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Analysis of the Capital Beltway Crash Problem

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16. Abstract

Sixty-four miles of interstate highway surrounding Washington, D.C. is known as the Capital Beltway. Police reports were provided by Maryland and Virginia covering all crashes (N = 4,447) on this roadway system for the years 1993-94. The most common type of crash was *Stop/Slowing* (36 percent of all Beltway crashes) in which one vehicle stops or slows, typically for congestion, and is rear-ended. *Ran Off Road* (23 percent) was second. *Sideswipe/Cutoff* (18 percent), third overall, was the most common type for tractor-trailers. Crashes were most prone to occur in close proximity to interchange locations. A cluster of *Ran Off Road* or *Stop/Slowing* crashes occurred at specific ramp locations within three Virginia interchanges. Ten percent of mainline Beltway crashes were followed by subsequent crashes. Crash risk increased for up to one hour and up to one mile approaching the site of a previous crash.

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I. Introduction

The Capital Beltway Safety Team has been charged with identifying, developing and implementing countermeasures to reduce crashes. This present project, as well as work being done by other organizations, provides technical support to the Safety Team. This report covers Task Order Number 9502 of contract number DTNH22-94-D-0544 between the National Highway Traffic Safety Administration and the Preusser Research Group, Inc.

To assist the Safety Team, NHTSA has suggested looking not only at physical factors, but also behavioral factors that lead to crashes on the Beltway. Crashes are usually the result of a combination of factors. These factors include physical characteristics of the roadway environment as well as behavioral decisions drivers make. Making changes in these factors can help reduce crashes.

The focus of the present effort is to identify how, why and where crashes occur on the Beltway. The second chapter of this report examines Beltway crashes using crash type analysis. In the third chapter, each of the crash types is examined by descriptive variables, including characteristics of the event, environmental conditions and driver information. In the fourth chapter, a series of tables and graphs show the distribution of crashes for every tenth of each mile of the Beltway. The fifth chapter describes all of the interchange locations for crash frequency and crash type. Locations that have an inordinate number of crashes are identified. The sixth chapter presents evidence that primary crash events can cause subsequent crashes. The last chapter contains a discussion.

II. Crash Type

Driver behavior immediately prior to a crash is typically a primary component of crash causation. Finding out what a driver or vehicle does immediately before a crash will help identify how and why a crash occurs. Learning how and why crashes occur helps to identify appropriate countermeasures that may reduce the number of crashes on the Beltway.

Developing crash-avoidance countermeasures that will reduce the number of motor vehicle crashes requires insight into how and why these crashes occur. One technique for studying how and why crashes occur and for developing targeted countermeasures is crash type analysis. The technique was developed by Snyder and Knoblauch (1971) who used it to investigate urban pedestrian crashes. The technique has also been used in analyses of rural pedestrian crashes (Knoblauch, 1977), bicycle crashes (Cross and Fisher, 1977), urban vehicle crashes (Retting et al., 1995) and motorcycle crashes (Preusser et al., 1995).

Crash type analysis involves developing crash type definitions that identify groups of crash events with common causal and pre-crash characteristics. Usually, these characteristics involve common driver errors, common roadway situations and common pre-crash movements of the involved vehicles. The focus is on driver and vehicle behavior within defined roadway situations immediately before the crash. Events after the initial impact, such as subsequent vehicle overturn, are much less important since these could result from any number of crash causation errors or situations.

The development of crash types involves classifying crash reports based on common pre-crash errors and situations; reading additional reports to test the integrity of the preliminary classification; and then developing crash type definitions to define each of the identified crash groups.

Crash type definitions alone suggest crash avoidance countermeasures. That is, if the pre-crash error and roadway situation can be identified; and subsequently eliminated by some countermeasure; then crashes of that type should no longer occur.

This study is based on all reports provided by the Virginia Department of Transportation and Maryland Department of Transportation. All police-reported Beltway crashes for two calendar years, 1993 and 1994, are examined.

Method

The states of Virginia and Maryland provided hard-copy police reports for all crashes occurring on the Capital Beltway. This roadway includes segments of route I-95 and I-495. All of the crashes occurred during the period October 1992 through December 1994.

The Virginia and Maryland crash reports were received in installments. Reports were first obtained for a previous and similar September 1994 Capital Beltway Safety Team study. These reports were for crashes occurring during the period October 1992 through September 1993. The remaining reports were subsequently obtained for this study. These reports were for the period October 1993 through December 1994.

Except when noted, only crashes involving one or more vehicles on the main line were included. Also, unless noted, all crash reports representing the period October 1992 through December 1992 were eliminated for the purpose of having crash data for two complete calendar years, 1993 and 1994. Therefore, the total number of reports used in this study equaled 4,447.

In addition to main line crashes, Virginia provided reports for events on ramps, merge lanes and breakdown lanes. The reports Maryland provided did not, generally, include crashes occurring on ramps. Virginia's comprehensive coverage of ramp crashes allowed for the analysis of the crash problem at interchanges on the Virginia portion of the Beltway. These 364 ramp crashes are dealt with in only one section of this report (see Chapter V) and excluded in all other analyses.

Crash type definitions were based on common pre-crash behavioral errors and situations leading to a crash occurrence. The crash type definitions used in this study were developed for classification of the reports used in the prior Capital Beltway Safety Team study. The development of the definitions was an iterative process whereby reports were read and grouped by identifiable defining characteristics. Then subsequent groups were formed as appropriate. Crash type codes were then assigned and keypunched with other crash descriptive information to form a data set. Using these pre-defined definitions, the "newer" reports were put through the same iterative process of being examined, grouped and subgrouped. Crash type codes were then assigned and keypunched with other coded crash report information to form a data set. The independent data sets were then combined to form a single 1993 - 1994 data set.

Results

The definition for each crash type is given on the following page. On subsequent pages the number of crashes by each type is discussed.

CRASH TYPE DEFINITIONS

Major Types (77.8 percent of all crashes 93-94)

Stop/Slowing One vehicle slows or stops on the roadway and is rear-ended by some other vehicle.

Typically, the first vehicle slows or stops in response to congestion. The trailing vehicle does not slow down in time, thus rear-ending the first vehicle.

Sideswipe/Cutoff Struck in the side by some vehicle that is changing lanes.

This crash group includes lane changes that were "forced" by traffic congestion ahead. Most often, one car (or light truck, van or motorcycle) sideswipes another car. Second most common is a tractor-trailer sideswiping a car.

Ran Off Road A vehicle leaves the road and strikes some object, or overturns, at the roadside, on the shoulder, or another point off the main travel lanes.

Vehicles may leave the roadway for a variety of reasons including loss of control and being forced off the road by some other vehicle.

Other and Less Frequent (22.2 percent of all crashes 93-94)

Lost Control in Road A vehicle spins, slides or overturns out of control on the main travel lanes. (Similar to "Ran Off Road" except that the first harmful event occurs on the main travel lanes.)

Run Down One vehicle, traveling straight ahead, is run down from behind by a faster moving vehicle.

Ramp Related Collision between one or more vehicles on the main line and one or more vehicles in an acceleration or deceleration lane.

Obstacle in Motion A vehicle is struck by some debris in motion on the main line.

Disabled Vehicle in Road A vehicle becomes disabled, stops on the main line, and is struck by some other vehicle on the main line. (This type does not include disabled vehicles on the shoulder or median.)

Obstacle in Road A vehicle strikes stationary debris on the main line.

Driver Black-Out Driver loses control of the vehicle because of some medical problem.

Other/Unknown A variety of other circumstances (includes emergency and highway department activity).

Crash Type Distribution
(1993 and 1994)

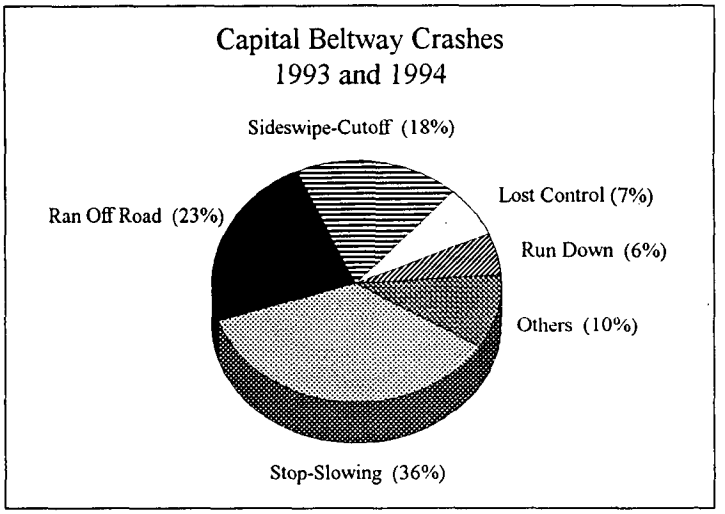
Crash Type	*Virginia*	*Maryland*	*Total*	*Percent*
Stop/Slowing	**792**	**819**	**1,611**	**36.2%**
Congestion	701	608	1,309	29.4%
Lead Veh Swerve	25	32	57	1.3%
Follow Veh Swerve	26	37	63	1.4%
Not Congestion	25	79	104	2.3%
Unknown	15	63	78	1.7%
Sideswipe/Cutoff	**369**	**440**	**809**	**18.2%**
Car > Car	162	201	363	8.2%
TrT > Car	84	102	186	4.2%
Car > TrT	50	49	99	2.2%
Other/Unknown	73	88	161	3.6%
Ran Off Road	**328**	**719**	**1,041**	**23.4%**
Other Less Frequent	**334**	**652**	**986**	**22.2%**
Loss Control in Road	101	201	302	6.8%
Run Down	83	167	250	5.6%
Ramp Related	61	55	116	2.6%
Disabled Veh in Road	17	38	55	1.2%
Obstacle in Motion	18	56	74	1.7%
Obstacle in Road	10	42	52	1.2%
Driver Black-Out	4	7	11	.2%
Other/Unknown	40	86	126	2.8%
Total	**1,823**	**2,624**	**4,447**	**100.0%**

Major Crash Types

The three most frequently occurring crash type categories accounted for 3,461 crashes or 77.8 percent of all crashes on the Beltway. The three crash types in decending rank were Stop/Slowing, Ran Off Road and Sideswipe/Cutoff.

