates plateaued in recent years. Thus, although post-65 speeds, fatal crashes, and fatalities are higher than prior to the speed limit change, there is no evidence that they will continue to increase each year.

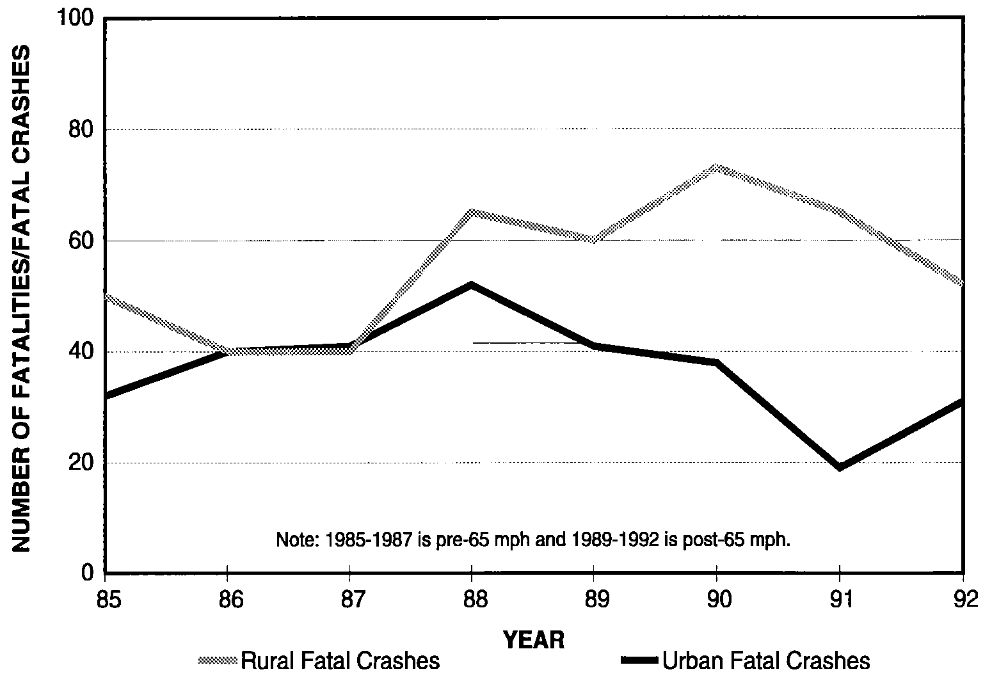

Figure ES-3. Fatal Crashes on Virginia's Urban and Rural Interstates, Pre- and Post-65 mph Limit.

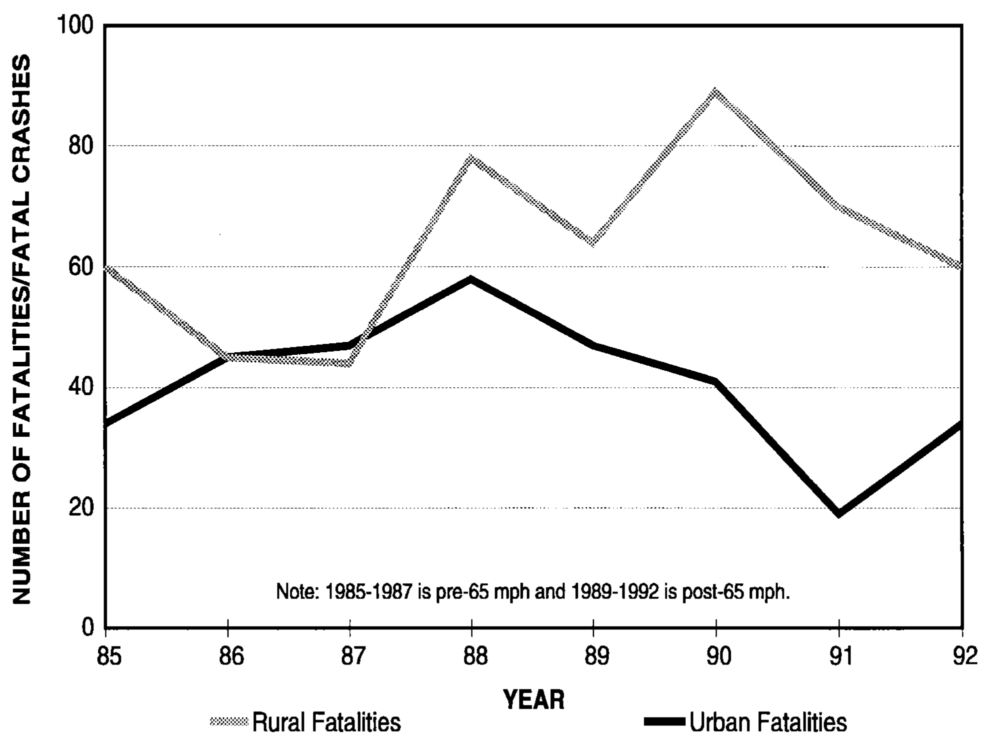

Figure ES-4. Fatalities on Virginia's Urban and Rural Interstates, Pre- and Post-65 mph Limit.

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INTRODUCTION

The Arab oil embargo of 1973 resulted in the Emergency Highway Energy Conservation Act of 1974, which set the national maximum speed limit (NMSL) at 55 mph for all roads as a fuel conservation measure. Prior to 1974, many states allowed speeds in excess of 55 mph. A benefit of the 55 mph NMSL was that serious crashes, fatalities, and serious injuries decreased (Transportation Research Board [TRB], 1984).

Between 1974 and 1986, the Federal Highway Administration (FHWA) enforced a mandatory compliance rate of 50% with the NMSL in order for states to receive full federal highway funding. Noncompliance could result in the FHWA impounding 10% of a state's federal-aid highway funds. Many states had increasing difficulty meeting this standard, especially larger, western states whose residents supported a higher speed limit to facilitate traveling long distances (McKnight & Klein, 1990). The mounting public desire for a higher speed limit combined with the states' concern about losing funding placed pressure on Congress to raise the NMSL.

Rural interstates, which had the lowest compliance rate and among the lowest fatality and injury rates of all road systems, surfaced in the Congressional debate as strong candidates for a higher speed limit. In 1987, Congress passed the Surface Transportation and Uniform Relocation Assistance Act (STURAA), which contained a provision allowing states to increase the maximum speed limit to 65 mph on all or a portion of their rural interstate highway systems. Further, rural interstates with a speed limit greater than 55 mph would be removed from the federal compliance monitoring program, thereby alleviating the threat to a state's federal-aid highway funding.

By the end of 1987, 38 states had increased the maximum speed limit on portions of their rural interstates to 65 mph. On July 1, 1988, Virginia became the fortieth of 41 states to adopt 65 mph as the maximum speed limit for at least a portion of their rural interstate system. The legislation included a provision that trucks and commercial buses be restricted to a 55 mph maximum speed limit. However, effective July 1, 1989, Virginia's rural interstate speed limit for commercial buses was raised to 65 mph.

Relationship of Speed and Crashes

Because of the reduction in serious crashes after the NMSL was put into effect, it was hypothesized that an increase in the speed limit on rural interstates would lead to an increase in the number of serious crashes and fatalities on these highways. Previous studies have found that an increase in speed is not related to an increase of crash frequency; however, an increase in speed has been demonstrated to affect the severity of crashes. For example, a 20% increase in speed (e.g., from 50 to 60 mph) produces a 44% increase in the kinetic energy that must be absorbed by the vehicle and its passengers in the event of a crash (Kelley, 1973). Thus, at higher speeds, crashes are potentially more severe.