Stop/Slowing (1,611 crashes)

This crash occurs when one vehicle slows or stops in a main travel lane and is struck by a second vehicle coming from behind. More than one-third of all Beltway crashes (36 percent) involved a vehicle that was stopping or slowing. In most cases (1,309 crashes), the police crash report indicated the lead vehicle slowed or stopped due to traffic congestion. The following vehicle, coming from behind in the same travel lane, did not reduce speed quickly enough to avoid a rear-end collision.



Two common variations of this crash type were "Lead Veh Swerve" (57 crashes) and "Follow Veh Swerve" (63 crashes). For both, one vehicle swerves moments before the crash, usually to avoid congestion. In Lead Veh Swerve, a vehicle changes lanes in front of a second vehicle then immediately slows down. In Follow Veh Swerve, a vehicle changes lanes coming in behind a vehicle that has already slowed or stopped, typically in response to congestion. Both Lead Veh and Follow Veh Swerve are often emergency maneuvers in which the swerving vehicle is attempting to avoid becoming the striking vehicle in a Stop/Slowing crash in one lane only to become involved in the same type of crash in the adjacent lane.

Some of the Stop/Slowing crashes are not congestion related (104 crashes). The "Not Congestion" sub-group included situations where the lead vehicle slowed because of: mechanical problems; debris on the roadway; or some other obstruction. The last Stop/Slowing sub-group is "Unknown" (78 crashes), which likely includes a mixture of congestion and non-congestion events but could not be separated on the basis of the information in the police crash report.

Ran Off Road (1,041 crashes)

The next most frequently occurring major crash type was "Ran Off Road." These events include situations where a vehicle leaves the main travel lanes and overturns or strikes some off-road object. This crash type accounts for 23 percent of all Beltway crashes.

Sideswipe/Cutoff (809 crashes)

This is the third of the three major crash types and accounts for 18 percent of all Beltway crashes. As the name implies, this crash involves one vehicle changing lanes into some other vehicle. The lane change maneuver is often made to avoid slower moving traffic ahead, and sometimes made to get into the right lane for an intended Beltway exit. This crash type is distinguished from "Lead Veh Swerve" and "Follow Veh Swerve" in that this crash occurs during the lane change, not immediately thereafter.

The most common sideswipe subgroup involved one light vehicle (car, pickup, motorcycle, van etc.) sideswiping a second light vehicle (363 crashes). Next are tractor-trailers sideswiping a light vehicle (186 crashes) followed by a light vehicle sideswiping a tractor-trailer (99 crashes). Straight trucks are included in the other/unknown category.

Less Frequent Crash Types

None of the remaining crash types accounted for more than 6.8 percent of the data. Each of these remaining types, shown under "Other and Less Frequent" in the Crash Distribution Table, is discussed below.

Lost Control in the Road (302 crashes)

This crash type is very similar to Ran Off Road. The distinguishing feature is that, here, the vehicle loses control and then experiences a first harmful event on the main travel lane. For Ran Off Road, the first harmful event occurs off the main travel lanes. Lost Control in Road crashes are typically multiple vehicle events while Ran Off Road is typically a single vehicle event. That is, in Lost Control in the Road crashes, the vehicle which is out of control strikes some other vehicle on the main line before it can regain control and/or leave the main line.

Run Down (250 crashes)

This crash type is similar to Stop/Slowing in that both crash types involve a vehicle being struck in the rear by an overtaking vehicle. The distinguishing feature is that, here, the lead vehicle was traveling at an unimpeded speed prior to the crash. This lead vehicle is literally "run down" by a second vehicle that might be speeding or traveling too fast for roadway conditions.

Ramp Related (116 crashes)

This crash type is very similar to Sideswipe/Cutoff. The distinguishing feature is that, here, one of the involved vehicles is on an acceleration or deceleration lane attempting to move onto or off the Beltway. A typical scenario is a vehicle trying to merge into the deceleration lane at the last instant thereby side-swiping another vehicle already in the lane; another involves a vehicle trying to merge from the acceleration lane onto the main line.

Obstacle in Motion (74 crashes)

In this crash type, debris moving along or across the road strikes, or is struck by, some vehicle. One common situation is a tire that has come loose and is bouncing across the road. Another common situation involves loose rock or gravel falling off a truck.

Disabled Vehicle in the Road (55 crashes)

This crash type involves one vehicle striking a second vehicle that has become disabled on one of the main travel lanes. Crashes involving a disabled vehicle struck in the breakdown lane or on the shoulder would most likely be classified as Ran Off Road, rather than Disabled Vehicle in the Road. Crashes involving striking a vehicle which has slowed or stopped for a disabled vehicle would most likely be classified as Stop/Slowing.

Obstacle in the Road (52 crashes)

This crash type is similar to Obstacle in Motion except that the debris has come to rest and is then struck by an oncoming vehicle.

Driver Black-Out (11 crashes)

This crash type covers specific medical conditions such as a heart attack or seizure. Not included are drivers who may have fallen asleep or who had too much to drink.

Other/Unknown (126 crashes)

This crash type includes situations in which the dynamics of the crash cannot be determined. Also included in this category are situations related to police and/or highway department activity.

III. Crash Descriptors

The following pages include information on the major crash types and pertinent crash characteristics. Variables of interest include: day of week; hour; crash injury level; fatal crashes; weather; presence of alcohol; driver age; driver residence; vehicle type; and tractor-trailer crashes. The chapters that follow give special attention to crash location, interchange crashes, and crashes that cause other crashes.

Day of Week

The majority of Beltway crashes occurred on weekdays. Friday had the most crashes, Sunday the least. Less than one of every ten crashes was on Sunday as compared with one of every five on Friday. Compared to other major crash types, Ran Off Road crashes were distributed most evenly among the seven days of the week and had the highest percentage of crashes on weekend days; Stop/Slowing had the lowest. The lower percentage of Stop/Slowing and Sideswipe/Cutoff crashes on weekends most likely can be attributed to the lower level of traffic density.

Major Crash Type by Day of Week

	Stop/Slowing	Sideswipe/Cutoff	Ran Off Road	Other
Week Day	**87.6%**	**79.8%**	**66.6%**	**75.5%**
Monday	13.7%	14.3%	13.3%	13.6%
Tuesday	15.0%	14.1%	12.9%	14.6%
Wednesday	17.6%	14.7%	11.7%	14.4%
Thursday	17.7%	15.1%	12.8%	14.9%
Friday	23.6%	21.6%	15.9%	18.0%
Week End	**12.2%**	**19.7%**	**32.5%**	**23.5%**
Saturday	08.0%	12.2%	16.6%	13.6%
Sunday	04.2%	07.5%	15.9%	09.9%

Total N includes unknown day of week, therefore, percentages add to less than 100%

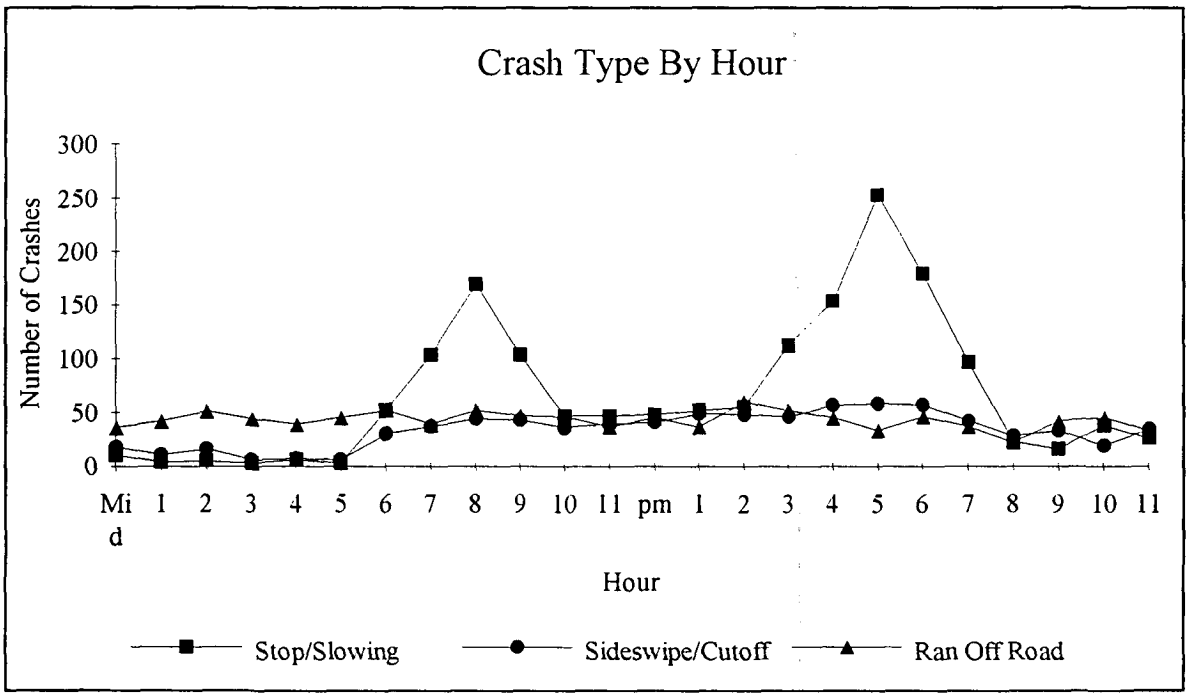
Hour

The three most common crash types differ substantially with respect to the hours of the day they are most likely to occur.

Stop/Slowing is very much related to traffic density and the congestion that occurs during the morning and, especially, the afternoon rush hours. The hours between seven to nine in the morning and four to seven in the evening have the greatest number of Stop/Slowing crashes.

Ran Off Road is distributed more or less evenly across the hours of the day. In effect, the occurrence of these primarily single-vehicle events is not dependent on traffic density.

Sideswipe/Cutoff is rare during the very early morning hours when there is little other traffic on the road. Then, as traffic begins to build in the morning, the number increases. The number of Sideswipe/Cutoff crashes continues to rise throughout afternoon hours, reaching its maximum at 6 pm. The number of crashes tapers thereafter. These crashes are density-related, at least to the extent that a certain amount of traffic is necessary for them to occur.



Crash Injury Level

Virginia crash reports cover a full range of crashes from relatively minor property damage to serious injury and fatality. Minor (non-towaway) property damage is generally not reported in Maryland. The reporting requirements for the two states are different. Maryland does not require a police crash report for minor property damage collisions; therefore, the crashes that are reported tend to average greater severity than Virginia's. The following table shows the total number of crashes by major crash type and crash injury level.

Major Crash Type By Crash Injury Level

	Fatal	Injury	Property Damage	Unknown	Total
Stop/Slowing	4 (<1%)	685 (35%)	876 (64%)	46	1,611
Sideswipe Cutoff	2 (<1%)	295 (29%)	450 (71%)	62	809
Ran Off Road	13 (1%)	466 (41%)	532 (57%)	30	1,041
Other	13 (1%)	418 (36%)	491 (63%)	64	986
All Crashes	32 (<1%)	1,864 (35%)	2,349 (64%)	202	4,447

Fatal Crashes

A total of 32 fatal crashes occurred during the period 1993 through 1994. Seventeen fatal crashes happened in 1993 and fifteen in 1994. Nine of the fatal crashes occurred on I-495, twenty-three on I-95.

Of these 32 fatal crashes: 13 were classified as Ran Off Road; four were Stop/Slowing; two were Sideswipe/Cutoff (in both cases, a car struck a tractor-trailer); and 13 were classified in the Other category. Of the thirteen crashes classified Other: one was Ramp-Related; one was Object in Motion; one was Driver Black-Out; The remaining ten could not be classified as any subtype of the category Other; six of these involved a pedestrian fatality, and, therefore, were placed in this category.

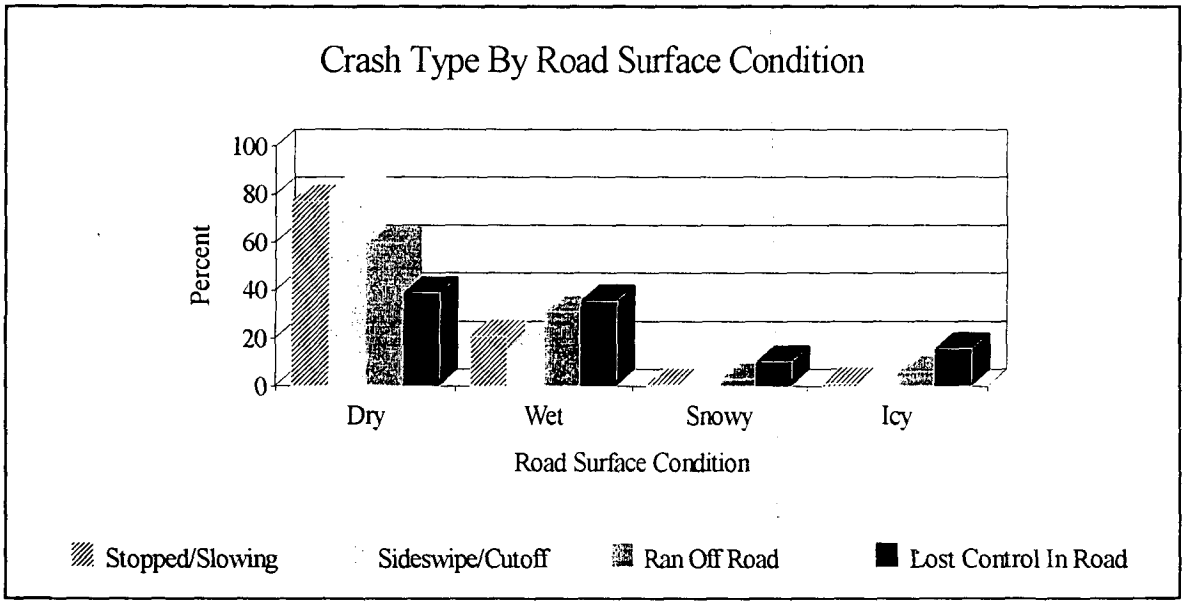
Other fatal crash facts include the following:

- Nineteen (59 percent) of the 32 crashes were single vehicle events. Eight crashes involved two vehicles and three crashes involved three. Only two fatal crashes involved four or more ve hicles.
- Twenty (63 percent) of the 32 crashes were on weekdays.
- Fifteen crashes (47 percent) occurred between 7 a.m. and 7 p.m.
- Two crashes (6 percent) involved alcohol, 30 did not.
- Twenty-eight fatal crashes (88 percent) were in clear weather and on dry roads.

Weather

Adverse weather and road surface conditions can be the primary cause or a contributing factor in a given crash. Most Beltway crashes occurred under the most favorable environmental conditions. Clear weather was reported for 78.8 percent of crashes; dry road conditions for 71.2 percent.

Less than ideal weather conditions and weather-affected roads are contributing factors for some of the Beltway crashes. Adverse road surface condition appears to have a greater influence on crash occurrence. Lost Control in Road and Ran Off Road crashes proved most affected by weather. These two crash types had a higher proportion of crashes in wet, snowy and icy conditions.



Alcohol-Related Crashes

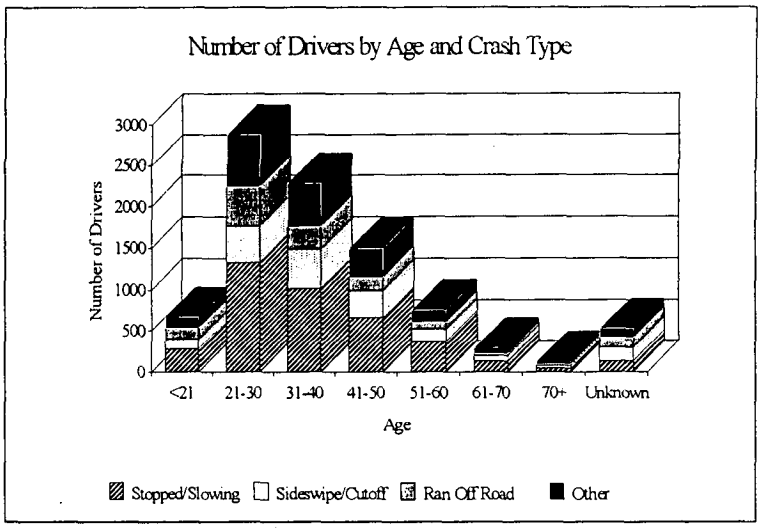
Overall, alcohol was involved in four percent of Beltway crashes. Compared to non-alcohol-related crashes, alcohol crashes differed in distribution among major crash types. Alcohol-related crashes were more likely to be Ran Off Road crashes and less likely to be Stop/Slowing crashes. This difference was likely due to the time of day these crashes occurred. One-third of alcohol-related crashes were single-vehicle events compared to 12 percent of non-alcohol-related crashes.

Alcohol Use By Crash Type

	Non-Alcohol	Alcohol-Related	Total
Stop/Slowing	1,581 (98%)	30 (2%)	1,611
Sideswipe/Cutoff	778 (96%)	31 (4%)	809
Ran Off Road	966 (93%)	75 (7%)	1,041
Other/Less Frequent	933 (95%)	53 (5%)	986
Total	4,258 (96%)	189 (4%)	4,447

Driver Age

There were approximately 9,000 motor vehicle drivers involved in Beltway crashes during 1993 and 1994. Nearly one-third (32 percent) of these drivers were 21 to 30 years old and one-fourth (25.3 percent) were between 31 and 40. Combined, these drivers accounted for 57.3 percent of the crashes. Drivers ages 41 to 50 were involved in fewer crashes (16.6 percent); drivers older than fifty even fewer (12.9 percent). Between age groups, the distribution of crashes by crash type showed uniformity. The above figure displays this distribution.