Speed variance, a measure of the relative distribution of travel speeds on a roadway, relates to crash frequency in that a greater variance in speed between vehicles correlates with a greater frequency of crashes, especially crashes involving two or more vehicles. Clearly, vehicles traveling the same speed in the same direction do not overtake one another; therefore, they cannot collide as long as the same speed is maintained. Garber and Gadiraju (1988) collected data from 36 sites in Virginia, including rural and urban interstates, rural and urban arterials, and freeways and expressways. They found that between 25 mph and 70 mph, speed variance decreases as the average speed increases. Thus, vehicles traveling at higher speeds would be more likely to be traveling at a similar speed and thus less likely to collide.

There is some evidence to support the view that an increase in speed will not result in more crashes. In a landmark study, Solomon (1964) determined that more crashes occur at lower speeds than at higher speeds. Figure 1 shows Solomon's U-shaped curve relating speed to crash rates. Solomon found that at speeds differing from the average, crash rates are higher than at speeds at or slightly above average (Solomon, 1968).

Lund and Freedman (1992) criticized Solomon, claiming he used poor research methods. According to them, Solomon sampled 51 sites from only 11 states, none of which was randomly selected or controlled for similarity. In fact, sites measured between 5 and 51 miles in length. In addition, Solomon included crashes occurring at intersections and those involving turning vehicles, which may account for the large number of crashes occurring at low speeds. Moreover, intersection crashes and crashes involving turning vehicles are not applicable to limited access, rural interstates.

Additionally, the Research Triangle Institute (1970) found no evidence that slower vehicles have more frequent crashes. The organization performed a study of rural interstate crashes in Indiana and removed from their data all crashes occurring at intersections and involving turns. The study found that when these crashes were removed, there was no difference in the crash frequency of vehicles traveling 15 mph or more below the speed limit and those traveling at the speed limit.

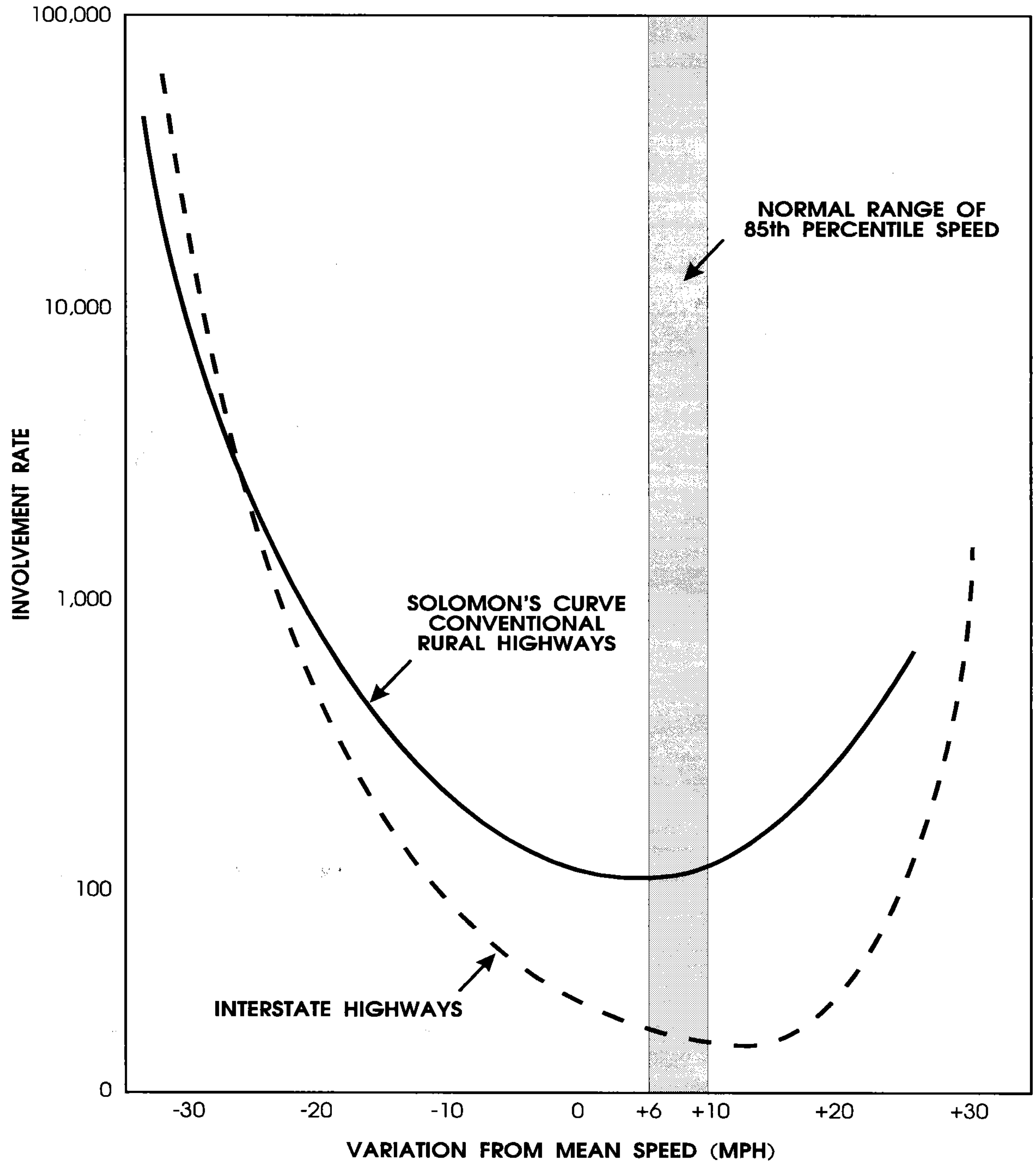

Figure 1. Relationship Between Variation From Mean Speed and Crash Involvement Rates.

Another topic related to speed variance is the effectiveness of differential speed limits (DSLs) for passenger vehicles and trucks. Trucks have slower acceleration rates and require more time to decelerate than passenger vehicles. Further, the weight and slower deceleration rate of large trucks function to increase the damage and injury potential of crashes between trucks and smaller vehicles. Higher speeds further increase the potential for damage and injury. However, speed variance is increased when trucks travel at a different speed than other vehicles. Garber and Gadiraju (1991) have argued against DSLs because they increase speed variance. Employing 11 sites in 4 states, their study found no significant evidence that DSLs result in a reduction in crashes between trucks and other vehicles, or any two-vehicle crashes. They have further suggested that, in Virginia, DSLs are responsible for an increased number of rear-end crashes.

After examination of other speed variance studies, it appears that truck-related increases in speed variance may be less of an issue in reality than in theory because the DSLs are often not obeyed. On average, truck speeds are lower than nontruck speeds, but not by the designated 10 mph. A study by Esterlitz, Baum, Zador, and Penny (1990) found that trucks traveled an average of 1.4 mph slower than nontrucks in states employing DSLs (cars 65 mph, trucks 55 mph), which is not a significantly lower speed.

Further, studies on drivers' attitudes toward the speed limit have demonstrated that drivers will ignore the posted speed limit and will tend to travel at the speed for which the particular roadway is designed or at a speed appropriate for existing conditions (Garber & Gadiraju, 1988). Sievers (1976) surveyed New Mexican drivers using self-report methods and found that fewer than 20% traveled at or below the 55 speed limit. Also, Garber and Gadiraju (1988) found that drivers tended to ignore the posted speed limit and travel at higher speeds as roadway characteristics improved.

Thus, from the literature, it is clear that higher speeds increase the severity of crashes. Further, speed variance has been attributed to causing an increase in the frequency of crashes. However, there is conflicting evidence regarding whether or not an increase in speed results in a decrease in speed variance and, thus, a reduction in crashes. Also, conflicting evidence exists as to whether DSLs are responsible for an increase in crashes in states maintaining DSLs.

Evidence from Individual States

Many states adopting the 65 mph speed limit during or after 1987 have studied its possible effects on travel and crashes in their state. A Michigan study that looked at the change in fatalities and injuries after the 65 mph speed limit used a monthly time series design to control for multiyear trends and cycles. The researchers also used the unemployment rate, alcohol consumption, proportion of drivers under 25, and recent implementation of an adult safety belt use law as covariants to control for their possible effects on death and injury. They found a 28.4% increase in fatalities and a 38.8% increase in serious injuries on rural interstates with a 65 mph speed limit. Between 1987 and 1990, there were no significant changes in fatalities or serious injuries on 55 mph roads (Streff & Schultz, 1990).

In Arizona, Upchurch (1989) compared data for three years before the 65 mph speed limit with data for one year after the 65 mph speed limit to determine the effect on fatalities. The author controlled for vehicle miles traveled (VMT) and found the rate of fatal crashes on rural interstates to be higher after the 65 mph implementation than for any of the three years before. The crash rate on urban interstates, which were posted at 55 mph, declined. However, Upchurch did not perform a time series analysis, nor did he report any tests of statistical significance.

In Alabama, Brown, Maghsoodloo, and McArdle (1990) used data from a year before and a year after the change to the 65 mph speed limit to estimate the effect. They found a significant 2.4 mph increase in speed and a 7.5% increase in average daily traffic (ADT) on rural interstates. They also examined crash data and reported that although crash severity did not increase, crash frequency rose almost 19%.

In Georgia, Wright and Sarasua (1991) compared crash and speed data for 6 months before and after the implementation of the 65 mph speed limit. They also performed a time series analysis to define patterns of change in crash and speed data. They found no significant increase in fatalities, but a significant increase in injuries. However, it is likely that the 6-month study period did not supply enough data and precluded seasonal variations.

In Ohio, Pant, Adhami, and Niehaus (1992) compared data for three-year periods, before and after the change to a 65 mph speed limit, on 55 mph and 65 mph interstates. They controlled for factors including weather and light conditions, seasons, day of week, time of day, and vehicle mix and compared the mean crash rates for the before and after periods. The mean fatal crash rate did not significantly increase after the implementation of the 65 mph speed limit.

In California, Smith (1990) found no evidence of an increase in fatalities after the 65 mph speed limit was put into effect. An exception was the significant increase in fatalities on a 65 mph "look-alike" freeway, defined as a highway constructed to interstate standards and connected to a 65 mph interstate. However, only 11 rural interstate miles were studied as opposed to 132 miles of "look-alike" freeway.

In Illinois, Sidhu (1990) found that most of the increase in rural interstate fatalities was due to the increase in pedestrian crashes and crashes involving drinking and driving. The author performed a linear regression using the crash rate on rural interstates for a five-year period before the 65 mph speed limit to ascertain the probable crash rate if the maximum speed limit had remained at 55 mph. He concluded there was no significant increase in fatalities due to the increased speed limit.

Thus, in general, studies of the impact of raising the speed limit have contradictory findings. Three studies reported an increase in fatalities and four studies reported no increase in fatalities, but several did report increases in injuries and crash frequency. However, these studies also varied in their adequacy of experimental design and sample size.

Evidence from National Studies

Like the research conducted by individual states, national studies surveying all or some of the states report widely varying results. Baum, Wells, and Lund (1991) included a multiple regression in their methods that accounted for seasonality of vehicle travel, business cycles, and the introduction of safety belt laws. They found a 15% to 16% nationwide increase in fatalities on roads with a 65 mph speed limit in 1987 compared to what would have been expected considering existing trends. They added that this increase was 26% to 29% in 1988.

McKnight and Klein (1990) and McKnight, Klein, and Tippets (1989) found increases in fatal crashes nationwide but found low or no increases in fatal crashes on 55 mph roads. Both studies compared crash data for five years prior to the change in the speed limit with one year after the increase and used a time series/intervention analysis. The studies found a 27% and a 21% increase, respectively, in fatal crashes on 65 mph interstates.

NHTSA's 1989 report to Congress revealed that rural interstate fatalities increased 21% in 1987 among states with a 65 mph speed limit, but 8 of 38 states accounted for 71% of this increase. When fatalities per VMT was calculated, this translated to a 14% increase in fatalities on 65 mph interstates.

Garber and Graham (1990) performed regression analyses for each state and used 65 mph dummy variables on 55 mph road fatality data to control for the effect of the 65 mph speed increase. They found an estimated 15% increase in fatalities on rural interstates with a 65 mph speed limit.

Chang, Carter, and Chen (1991) performed a rigorous series of six analyses on 65 mph and 55 mph states as well as a before-after comparison of the effects of the 65 mph speed limit in the 32 states that had raised their maximum speed limit by June 30, 1987. They concluded there was a significant increase in fatalities on rural interstates, but when the fatality rate was calculated controlling for annual VMT, this increase was not as substantial.

A recent national study (Lave & Elias, 1992) took a different approach and looked at fatality rates on all roads. The authors estimated that the 65 mph speed limit resulted in a decrease in fatality rates of 3.5% to 5% on all roads. Employing the same statistical methods of Garber and Graham (1990), Lave and Elias hypothesized that more police would be present on 55 mph roads because the federal government no longer included the 65 mph roads in the federal compliance program. They suggested that an increased police presence on 55 mph roads would account for a decrease in fatalities on these roads. They also speculated that more drivers switched from 55 mph roads to safer, 65 mph roads, which could also explain a decrease in overall highway fatalities.

Inconsistencies in State and National Findings

The inconsistent state and national evidence may be attributed to several factors. First, McKnight, Klein, and Tippets (1989) suggested that differences in state fatality rates are due to the varying characteristics of the states, such as differences in VMT, alcohol consumption, amount of weekend travel, and safety belt laws.

Another possibility is mentioned in two reports from Michigan (Wagenaar, Streff, & Schultz, 1989; Streff & Schultz, 1990). The authors claimed that faulty statistical and survey methods employed by researchers from various states are responsible for studies that do not find a significant increase in the number of serious crashes and/or fatalities. For example, Wagenaar et al. (1989) stated that McCarthy (1988) began his survey of Indiana at the same time as the mandatory safety belt law for that state was placed into effect. Other sampling errors cited by the authors included small or nonrepresentative samples and insufficiently rigorous statistics. Wagenaar et al. (1989) stated that the most effective method of analysis is a time series analysis that controls for effects such as seasonal differences.

PURPOSE AND SCOPE

When the speed limit change was authorized in Virginia, the General Assembly included a sunset provision in the statute. This provision stated that the higher speed limit was to extend for a 5-year period, during which time the Virginia Department of State Police (VSP) would collect crash data and present them to the Virginia Department of Transportation (VDOT) to monitor.

This is the fifth report in a series on the impact of the implementation of the 65 mph speed limit in Virginia. Even though the sunset provision was removed by the 1992 General Assembly, monitoring continued. Information provided in previous reports has been reviewed and used by legislators, VDOT, VSP, and the Virginia Department of Motor Vehicles (DMV). The authors undertook this study to document and provide further information to state agencies and legislators with an interest in this issue.