These percentages reflect only the ages of drivers who were involved in a crash and not the likelihood that any certain age might be over or under represented on the Beltway. To compute exposure, we would need to look at the total number of drivers in each age group and calculate the number of miles they drive on the Beltway.

Driver Residence

Because tractor-trailer drivers, by occupation, are usually driving long distances, their residences are likely to be of greater distance from the Beltway. Eighty-three percent of the tractor-trailer drivers involved in crashes are from locations over ten miles away from the Beltway. In comparison, drivers of straight trucks, normally used for shorter trips, were more likely to come from locations in and around the Beltway. About half (46 percent) of the drivers of all other vehicles lived within 10 miles of the Beltway.

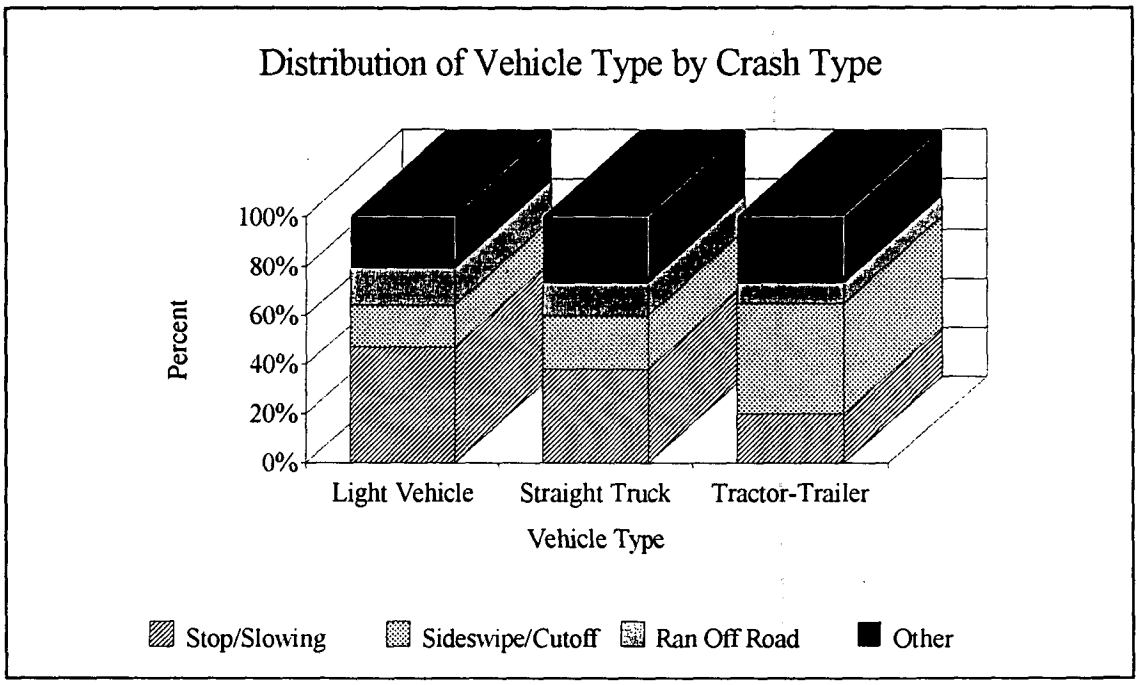
Proximity of Residence

	Inside Beltway	Beltway + 3 Miles	Beltway + 10 Miles	Other MD or VA	Outside MD or VA	Unknown
Tractor-Trailer	3%	1%	3%	31%	52%	10%
Straight Truck	14%	8%	13%	50%	10%	4%
All Other	18%	14%	14%	35%	12%	8%

Vehicle Type

In the 4,447 crashes occurring on the Beltway, over 9,000 vehicles were involved. Nearly 10 percent (N=869) of these vehicles were tractor-trailers and nearly six percent (N=517) were straight trucks. These two vehicle types were involved in 1,148 crashes, or 25 percent of the total crashes.

Different vehicle types have distinct differences in the type of crashes they are involved in. The following table shows the distribution of crashes by three vehicle types: tractor-trailers; straight-trucks; and light passenger vehicles. Not included are buses, emergency vehicles, other vehicle types and unknowns.



Tractor-Trailer Crashes

One or more tractor-trailers were involved in 716, or 16 percent, of the Beltway crashes. The distribution of these crashes by major crash types is as follows: Stop/Slowing (18.4 percent); Ran Off Road (8.2 percent); Sideswipe/Cutoff (45.7 percent); Other (27.7 percent). There are glaring differences between these percentages and what is found for all crashes. Tractor-trailers have few Ran Off Road crashes and a disproportionately high number of Sideswipe/Cutoff crashes. Nearly one-quarter (24 percent) of tractor-trailer crashes involved the truck sideswiping a light vehicle; 13.1 percent involved a light vehicle sideswiping a tractor-trailer. Also, the percentage of crashes that are Ramp Related is higher for tractor-trailer crashes (6.4 percent) than for all other vehicle types.

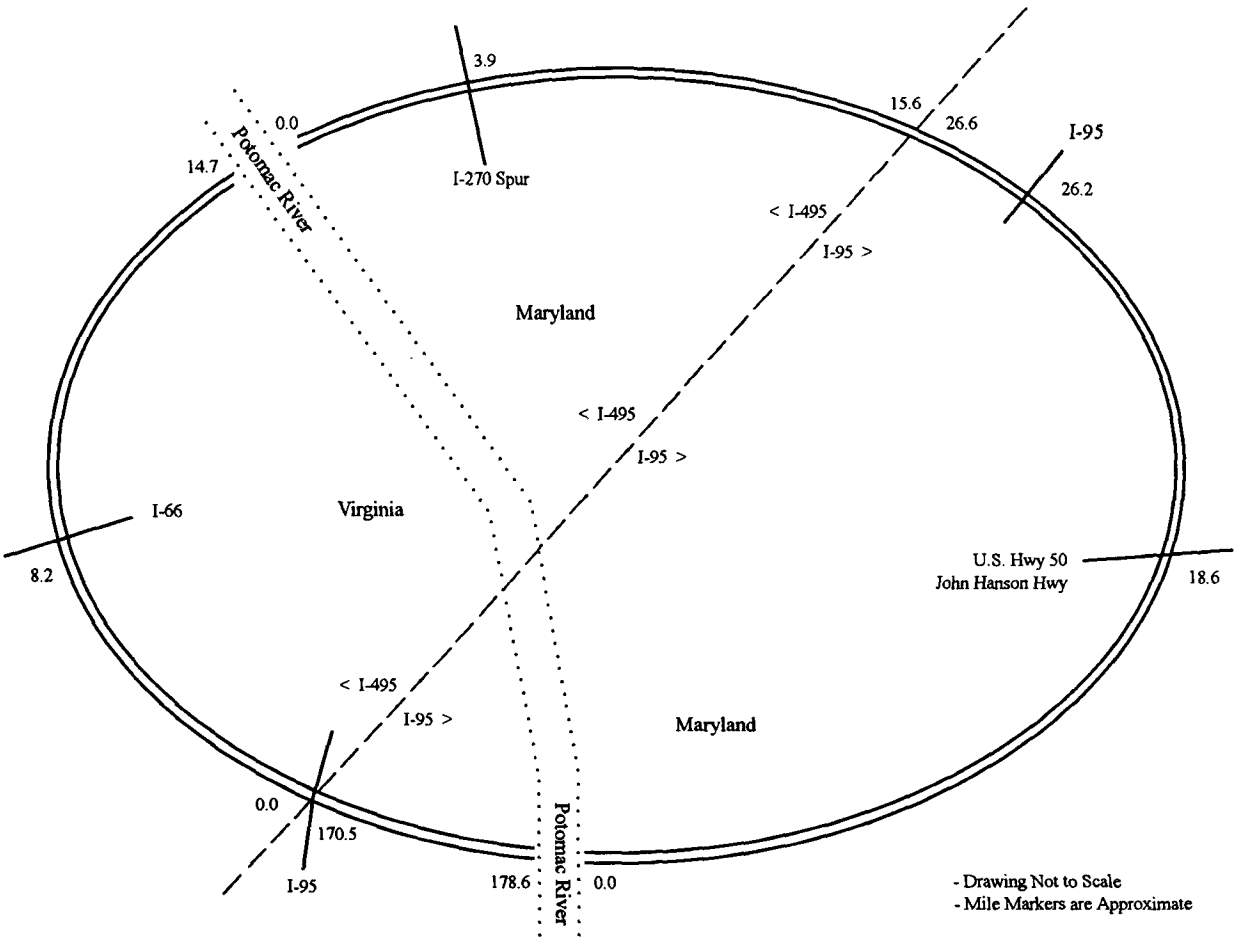
Crashes involving tractor-trailers did not result in more severe injuries compared to all crashes combined. Approximately 37 percent of tractor-trailer crashes involved an injury compared to the rate of 42.3 percent for all crashes combined. Crashes involving tractor-trailers had only a slightly higher rate of fatal injury, 0.84 percent compared to 0.73 percent.