The scope of the current study was limited to Virginia's urban and rural interstates. Periods of study were 1985-1987 (pre-65) and 1989-1992 (post-65). Because Virginia changed to 65 mph during 1988, that year is considered a transition period and was not included in the study.

METHODOLOGY

This study focused on the changes in travel speeds, fatal crashes, fatalities, and truck crashes that occurred on Virginia's rural interstates after the implementation of the 65 mph speed limit until December 31, 1992. Data for urban interstates, noninterstates, and all systems were compared to data for rural interstates in an attempt to determine whether similar patterns emerged for rural interstates and other highways that were not subject to the 65 mph speed limit. This was done to isolate the effect of the increase in the speed limit from that of other possible changes.

In Virginia, speed data are collected at permanent speed monitoring sites established for the federal speed compliance monitoring program, for which quarterly and annual reports are made to the Federal Highway Administration (FHWA). However, these data are compiled based on federal fiscal year, not calendar year. Because this study focused on changes between calendar years, quarterly reports of average and 85th percentile speed (the speed at or below which 85% of the vehicles travel) were averaged to provide an estimate of travel speeds for the calendar year.

The federal speed compliance monitoring program did not require that speeds be monitored on interstate highways posted at 65 mph in any of the years studied. Thus Virginia, like many other states, did not routinely collect speed data at rural interstate speed monitoring stations. Special provisions were made by VDOT to conduct 24-hour rural interstate speed surveys during each post-65 year. Thus, the reliability of rural interstate speed data for post-65 years is not as good as for previous years. Fortunately, speed data for the urban interstates remain as reliable as they have been in the past because the data collection methods have remained constant in urban areas.

Daytime speed surveys were conducted on rural interstates before the speed limit increased to 65 mph and each autumn subsequent to the increase. The speed survey allowed the study team to distinguish between the speeds of passenger vehicles and trucks, which are subject to different speed limits on Virginia's rural interstates. Through 1990, the survey was conducted using hand-held radar units. Every attempt was made to conceal the research vehicle so that its presence would not affect the speeds of passing vehicles. However, due to the widespread use of radar detectors, especially among truck drivers, the method of collection may have affected the data. That is, radar detectors may have alerted motorists to the use of radar, thereby causing them to reduce their speed. Thus, beginning in 1991, the radar speed data were supplemented by data collected by hand-held laser speed detection units, for which detection by approaching motorists is much more difficult than for radar units.

Because Virginia increased its rural interstate speed limit in July 1988, that year was considered a year of transition. Thus, the 3-year period 1985-1987 was considered the "before" period (i.e., pre-65). The 4-year period 1989-1992 was considered the "after" period (i.e., post-65). The use of data from multiple years reduces the influence of unusually high or low single-year data caused by random and nonrandom fluctuations. Also, in the analysis, absolute numbers of crashes and fatalities were used rather than crash rates. This was done because reported volume data on interstates are averaged for both urban and rural systems. Thus, if volumes increased more on rural interstates, relative rates would be misleading.

In the analysis of speed and crash data, the pre-65 average was compared to the post-65 average. Further, because crash data were available by month, differences in fatal crash and fatality data pre-65 and post-65 were tested for statistical significance using analysis of variance (ANOVA) to compare monthly totals.

The configurations of the fatal interstate crashes were also considered. Specifically, rural and urban interstate pre-65 and post-65 fatal crashes were analyzed to determine changes in the number involving trucks, sideswipes, wrong-way drivers, pedestrians, and phantom vehicles (vehicles that were a contributing factor in the crash but were not involved in the crash). Additionally, changes were noted in the number of fatal crashes involving rear-end collisions, alcohol, speed in excess of the posted limit, and vehicles running off the road.

Finally, vehicle crash types relating to speed variance were examined. Since Virginia had a DSL for trucks (55 mph), increased speed variance theoretically occurred on Virginia's rural interstates, and speed variance is believed to result in an increase of crashes.

RESULTS AND DISCUSSION

Table 1 shows the average annual speeds of all vehicles on Virginia's rural interstates collected at speed monitoring stations. Post-65 average speed increased by 5.2 mph to 63.8 mph and the 85th percentile speed increased by 6.3 mph to 70.5 mph. On urban interstates, a more modest increase of 3.1 mph brought the average speed up to 57.4 mph, and the 85th percentile speed rose by 3.5 mph to 65.5 mph. The increases on rural interstates are indicative of an upward trend that began in 1989. However, since then, average rural interstate speeds have begun to level off (see Appendix A).

Table 2 shows that fatalities on rural interstates increased by 21.1 to an average of 70.8 per year. Using ANOVA, this increase was found to be statistically significant at $p < .01$. In contrast, fatalities on urban interstates decreased by 6.7, resulting in an average of 35.3 per year. However, this decrease was not statistically significant. Interestingly, the significant decrease in noninterstate fatalities ($p < .01$) resulted in a net decrease in total traffic fatalities.

Table 3 shows patterns in fatal crashes. Average annual rural interstate fatal crashes increased by 19.2. This increase was found to be significant ($p < .01$). However, urban interstate fatal crashes decreased, though not significantly, by 5.4. Noninterstate fatal crashes decreased by 82.2 per year, which was significant at $p < .01$.

Although fatalities and fatal crashes on rural interstates are significantly greater than those that occurred pre-65, they seem to have maintained a constant level. Like average speed, fatalities and fatal crashes were not as high in 1991 and 1992 as in the post-65 years of 1989 and 1990 (see Appendix A).

Table 4 presents average monthly fatal crash and fatality data for rural interstates. The average number of fatal crashes increased during 10 months. The average number of fatalities also increased during 10 months, the largest increase occurring during the month of May, with an average of 4.3 fatal crashes and 5.1 fatalities.

Table 5 shows the average monthly fatal crash and fatality data for urban interstates. Fatal crashes increased during 6 of 12 months, and fatalities increased during 5 months.

Table 1: Average and 85th Percentile Speeds
Pre (1985-1987) vs. Post (1989-1992)

Speeds (mph)	1985	1986	1987	1988	1989	1990	1991	1992	Pre-65	Post-65	Difference
Rural Interstates											
Average	59.2	58.4	58.2	60.2	63.4	65.5	62.8	63.3	58.6	63.8	+ 5.2
85th Percentile	64.8	63.8	64.0	67.0	70.0	72.2	69.7	69.9	64.2	70.5	+ 6.3
Urban Interstates											
Average	54.2	54.0	54.6	59.9	57.8	58.3	56.1	57.3	54.3	57.4	+ 3.1
85th Percentile	61.8	60.8	63.5	68.5	66.0	66.3	64.8	65.0	62.0	65.5	+ 3.5

Table 2: Average Annual Fatalities
Pre (1985-1987) vs. Post (1989-1992)

Highway Type	1985	1986	1987	1988	1989	1990	1991	1992	Pre-65	Post-65	Difference
Rural Interstate	60	45	44	78	64	89	70	60	49.7	70.8	+ 21.1
Urban Interstate	34	45	47	58	47	41	19	34	42.0	35.3	- 6.7
Noninterstate	886	1,028	931	993	888	941	849	745	948.3	855.8	- 92.5
Total	980	1,118	1,022	1,129	999	1,071	938	839	1,070	961.8	- 78.2

Table 3: Average Annual Fatal Crashes
Pre (1985-1987) vs. Post (1989-1992)

Highway Type	1985	1986	1987	1988	1989	1990	1991	1992	Pre-65	Post-65	Difference
Rural Interstate	50	40	40	65	60	73	65	52	43.3	62.5	+ 19.2
Urban Interstate	32	40	41	52	41	38	19	31	37.7	32.3	- 5.4
Noninterstate	814	917	825	852	812	837	753	677	852.0	769.8	- 82.2
Total	896	997	906	969	913	948	837	760	933.0	864.5	- 68.5

Table 4: Average Annual Fatal Crashes and Fatalities on Rural Interstates by Month

Pre (1985-1987 vs. Post (1989-1992)

	Pre-65		Post-65		Pre-Post Difference	
Month	Crashes	Fatalities	Crashes	Fatalities	Crashes	Fatalities
Jan	2.7	3.0	2.8	3.0	+ 0.1	0.0
Feb	2.0	2.7	4.0	5.0	+ 2.0	+ 2.3
Mar	3.7	4.0	3.5	4.3	- 0.2	+ 0.3
Apr	2.0	2.7	4.5	4.8	+ 2.5	+ 2.1
May	3.0	3.7	7.3	8.8	+ 4.3	+ 5.1
June	3.3	4.0	5.0	5.8	+ 1.7	+ 1.8
July	4.0	5.0	6.5	7.8	+ 2.5	+ 2.8
Aug	6.0	6.7	7.3	7.5	+ 1.3	+ 0.8
Sept	5.3	5.7	6.0	6.5	+ 0.7	+ 0.8
Oct	5.0	5.7	8.0	8.8	+ 3.0	+ 3.1
Nov	4.3	4.7	3.8	4.3	- 0.5	- 0.4
Dec	2.0	2.0	4.3	4.8	+ 2.3	+ 2.8
Total	43.3	49.7	62.5	70.8	+ 19.2	+ 21.1

Table 6 shows interstate fatal crashes by route. The largest increase on any rural interstate was on I-81, with an increase of 6.3 per year to yield an average of 21.8 per year. Fatal crashes on rural I-95 also increased substantially, by 5.5 per year, to an average of 19.8, and on rural I-64 by 4.7 per year, for an average of 11.0. There were substantial increases in fatal crashes on some urban interstate routes and substantial decreases on others. Fatal crashes on urban I-95 increased by 4.2 per year and those on urban I-64 decreased by 4.0. Fatal crashes on urban I-81 decreased by 4.0 per year to an average of 0.3 per year.

Table 5: Average Annual Fatal Crashes and Fatalities on Urban Interstates by Month Pre (1985-1987) vs. Post (1989-1992)

	Pre-65		Post-65		Pre-Post Difference	
Month	Crashes	Fatalities	Crashes	Fatalities	Crashes	Fatalities
Jan	1.0	1.0	2.8	2.8	+ 1.8	+ 1.8
Feb	3.3	3.3	1.0	1.0	- 2.3	- 2.3
Mar	1.3	1.3	1.8	1.8	+ 0.5	+ 0.5
Apr	4.3	5.0	2.0	2.3	- 2.3	- 2.7
May	2.0	2.0	2.0	2.3	0.0	+ 0.3
June	6.3	6.7	2.8	3.3	- 3.5	- 3.4
July	4.7	5.0	4.0	4.5	- 0.7	- 0.5
Aug	3.7	4.0	3.8	3.8	+ 0.1	- 0.2
Sept	3.0	3.0	4.0	4.0	+ 1.0	+ 1.0
Oct	3.0	5.3	3.8	4.5	+ 0.8	- 0.8
Nov	3.3	3.7	1.5	1.8	- 1.8	- 1.9
Dec	1.7	1.7	3.0	3.5	+ 1.3	+ 1.8
Total	37.7	42.0	32.3	35.3	- 5.4	- 6.7

Configuration of Crashes

Selected characteristics of fatal crashes are shown in Tables 7 through 12. Table 7 shows that on rural interstates, fatal truck crashes increased by 7.0. Sideswipes, wrong-way, pedestrian, and phantom fatal crashes increased by lesser amounts, ranging from an 0.3 increase in fatal pedestrian crashes to a 2.8 increase in fatal sideswipe and phantom crashes. On urban interstates, only sideswipe and wrong-way fatal crashes increased, 0.3 in both cases. On urban interstates, fatal truck crashes decreased by 2.4 to result in an average of 10.3.

Table 8 shows that most of the increase in fatal crashes on rural interstates was accounted for by non-rear-end crashes. However, rear-end crashes in general increased slightly, with a 1.8 increase on rural interstates. In particular, on rural interstates, there was an increase of 2.3 in fatal rear-end crashes in which a nontruck struck a truck. This brought the post-65 average to 4.3 crashes involving nontrucks rear-ending trucks. Overall, there was an increase of 1.3 in rear-end crashes on urban interstates compared to a decrease of 7.2 in non-rear-end crashes. The largest increase in fatal rear-end crashes on urban interstates was an increase of 1.0 in nontruck into nontruck fatal rear-end crashes, resulting in a post-65 average of 4.3.

Table 9 shows a decrease in alcohol-related fatal crashes on both rural and urban interstates. Non-alcohol-related fatal crashes on urban interstates decreased by 2.3 to an average of 12.0. However, non-alcohol-related fatal crashes on rural interstates increased by 16.8 to an average of 35.8. Further, there was an increase of 4.0 in fatal crashes on rural interstates in which the alcohol content of the driver or pedestrian was unable to be determined.

Table 6: Average Annual Fatal Crashes by Route
Pre (1985-1987) vs. Post (1989-1992)

Route	Pre-65	Post-65	Pre-Post Difference
Rural			
64	6.3	11.0	+ 4.7
66	2.0	1.0	- 1.0
77	2.7	3.3	+ 0.6
81	15.7	22.0	+ 6.3
85	1.7	4.5	+ 2.8
95	14.3	19.8	+ 5.5
295	0.7	1.0	+ 0.3
Total	43.3	62.5	+ 19.2
Urban			
64	14.3	10.0	- 4.3
264	2.7	2.3	- 0.4
464	0.3	0.0	- 0.3
564	0.3	0.5	+ 0.2
664	0.3	0.8	+ 0.5
66	2.7	3.8	+ 1.1
81	4.3	0.3	- 4.0
581	1.3	1.0	- 0.3
85	0.3	0.3	0.0
95	6.3	10.5	+ 4.2
195	0.0	0.3	+ 0.3
295	0.7	0.3	- 0.4
395	1.3	1.5	+ 0.2
495	2.7	1.0	- 1.7
Total	37.7	32.3	- 5.4

Table 10 shows that there was an average decrease of 2.7 fatal crashes on urban interstates involving speeds in excess of the posted limit and an average decrease of 0.2 in such crashes on rural interstates. Nonspeeding fatal crashes increased on rural interstates by 16.3 to reach a post-65 average of 38.3. Nonspeeding fatal crashes decreased on urban interstates by 4.2 to an average of 13.5. However, the number of crashes for which the speed of the vehicle was not known increased on both rural and urban interstates.

Data on fatal run-off-road (ROR) crashes are presented in Tables 11 and 12. Table 11 shows that rural interstate fatal ROR crashes increased by 16.0 to reach an average of 44.0. The majority of the increase were ROR to the left crashes by nontrucks. Table 12 shows a decrease in fatal ROR crashes on urban interstates. Most fatal ROR crash configurations on urban interstates decreased, with a decrease of 8.5 in the total. The majority of the decrease occurred in the ROR right category. Non-ROR crashes increased slightly.