IV. Crash Location

Nearly fifty percent (2,206) of the Beltway crashes occurred on route I-495 and just over fifty percent (2,238) on I-95. The crashes on these routes were not distributed evenly across distance points. Some locations had more crashes than others.

Tables on the next four pages show the number of crashes by each tenth of a mile on the Beltway for both inner and outer loops. Histographs on subsequent pages show the "moving average" number of crashes for each tenth mile on the Beltway. The moving average number of crashes was derived by counting all crashes within a one mile range surrounding each tenth mile. The number of crashes for a particular tenth mile were added with the number occurring within the five tenths "upstream" and four tenths "downstream". The total was divided by ten. This method of looking at the distribution of crashes across Beltway milepoints serves two purposes. First, officers do not always record crashes at their exact locations but in near proximity. For example, in Virginia, the number of crashes are over-represented at whole number milepoints. This is likely due to the tendency to report whole numbers when unsure of an exact location. In Maryland, it appears that landmarks with well known and specific milepoints are often used to identify the whereabouts of crashes in close proximity. This is evident from extremely high numbers of crashes at very specific mile points. Second, graphing moving averages clearly shows areas of the Beltway that have more than their share of crashes. In most cases, the peaks in the histographs represent close proximity of interchange locations.

Capital Beltway: Mile Marker Reference Points



Number of Capital Beltway Crashes by Mile Point; Virginia, 1993 - 1994

I-495 Inner Loop						I-495 Outer Loop						I-95 Inner Loop				I-95 Outer Loop			
mile pt.	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*
0	0	5	3	10	4	0	0	5	5	10	7	170.5	6	175	6	170.6	0	175	6
0.1	4	5.1	3	10.1	1	0.1	10	5.1	2	10.1	2	170.6	3	175.1	3	170.7	0	175.1	4
0.2	1	5.2	2	10.2	0	0.2	4	5.2	2	10.2	2	170.7	7	175.2	2	170.8	3	175.2	0
0.3	0	5.3	4	10.3	0	0.3	3	5.3	2	10.3	3	170.8	13	175.3	2	170.9	0	175.3	2
0.4	1	5.4	5	10.4	2	0.4	1	5.4	6	10.4	0	170.9	1	175.4	2	171	13	175.4	7
0.5	4	5.5	4	10.5	5	0.5	9	5.5	2	10.5	0	171	17	175.5	2	171.1	1	175.5	5
0.6	0	5.6	7	10.6	2	0.6	2	5.6	6	10.6	1	171.1	5	175.6	5	171.2	0	175.6	7
0.7	0	5.7	9	10.7	5	0.7	0	5.7	2	10.7	1	171.2	1	175.7	2	171.3	1	175.7	3
0.8	0	5.8	2	10.8	1	0.8	6	5.8	3	10.8	3	171.3	1	175.8	1	171.4	0	175.8	5
0.9	0	5.9	4	10.9	2	0.9	2	5.9	3	10.9	3	171.4	5	175.9	0	171.5	4	175.9	4
1	13	6	15	11	8	1	34	6	11	11	9	171.5	12	176	7	171.6	1	176	20
1.1	2	6.1	6	11.1	9	1.1	6	6.1	7	11.1	6	171.6	3	176.1	1	171.7	1	176.1	3
1.2	2	6.2	3	11.2	2	1.2	3	6.2	3	11.2	5	171.7	4	176.2	1	171.8	1	176.2	3
1.3	0	6.3	3	11.3	0	1.3	2	6.3	2	11.3	5	171.8	9	176.3	1	171.9	1	176.3	11
1.4	3	6.4	6	11.4	2	1.4	2	6.4	1	11.4	5	171.9	11	176.4	0	172	7	176.4	1
1.5	0	6.5	5	11.5	8	1.5	6	6.5	5	11.5	8	172	30	176.5	0	172.1	2	176.5	8
1.6	6	6.6	1	11.6	0	1.6	8	6.6	1	11.6	1	172.1	2	176.6	0	172.2	5	176.6	4
1.7	0	6.7	2	11.7	1	1.7	3	6.7	0	11.7	2	172.2	9	176.7	1	172.3	1	176.7	5
1.8	4	6.8	4	11.8	0	1.8	7	6.8	2	11.8	2	172.3	7	176.8	0	172.4	8	176.8	4
1.9	2	6.9	1	11.9	0	1.9	1	6.9	1	11.9	0	172.4	15	176.9	1	172.5	5	176.9	5
2	8	7	8	12	5	2	5	7	8	12	7	172.5	10	177	19	172.6	4	177	16
2.1	2	7.1	5	12.1	1	2.1	4	7.1	3	12.1	4	172.6	10	177.1	3	172.7	1	177.1	11
2.2	1	7.2	5	12.2	0	2.2	3	7.2	2	12.2	3	172.7	1	177.2	7	172.8	2	177.2	9
2.3	3	7.3	7	12.3	1	2.3	2	7.3	6	12.3	4	172.8	8	177.3	3	172.9	0	177.3	9
2.4	6	7.4	3	12.4	0	2.4	3	7.4	3	12.4	1	172.9	2	177.4	4	173	10	177.4	3
2.5	7	7.5	10	12.5	3	2.5	4	7.5	4	12.5	5	173	6	177.5	16	173.1	1	177.5	16
2.6	12	7.6	9	12.6	3	2.6	10	7.6	3	12.6	2	173.1	0	177.6	4	173.2	1	177.6	4
2.7	8	7.7	1	12.7	0	2.7	5	7.7	4	12.7	3	173.2	4	177.7	0	173.3	2	177.7	0
2.8	9	7.8	4	12.8	1	2.8	1	7.8	12	12.8	7	173.3	1	177.8	4	173.4	3	177.8	2
2.9	2	7.9	8	12.9	3	2.9	4	7.9	6	12.9	3	173.4	3	177.9	1	173.5	4	177.9	1
3	2	8	12	13	5	3	4	8	10	13	8	173.5	11	178	3	173.6	1	178	0
3.1	1	8.1	10	13.1	1	3.1	5	8.1	2	13.1	2	173.6	1	178.1	0	173.7	1	178.1	0
3.2	4	8.2	1	13.2	2	3.2	5	8.2	2	13.2	3	173.7	1	178.2	0	173.8	2	178.2	0
3.3	4	8.3	2	13.3	1	3.3	4	8.3	7	13.3	0	173.8	1	178.3	0	173.9	0	178.3	3
3.4	1	8.4	7	13.4	5	3.4	2	8.4	4	13.4	4	173.9	2	178.4	0	174	9	178.4	0
3.5	5	8.5	1	13.5	4	3.5	3	8.5	2	13.5	1	174	8	178.5	0	174.1	1	178.5	0
3.6	0	8.6	1	13.6	3	3.6	1	8.6	0	13.6	1	174.1	2	178.6	0	174.2	1	178.6	0
3.7	2	8.7	3	13.7	5	3.7	2	8.7	2	13.7	2	174.2	1			174.3	0		
3.8	4	8.8	1	13.8	3	3.8	2	8.8	2	13.8	0	174.3	0			174.4	2		
3.9	1	8.9	1	13.9	6	3.9	2	8.9	1	13.9	2	174.4	2			174.5	1		
4	7	9	1	14	8	4	7	9	6	14	8	174.5	1			174.6	5		
4.1	2	9.1	2	14.1	5	4.1	3	9.1	2	14.1	0	174.6	2			174.7	0		
4.2	7	9.2	0	14.2	2	4.2	11	9.2	0	14.2	4	174.7	0			174.8	2		
4.3	0	9.3	3	14.3	3	4.3	9	9.3	0	14.3	5	174.8	2			174.9	0		
4.4	2	9.4	3	14.4	3	4.4	4	9.4	5	14.4	2	174.9	1						
4.5	5	9.5	7	14.5	1	4.5	5	9.5	6	14.5	2								
4.6	0	9.6	2	14.6	1	4.6	2	9.6	4	14.6	0								
4.7	3	9.7	2			4.7	5	9.7	3	14.7	0								
4.8	1	9.8	1			4.8	5	9.8	4										
4.9	1	9.9	2			4.9	4	9.9	4										

Number of Capital Beltway Crashes by Mile Point; Maryland, 1993 - 1994

I-495 Inner Loop								I-495 Outer Loop							
mile pt.	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*
0	6	4	10	8	3	12	13	0	1	4	14	8	2	12	13
0.1	4	4.1	2	8.1	3	12.1	1	0.1	7	4.1	5	8.1	4	12.1	2
0.2	4	4.2	6	8.2	12	12.2	0	0.2	4	4.2	7	8.2	5	12.2	2
0.3	7	4.3	0	8.3	24	12.3	0	0.3	7	4.3	0	8.3	25	12.3	0
0.4	13	4.4	3	8.4	10	12.4	3	0.4	6	4.4	3	8.4	5	12.4	3
0.5	9	4.5	0	8.5	6	12.5	2	0.5	5	4.5	0	8.5	6	12.5	2
0.6	6	4.6	0	8.6	3	12.6	14	0.6	5	4.6	4	8.6	5	12.6	10
0.7	2	4.7	0	8.7	3	12.7	2	0.7	0	4.7	1	8.7	0	12.7	0
0.8	3	4.8	3	8.8	2	12.8	2	0.8	1	4.8	1	8.8	5	12.8	3
0.9	2	4.9	1	8.9	0	12.9	0	0.9	1	4.9	0	8.9	0	12.9	0
1	3	5	2	9	1	13	3	1	9	5	0	9	0	13	1
1.1	7	5.1	1	9.1	4	13.1	0	1.1	3	5.1	2	9.1	2	13.1	1
1.2	1	5.2	0	9.2	3	13.2	7	1.2	1	5.2	0	9.2	5	13.2	7
1.3	1	5.3	0	9.3	2	13.3	0	1.3	2	5.3	0	9.3	3	13.3	1
1.4	2	5.4	2	9.4	2	13.4	1	1.4	2	5.4	3	9.4	1	13.4	0
1.5	1	5.5	2	9.5	3	13.5	0	1.5	1	5.5	1	9.5	2	13.5	1
1.6	1	5.6	16	9.6	4	13.6	0	1.6	0	5.6	4	9.6	2	13.6	0
1.7	2	5.7	0	9.7	0	13.7	3	1.7	0	5.7	0	9.7	2	13.7	2
1.8	1	5.8	5	9.8	2	13.8	0	1.8	1	5.8	1	9.8	1	13.8	1
1.9	11	5.9	2	9.9	7	13.9	0	1.9	3	5.9	0	9.9	9	13.9	0
2	5	6	0	10	2	14	3	2	1	6	0	10	4	14	3
2.1	3	6.1	0	10.1	5	14.1	4	2.1	0	6.1	1	10.1	1	14.1	3
2.2	2	6.2	1	10.2	3	14.2	15	2.2	5	6.2	1	10.2	1	14.2	12
2.3	4	6.3	2	10.3	5	14.3	1	2.3	3	6.3	1	10.3	2	14.3	2
2.4	19	6.4	1	10.4	13	14.4	1	2.4	14	6.4	1	10.4	1	14.4	0
2.5	9	6.5	7	10.5	31	14.5	0	2.5	0	6.5	2	10.5	14	14.5	0
2.6	2	6.6	7	10.6	3	14.6	0	2.6	4	6.6	14	10.6	5	14.6	0
2.7	3	6.7	30	10.7	9	14.7	1	2.7	1	6.7	22	10.7	4	14.7	1
2.8	2	6.8	7	10.8	2	14.8	0	2.8	2	6.8	5	10.8	4	14.8	0
2.9	4	6.9	7	10.9	0	14.9	0	2.9	3	6.9	9	10.9	1	14.9	0
3	1	7	1	11	6	15	0	3	0	7	0	11	2	15	0
3.1	2	7.1	1	11.1	0	15.1	0	3.1	1	7.1	0	11.1	0	15.1	0
3.2	2	7.2	3	11.2	8	15.2	0	3.2	3	7.2	3	11.2	6	15.2	0
3.3	0	7.3	10	11.3	0	15.3	1	3.3	0	7.3	7	11.3	0	15.3	0
3.4	1	7.4	9	11.4	0	15.4	1	3.4	1	7.4	3	11.4	0	15.4	0
3.5	5	7.5	6	11.5	7	15.5	0	3.5	1	7.5	3	11.5	3	15.5	0
3.6	2	7.6	1	11.6	2	15.6	0	3.6	5	7.6	1	11.6	0	15.6	0
3.7	12	7.7	1	11.7	1			3.7	11	7.7	1	11.7	1		
3.8	11	7.8	7	11.8	2			3.8	27	7.8	10	11.8	5		
3.9	3	7.9	1	11.9	5			3.9	12	7.9	1	11.9	2		

Number of Capital Beltway Crashes by Mile Point; Maryland, 1993 - 1994

I-95 Inner Loop

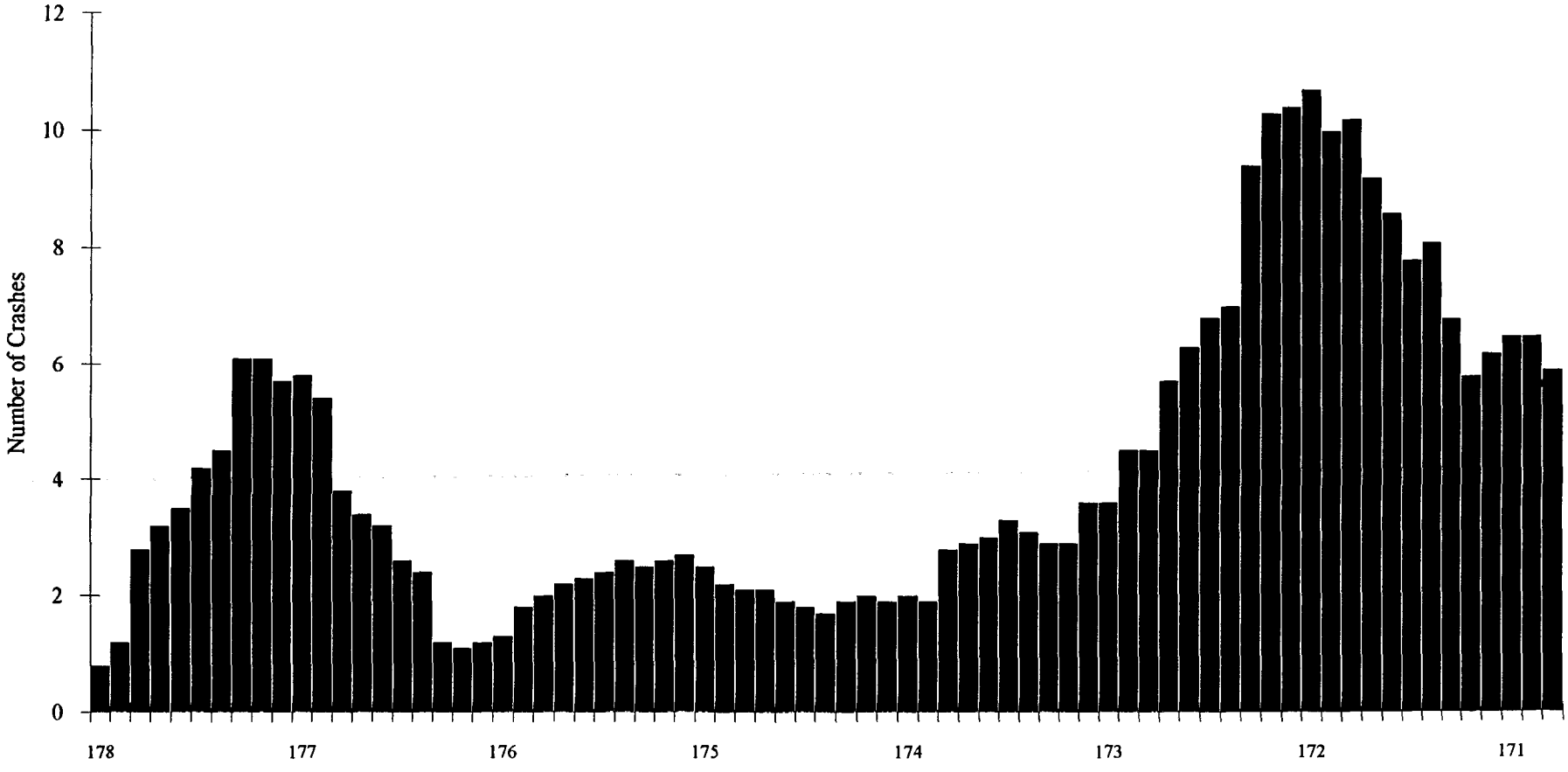
mile pt.	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*
0	3	4	1	8	0	12	1	16	1	20	0	24	2
0.1	3	4.1	0	8.1	1	12.1	1	16.1	4	20.1	2	24.1	1
0.2	1	4.2	2	8.2	4	12.2	4	16.2	2	20.2	1	24.2	4
0.3	2	4.3	4	8.3	6	12.3	3	16.3	0	20.3	0	24.3	2
0.4	3	4.4	17	8.4	1	12.4	1	16.4	1	20.4	1	24.4	2
0.5	15	4.5	4	8.5	3	12.5	0	16.5	5	20.5	0	24.5	0
0.6	4	4.6	5	8.6	0	12.6	0	16.6	18	20.6	0	24.6	0
0.7	0	4.7	2	8.7	2	12.7	1	16.7	10	20.7	0	24.7	4
0.8	3	4.8	0	8.8	0	12.8	1	16.8	5	20.8	2	24.8	2
0.9	2	4.9	3	8.9	0	12.9	1	16.9	0	20.9	0	24.9	7
1	1	5	0	9	2	13	0	17	0	21	10	25	7
1.1	1	5.1	0	9.1	5	13.1	3	17.1	1	21.1	1	25.1	5
1.2	3	5.2	2	9.2	3	13.2	15	17.2	0	21.2	1	25.2	20
1.3	3	5.3	1	9.3	0	13.3	4	17.3	1	21.3	1	25.3	4
1.4	1	5.4	2	9.4	2	13.4	1	17.4	1	21.4	0	25.4	9
1.5	4	5.5	0	9.5	1	13.5	1	17.5	3	21.5	1	25.5	2
1.6	7	5.6	5	9.6	5	13.6	1	17.6	6	21.6	0	25.6	0
1.7	25	5.7	3	9.7	1	13.7	1	17.7	0	21.7	0	25.7	4
1.8	33	5.8	2	9.8	9	13.8	0	17.8	1	21.8	1	25.8	0
1.9	6	5.9	1	9.9	2	13.9	0	17.9	2	21.9	0	25.9	2
2	6	6	0	10	7	14	1	18	0	22	7	26	6
2.1	1	6.1	0	10.1	2	14.1	0	18.1	5	22.1	0	26.1	3
2.2	1	6.2	1	10.2	0	14.2	0	18.2	0	22.2	23	26.2	3
2.3	3	6.3	0	10.3	7	14.3	4	18.3	0	22.3	0	26.3	0
2.4	3	6.4	2	10.4	0	14.4	0	18.4	2	22.4	2	26.4	1
2.5	5	6.5	0	10.5	2	14.5	3	18.5	1	22.5	3	26.5	2
2.6	10	6.6	1	10.6	3	14.6	4	18.6	11	22.6	4	26.6	7
2.7	9	6.7	1	10.7	11	14.7	7	18.7	3	22.7	1		
2.8	34	6.8	1	10.8	16	14.8	29	18.8	3	22.8	2		
2.9	7	6.9	1	10.9	7	14.9	3	18.9	2	22.9	0		
3	7	7	1	11	7	15	0	19	0	23	3		
3.1	3	7.1	2	11.1	0	15.1	0	19.1	2	23.1	15		
3.2	4	7.2	7	11.2	1	15.2	1	19.2	1	23.2	13		
3.3	4	7.3	4	11.3	1	15.3	4	19.3	0	23.3	1		
3.4	0	7.4	19	11.4	0	15.4	0	19.4	2	23.4	1		
3.5	2	7.5	5	11.5	0	15.5	0	19.5	1	23.5	2		
3.6	2	7.6	5	11.6	0	15.6	6	19.6	16	23.6	0		
3.7	0	7.7	1	11.7	0	15.7	0	19.7	4	23.7	2		
3.8	3	7.8	0	11.8	4	15.8	3	19.8	5	23.8	2		
3.9	3	7.9	1	11.9	2	15.9	1	19.9	4	23.9	1		