Table 7: Average Annual Fatal Crash Characteristics
Pre (1985-1987) vs. Post (1989-1992)

Crash Type	Pre-65	Post-65	Pre-Post Difference
Rural			
Sideswipe	2.7	5.5	+ 2.8
Truck	11.0	18.0	+ 7.0
Pedestrian	5.7	6.0	+ 0.3
Wrong way	1.7	3.5	+ 1.8
Phantom	1.0	3.0	+ 2.0
Total	43.3	62.5	+ 19.2
Urban			
Sideswipe	2.7	3.0	+ 0.3
Truck	12.7	10.3	- 2.4
Pedestrian	7.0	5.5	- 1.5
Wrong way	0.7	1.0	+ 0.3
Phantom	1.0	1.0	0.0
Total	37.7	32.3	- 5.4

Table 8: Average Annual Rear-End Crashes
Pre (1985-1987) vs. Post (1989-1992)

Crash Type	Pre-65	Post-65	Pre-Post Difference
Rural			
Rear end	7.7	9.5	+ 1.8
Truck into truck	1.7	0.8	- 0.9
Truck into nontruck	1.7	1.5	- 0.2
Nontruck into nontruck	2.3	3.0	+ 0.7
Nontruck into truck	2.0	4.3	+ 2.3
Non-rear end	35.7	52.8	+ 17.1
Total	43.3	62.5	+ 19.2
Urban			
Rear end	8.7	10.0	+ 1.3
Truck into truck	1.0	0.5	- 0.5
Truck into nontruck	1.0	1.5	+ 0.5
Nontruck into nontruck	3.3	4.3	+ 1.0
Nontruck into truck	3.3	3.8	+ 0.5
Non-rear end	29.0	21.8	- 7.2
Total	37.7	32.3	- 5.4

Table 9: Average Annual Alcohol-RelatedCrashes Pre (1985-1987) vs. Post (1989-1992)

Crash Type	Pre-65	Post-65	Pre-Post Difference
Rural			
Alcohol related	13.3	11.8	- 1.5
Non-alcohol related	19.0	35.8	+ 16.8
Alcohol unknown	11.0	15.0	+ 4.0
Total	43.3	62.5	+ 19.2
Urban			
Alcohol related	12.7	10.3	- 2.4
Non-alcohol related	14.3	12.0	- 2.3
Alcohol unknown	10.7	10.0	- 0.7
Total	37.7	32.3	- 5.4

Table 10: Average Annual Crashes Involving Speeding Pre (1985-1987) vs. Post (1989-1992)

Crash Type	Pre-65	Post-65	Pre-Post Difference
Rural			
All speeding crashes	18.7	18.5	- 0.2
Single nontruck	10.7	10.8	+ 0.1
Single truck	0.7	0.5	- 0.2
Nontruck in collision	4.7	4.5	- 0.2
Truck in collision	1.3	2.0	+ 0.7
Other	1.3	0.8	- 0.5
Nonspeeding	22.0	38.3	+ 16.3
Speeding unknown	2.7	5.8	+ 3.1
Total	43.3	62.5	+ 19.2
Urban			
All speeding crashes	16.7	14.0	- 2.7
Single nontruck	9.3	6.5	- 2.8
Single truck	0.3	0.0	- 0.3
Nontruck in collision	5.3	6.0	+ 0.7
Truck in collision	1.0	0.3	- 0.7
Other	0.7	1.3	+ 0.6
Nonspeeding	17.7	13.5	- 4.2
Speeding unknown	3.3	4.8	+ 1.5
Total	37.7	32.3	- 5.4

Table 11: Average Annual Run-Off-Road (ROR) Rural Interstate Fatal Crashes by Direction and Incursion

Pre (1985-1987) vs. Post (1989-1992)

Crash Type	Pre-65	Post-65	Pre-Post Difference
Right			
Truck	1.7	1.8	+ 0.1
Nontruck	12.0	14.0	+ 2.0
Left not into other lane			
Truck	1.0	2.8	+1.8
Nontruck	11.7	20.5	+ 8.6
Left into other lane (collision)			
Truck	0.0	0.8	+ 0.8
Nontruck	0.3	2.8	+ 2.5
Left into other lane (no collision)			
Truck	0.0	0.3	+ 0.3
Nontruck	1.3	1.3	0.0
Total ROR	28.0	44.0	+ 16.0
Total non-ROR	15.3	18.5	+ 3.2
Total	43.3	62.5	+ 19.2

Table 12: Average Annual Run-Off-Road (ROR) Urban Interstate Fatal Crashes by Direction and Incursion

Pre (1985-1987) vs. Post (1989-1992)

Crash Type	Pre-65	Post-65	Pre-Post Difference
Right			
Truck	1.3	0.8	- 0.5
Nontruck	10.3	6.0	- 4.3
Left not into other lane			
Truck	2.3	1.0	- 1.3
Nontruck	6.3	6.5	+ 0.2
Left into other lane (collision)			
Truck	0.0	0.0	0.0
Nontruck	2.3	1.5	- 0.8
Left into other lane (no collision)			
Truck	0.0	0.0	0.0
Nontruck	0.7	0.0	- 0.7
Total ROR	23.3	15.8	- 7.5
Total non-ROR	14.3	16.5	+ 2.2
Total	37.7	32.3	- 5.4

Speed Variance and Vehicle Crash Types

As discussed in an earlier report (Lynn & Jernigan, 1992), it was originally expected that instituting a speed differential would result in increased speed variance and, thus, in more crashes on rural interstates. What actually occurred was quite different. As noted in Table 13, crashes on rural interstates increased overall, but the major increase was not in collisions between passenger vehicles and trucks, but rather in collisions involving only passenger vehicles and in crashes involving a single passenger vehicle. (See Appendix B for complete data.)

Table 13 also shows that, based on the radar and laser survey of speeds on rural interstates, the mean speed for passenger vehicles increased from 62.0 mph pre-65 to an average speed of 68.8 mph post-65. Speed variance between passenger vehicles decreased from 19.3 mph pre-65 to 15.3 mph post-65. The mean speed for trucks also increased slightly, from 59.4 mph pre-65 to 61.2 mph post-65. The speed variance between trucks increased from 13.5 mph pre-65 to 15.2 post-65. When the speeds for both types of vehicles were combined, speed variance increased dramatically from 19.0 pre-65 to 28.1 post-65.

Table 13: Speed Characteristics and Crashes by Type of Accident

Crash Type	Mean (88 [Pre] vs 89-92 [Post])	Variance (88 [Pre] vs 89-92 [Post])	Difference in Total Crashes (86-87 [Pre] vs 89-92 [Post])
Rural			
Single Truck	+ 1.8 mph	-	-82
Single Passenger Vehicle	+ 6.8 mph	-	+ 322
Passenger vehicle/passenger vehicle	+ 6.8 mph	- 4.0	+ 155
Truck/truck	+ 1.8 mph	+ 1.7	-13
Passenger vehicle/truck	+ 4.9 mph	+ 9.1	- 90
Urban			
Single truck	+ 1.6 mph	-	- 31
Single passenger vehicle	+ 1.7 mph	-	+ 214
Passenger vehicle/passenger vehicle	+ 1.7 mph	+ 9.6	+ 882
Truck/truck	+ 1.6 mph	+ 1.9	- 10
Passenger vehicle/truck	+ 2.0 mph	+ 7.6	- 53

Crashes in which a passenger vehicle and a truck collided were expected to increase dramatically on rural interstates. This was an especially gloomy prediction, considering that collisions between a truck and a smaller passenger vehicle tend to be more serious than other types of crashes. This prediction was not substantiated by the data: passenger vehicle/truck crashes decreased from 538 pre-65 to 448 post-65. Single passenger vehicle crashes increased by 322 and single truck crashes declined by an average of 82 per year post-65. Finally, passenger vehicle collisions increased from 693 pre-65 (1986-1987 average) to 848 post-65 (1989-1992 average), and crashes in which trucks collided with other trucks decreased from 58 pre-65 to 45 post-65. These findings indicate that the DSL for passenger vehicles and trucks on Virginia's rural interstates has not resulted in an increase in collisions attributed to speed variance.