Number of Capital Beltway Crashes by Mile Point; Maryland, 1993 - 1994

I-95 Outer Loop

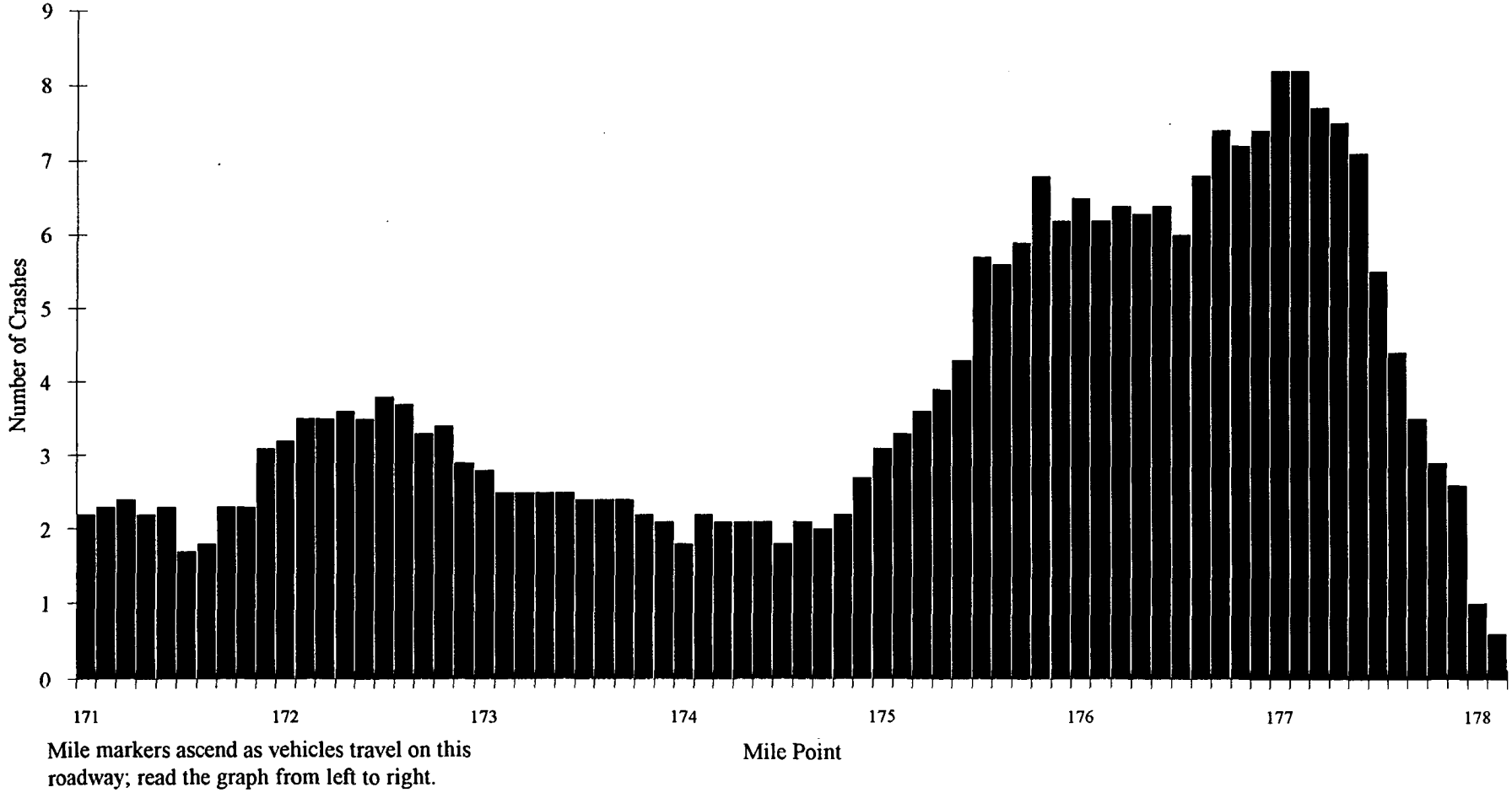
mile pt.	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*	*mile pt.*	*crashes*
0	0	4	1	8	1	12	1	16	0	20	2	24	0
0.1	1	4.1	1	8.1	1	12.1	1	16.1	4	20.1	1	24.1	0
0.2	1	4.2	2	8.2	3	12.2	0	16.2	0	20.2	0	24.2	7
0.3	0	4.3	3	8.3	4	12.3	5	16.3	0	20.3	0	24.3	0
0.4	3	4.4	10	8.4	2	12.4	2	16.4	4	20.4	1	24.4	1
0.5	14	4.5	7	8.5	1	12.5	1	16.5	5	20.5	1	24.5	0
0.6	1	4.6	2	8.6	1	12.6	2	16.6	12	20.6	3	24.6	0
0.7	2	4.7	0	8.7	0	12.7	2	16.7	15	20.7	1	24.7	3
0.8	2	4.8	0	8.8	2	12.8	2	16.8	2	20.8	0	24.8	0
0.9	1	4.9	1	8.9	2	12.9	0	16.9	0	20.9	2	24.9	1
1	1	5	0	9	4	13	4	17	0	21	11	25	1
1.1	1	5.1	0	9.1	7	13.1	2	17.1	2	21.1	4	25.1	5
1.2	1	5.2	0	9.2	1	13.2	8	17.2	1	21.2	3	25.2	27
1.3	1	5.3	0	9.3	2	13.3	2	17.3	1	21.3	2	25.3	8
1.4	3	5.4	1	9.4	1	13.4	3	17.4	1	21.4	0	25.4	7
1.5	1	5.5	1	9.5	0	13.5	0	17.5	1	21.5	0	25.5	3
1.6	5	5.6	1	9.6	1	13.6	1	17.6	5	21.6	1	25.6	3
1.7	5	5.7	2	9.7	0	13.7	1	17.7	1	21.7	0	25.7	4
1.8	8	5.8	2	9.8	6	13.8	5	17.8	2	21.8	0	25.8	0
1.9	3	5.9	0	9.9	3	13.9	1	17.9	2	21.9	0	25.9	3
2	1	6	0	10	5	14	0	18	1	22	6	26	8
2.1	2	6.1	0	10.1	1	14.1	0	18.1	5	22.1	1	26.1	6
2.2	1	6.2	1	10.2	1	14.2	1	18.2	3	22.2	21	26.2	5
2.3	1	6.3	0	10.3	3	14.3	1	18.3	0	22.3	1	26.3	0
2.4	0	6.4	2	10.4	0	14.4	0	18.4	2	22.4	6	26.4	2
2.5	2	6.5	1	10.5	1	14.5	1	18.5	2	22.5	5	26.5	4
2.6	4	6.6	3	10.6	6	14.6	5	18.6	10	22.6	4	26.6	3
2.7	3	6.7	3	10.7	4	14.7	7	18.7	5	22.7	1		
2.8	6	6.8	0	10.8	11	14.8	12	18.8	2	22.8	2		
2.9	1	6.9	1	10.9	2	14.9	4	18.9	0	22.9	2		
3	2	7	3	11	2	15	2	19	0	23	17		
3.1	1	7.1	1	11.1	0	15.1	0	19.1	1	23.1	0		
3.2	0	7.2	3	11.2	2	15.2	0	19.2	0	23.2	7		
3.3	2	7.3	5	11.3	1	15.3	2	19.3	1	23.3	3		
3.4	0	7.4	10	11.4	0	15.4	0	19.4	0	23.4	1		
3.5	0	7.5	0	11.5	1	15.5	0	19.5	2	23.5	2		
3.6	3	7.6	4	11.6	2	15.6	1	19.6	29	23.6	2		
3.7	1	7.7	0	11.7	0	15.7	0	19.7	4	23.7	2		
3.8	1	7.8	1	11.8	0	15.8	2	19.8	2	23.8	3		
3.9	1	7.9	0	11.9	1	15.9	0	19.9	0	23.9	1		