On urban interstates, speeds for all vehicle types increased less than 2 mph, indicating that urban interstate crashes should be only slightly more severe after the speed limit increase, if at all. However, although passenger vehicle variance decreased on rural interstates, it increased dramatically on urban interstates, corresponding with an average increase in passenger vehicle collisions of 882 per year post-65. Total variance results for urban interstates were similar to those for rural interstates, whereas truck speed variance increased as much on the urban interstates as on the rural interstates. Thus, since Virginia's speed limit on urban interstates has remained at 55 mph for both passenger vehicles and trucks, and speed variance increased on these interstates, it appears even less likely that the DSL on rural interstates is a major contributor to speed variance.

CONCLUSIONS

It is evident that speeds, fatalities, and fatal crashes have increased on rural interstates since the speed limit was raised from 55 mph to 65 mph. However, the increases may have plateaued or even decreased on rural interstates. For instance, as can be seen in Appendix A, Table A-1, the average and 85th percentile speeds on rural interstates for post-65 years 1989 and 1990 are greater than those for both 1991 and 1992. Urban interstate speeds also decreased, though by slighter amounts. This finding diminishes some of the early speculation that speeds would continue to increase each year.

Increases in fatalities and fatal crashes may also have leveled off or declined, considering the two most recent post-65 mph years (see Tables A-2 and A-3). The rural interstate fatality and fatal crash averages for 1991 and 1992 are all less than those reported for 1989 and 1990. Urban interstate fatalities and fatal crashes also decreased in 1991 and 1992 when compared to 1989 and 1990 averages.

Rural interstate fatalities and fatal crashes still remain higher than they were pre-65. However, the initial increases in speeds, fatal crashes, and fatalities that followed the introduction of the 65 mph speed limit have leveled off in recent years.

Finally, suspected increases in crashes involving passenger vehicles and trucks due to DSLs on rural interstates did not occur. Although there was a slight increase (2.3) in fatal rear-end crashes in which a nontruck struck a truck, which is the configuration expected from a DSL, this increase was not significant. The majority of the increase in fatal crashes involved single vehicles running off the road, which is not likely the result of a DSL.

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Appendix A
Average Speed, Crashes, and Crash Configurations
1985-1992

Table A-1. Average and 85th Percentile Speeds

Speeds (mph)	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
Rural interstates								
Average	59.2	58.4	58.2	60.2	63.4	65.5	62.8	63.3
85th percentile	64.8	63.8	64.0	67.0	70.0	72.2	69.7	69.9
Urban interstates								
Average	54.2	54.0	54.6	59.9	57.8	58.3	56.1	57.3
85th percentile	61.8	60.8	63.5	68.5	66.0	66.3	64.8	65.0

Table A-2. Fatalities

Highway Type	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
Rural interstate	60	45	44	78	64	89	70	60
Urban interstate	34	45	47	58	47	41	19	34
Noninterstate	886	1,028	931	993	888	941	849	745
Total	980	1,118	1,022	1,129	999	1,071	938	839

Table A-3. Fatal Crashes

Highway Type	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
Rural interstate	50	40	40	65	60	73	65	52
Urban interstate	32	40	41	52	41	38	19	31
Noninterstate	814	917	825	852	812	837	753	677
Total	896	997	906	969	913	948	837	760

Table A-4. Fatal Crashes on Rural Interstates by Month

Month	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
January	2	3	3	3	3	4	4	0
February	1	1	4	4	4	4	2	6
March	3	5	3	3	2	8	3	1
April	4	1	1	5	2	5	3	7
May	2	3	4	5	9	5	12	3
June	5	3	2	6	6	9	3	2
July	6	2	4	5	6	6	5	9
August	7	6	5	6	5	6	10	8
September	5	6	5	5	8	7	4	5
October	6	7	2	12	9	6	8	9
November	5	1	7	6	4	6	4	1
December	4	2	0	5	2	7	7	1
Total	50	40	40	65	60	73	65	52

Table A-5. Fatalities on Rural Interstates by Month

Month	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
January	2	4	3	3	3	5	4	0
February	2	1	5	5	4	6	2	8
March	4	5	3	3	2	10	3	2
April	5	2	1	6	2	6	3	7
May	4	3	4	5	10	6	15	4
June	6	3	3	6	7	11	3	2
July	6	3	6	7	6	9	6	10
August	8	7	5	8	5	6	10	9
September	5	7	5	7	8	7	4	7
October	8	7	2	13	11	6	9	9
November	6	1	7	8	4	8	4	1
December	4	2	0	7	2	9	7	1
Total	60	45	44	78	64	89	70	60

Table A-6. Fatal Crashes on Urban Interstates by Month

Month	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
January	1	2	0	2	3	4	2	2
February	3	4	3	0	1	1	0	2
March	1	2	1	3	5	1	0	1
April	3	4	6	2	6	1	0	1
May	3	1	2	7	2	1	0	5
June	5	8	6	7	3	4	3	1
July	4	5	5	6	2	9	3	2
August	3	3	5	4	5	7	0	3
September	2	3	4	6	5	2	3	6
October	2	2	5	5	5	3	4	3
November	3	6	1	4	2	2	1	1
December	2	0	3	6	2	3	3	4
Total	32	40	41	52	41	38	19	31

Table A-7. Fatalities on Urban Interstates by Month

Month	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
January	1	2	0	2	3	4	2	2
February	3	4	3	0	1	1	0	2
March	1	2	1	7	5	1	0	1
April	3	5	7	2	6	1	0	2
May	3	1	2	8	2	2	0	5
June	6	8	6	7	4	4	3	2
July	4	5	6	7	2	11	3	2
August	3	3	6	4	5	7	0	3
September	2	3	4	6	5	2	3	6
October	2	6	8	5	7	3	4	4
November	4	6	1	4	3	2	1	1
December	2	0	3	6	4	3	3	4
Total	34	45	47	58	47	41	19	34

Table A-8. Fatal Crashes by Route

Route	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
Rural								
64	4	8	7	9	7	9	19	9
66	2	1	3	6	2	1	1	0
77	3	3	2	2	5	3	2	3
81	17	14	16	26	19	26	22	21
85	1	3	1	3	7	4	5	2
95	21	11	11	19	19	30	16	14
295	2	0	0	0	1	0	0	3
Total	50	40	40	65	60	73	65	52
Urban								
64	11	15	17	14	12	11	5	12
264	3	1	4	6	4	4	0	1
464	0	1	0	0	0	0	0	0
564	1	0	0	0	0	2	0	0
664	0	1	0	0	0	2	0	1
66	4	3	1	4	4	4	5	2
81	2	7	4	4	1	0	0	0
581	3	1	0	0	1	1	0	2
85	0	0	1	1	1	0	0	0
95	5	6	8	15	14	11	7	10
195	0	0	0	0	0	1	0	0
295	0	1	1	0	1	0	0	0
395	0	2	2	6	2	2	2	0
495	3	2	3	2	1	0	0	3
Total	32	40	41	52	41	38	19	31

Table A-9. Fatal Crash Characteristics

Crash Type	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
Rural								
Sideswipe	2	2	4	7	5	8	6	3
Truck	13	7	13	21	12	27	16	17
Pedestrian	6	4	7	8	5	2	10	7
Wrong way	3	1	1	4	3	2	2	7
Phantom	3	0	0	4	0	2	5	5
Total	50	40	40	65	60	73	65	52
Urban								
Sideswipe	4	2	2	2	5	4	2	1
Truck	11	17	10	11	11	9	8	13
Pedestrian	5	6	10	7	5	6	6	5
Wrong way	0	0	2	5	0	3	0	1
Phantom	1	2	0	6	2	0	1	1
Total	32	40	41	52	41	38	19	31

Table A-10. Rear-End Crashes

Crash Type	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
Rural								
Rear end	8	7	8	11	9	13	7	9
Truck-truck	3	1	1	1	0	2	1	0
Truck-nontruck	2	0	3	3	2	1	1	2
Nontruck-nontruck	2	2	3	3	5	1	1	5
Nontruck-truck	1	4	1	4	2	9	4	2
Non-rear end	42	33	32	54	50	60	58	43
Total	50	40	40	65	60	73	65	52
Urban								
Rear end	4	13	9	8	12	8	6	14
Truck-truck	0	2	1	0	1	0	1	0
Truck-nontruck	1	1	1	2	1	1	1	3
Nontruck-nontruck	2	5	3	5	6	5	1	5
Nontruck-truck	1	5	4	1	4	2	3	6
Non-rear end	28	26	32	44	29	30	13	17
Total	32	40	41	52	41	38	19	31

Table A-11. Alcohol-Related Crashes

Crash Type	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
Rural								
Alcohol related	18	14	8	14	9	18	15	5
Non-alcohol related	22	16	19	34	35	37	37	34
Alcohol unknown	10	10	13	17	16	18	13	13
Total	50	40	40	65	60	73	65	52
Urban								
Alcohol related	11	12	15	20	15	12	8	6
Non-alcohol related	13	16	14	20	13	18	6	11
Alcohol unknown	8	12	12	12	13	8	5	14
Total	32	40	41	52	41	38	19	31

Table A-12. Crashes Involving Speeding

Crash Type	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
Rural								
All speeding	23	18	15	21	16	24	24	10
Single nontruck	14	11	7	8	10	9	18	6
Single truck	1	1	0	0	0	1	0	1
Nontruck collision	6	4	4	9	4	10	2	2
Truck collision	1	0	3	4	2	4	1	1
Other	1	2	1	0	0	0	3	0
Nonspeeding	25	21	20	38	38	39	36	40
Speeding unknown	2	1	5	6	6	10	5	2
Total	50	40	40	65	60	73	65	52
Urban								
All speeding	17	11	22	22	22	12	11	11
Single nontruck	10	8	10	10	11	3	5	7
Single truck	1	0	0	2	0	0	0	0
Nontruck collision	4	3	9	9	11	8	2	3
Truck collision	1	0	2	1	0	0	0	1
Other	1	0		1	0	0	1	4
Nonspeeding	13	22	18	20	12	16	8	18
Speeding unknown	2	7	1	10	7	10	0	2
Total	32	40	41	52	41	38	19	31

Table A-13. Run-Off-Road (ROR) Fatal Crashes on Rural Interstates by Direction and Incursion

Direction	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
Right								
Truck	3	0	2	1	1	3	2	1
Nontruck	16	14	6	15	14	18	14	10
Left not into other lane								
Truck	1	1	1	0	3	3	2	3
Nontruck	10	12	13	22	23	23	25	11
Left into other lane (collision)								
Truck	0	0	0	0	0	2	1	0
Nontruck	0	0	1	3	3	5	1	2
Left into other lane (no collision)								
Truck	0	0	0	0	0	0	1	0
Nontruck	2	1	1	2	3	2	0	0
Total ROR	32	28	24	42	47	56	46	27
Total non-ROR	18	12	16	23	13	17	19	25
Total	50	40	40	65	60	73	65	52

Table A-14. Run-Off-Road (ROR) Fatal Crashes on Urban Interstates by Direction and Incursion

Direction	1985	1986	1987	1988 (Transition)	1989	1990	1991	1992
Right								
Truck	2	1	1	1	0	1	1	1
Nontruck	9	11	11	7	9	7	2	6
Left not into other lane								
Truck	3	4	0	1	1	1	1	1
Nontruck	6	6	7	14	8	10	3	5
Left into other lane (collision)								
Truck	0	0	0	0	0	0	0	0
Nontruck	1	3	3	3	3	3	0	0
Left into other lane (no collision)								
Truck	0	0	0	0	0	0	0	0
Nontruck	0	1	1	1	0	0	0	0
Total ROR	21	26	23	27	21	22	7	13
Total non-ROR	11	14	18	25	20	16	12	18
Total	32	40	41	52	41	38	19	31

Appendix B
Average Speed and Crashes by Vehicle Type and Roadway System

Table B-1. Radar/Laser Study Mean and Variance by Vehicle Type

	88	89	90	91	92	Post-65 Average
Rural						
Passenger	62.0 (19.3)	68.3 (17.3)	69.1 (15.2)	68.6 (14.8)	69.1 (14.0)	68.8 (15.3)
Trucks	59.4 (13.5)	61.6 (15.7)	61.5 (15.5)	60.7 (16.5)	61.1 (13.1)	61.2 (15.2)
Passenger/trucks	61.3 (19.0)	66.0 (27.0)	66.5 (28.4)	66.4 (27.8)	65.7 (29.0)	66.2 (28.1)
Urban						
Passenger	61.4 (17.5)	63.1 (28.2)	62.8 (29.4)	63.0 (26.9)	63.6 (23.9)	63.1 (27.1)
Trucks	58.3 (13.8)	60.1 (17.2)	59.4 (15.3)	59.6 (17.3)	60.3 (13.1)	59.9 (15.7)
Passenger/trucks	60.1 (18.3)	62.2 (26.7)	61.7 (27.5)	61.9 (26.4)	62.6 (22.9)	62.1 (25.9)

Table B-2. Crashes by Vehicle Involvement

	86	87	88	89	90	91	92	Pre-65 Average	Post-65 Average
Rural									
Single truck	238	239	182	224	162	92	148	238.5	156.5
Single passenger	1,552	1,564	1,675	2,194	1,906	1,728	1,693	1,558.0	1,880.3
Passenger/passenger	695	690	711	963	825	758	844	692.5	847.5
Truck/truck	52	63	49	58	38	44	38	57.5	44.5
Passenger/truck	519	556	471	549	430	389	422	537.5	447.5
Urban									
Single truck	134	137	133	127	125	62	104	135.5	104.5
Single passenger	1,367	1,533	1,514	1,750	1,702	1,555	1,649	1,450.0	1,664.0
Passenger/ passenger	3,193	4,118	4,207	4,557	4,629	4,345	4,619	3,655.5	4,537.5
Truck/truck	45	62	61	56	43	38	39	53.5	44.0
Passenger/truck	905	1,133	1,141	1,089	1,034	857	885	1,019.0	966.3