Average Number of Crashes by Mile Point; Virginia, I-95 Inner Loop



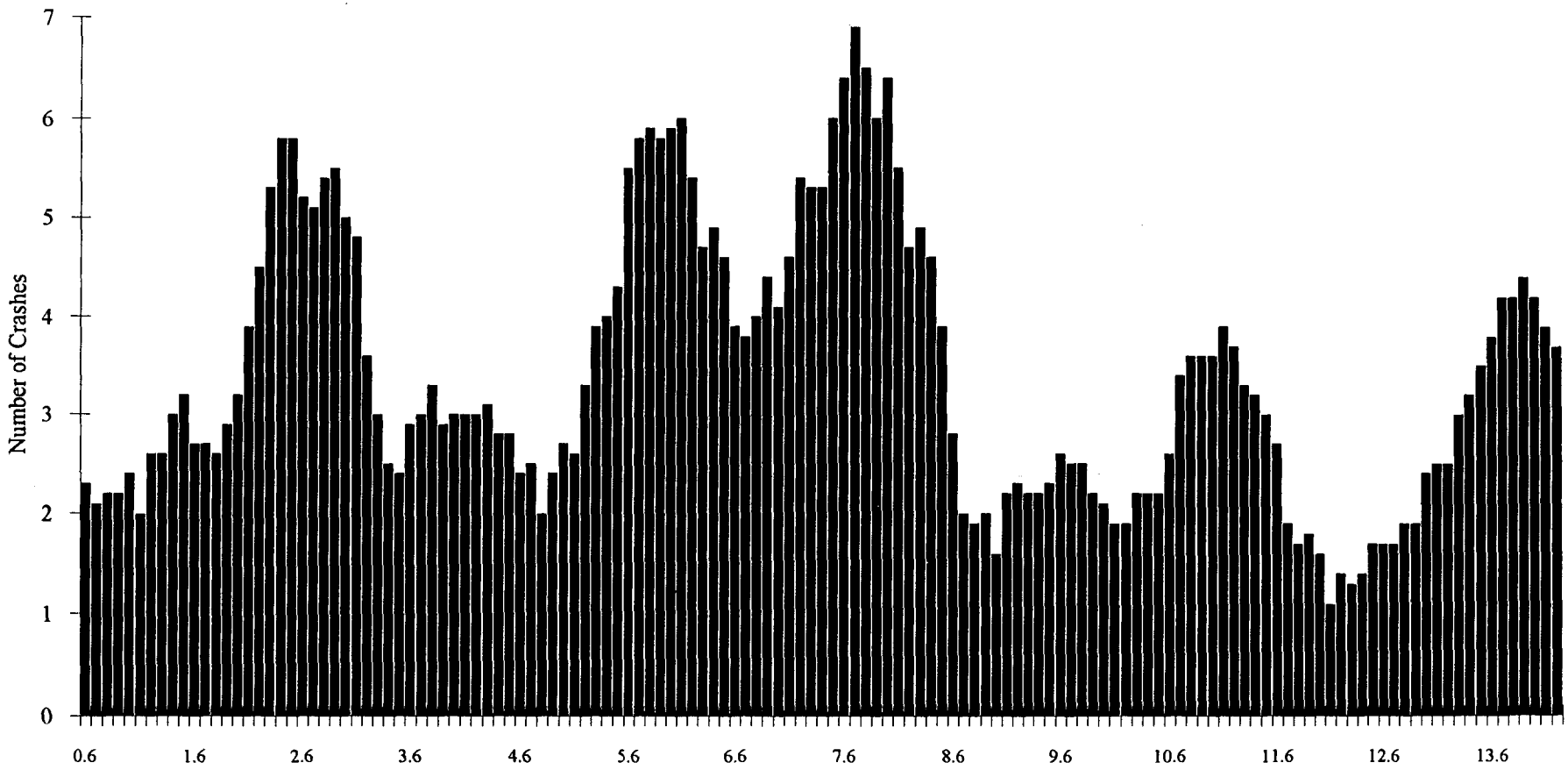
Mile markers descend as vehicles travel on this roadway; read the graph from left to right.

Average Number of Crashes by Mile Point; Virginia, I-95 Outer Loop



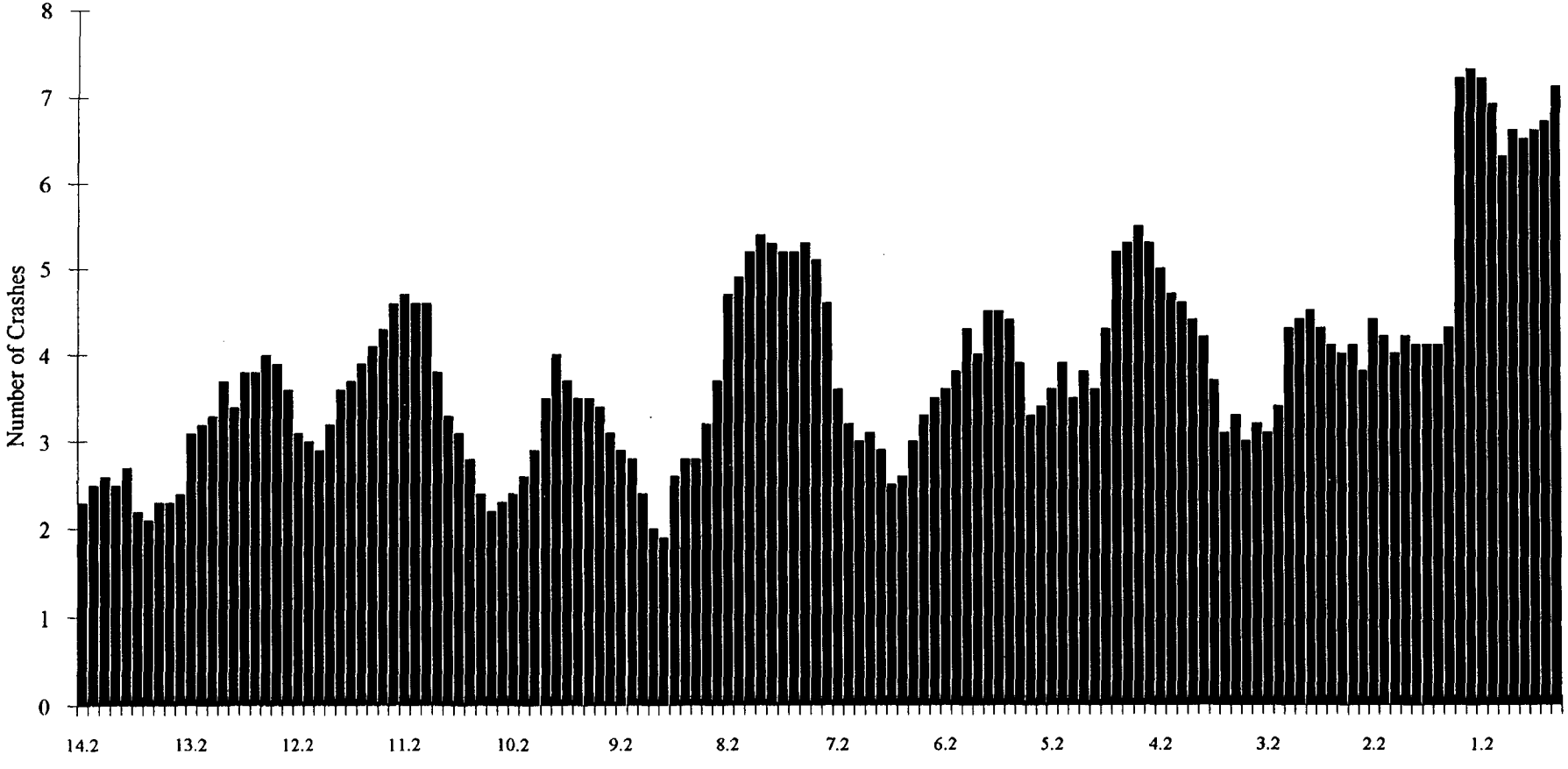
Mile markers ascend as vehicles travel on this roadway; read the graph from left to right.

Average Number of Crashes by Mile Point; Virginia, I-495 Inner Loop



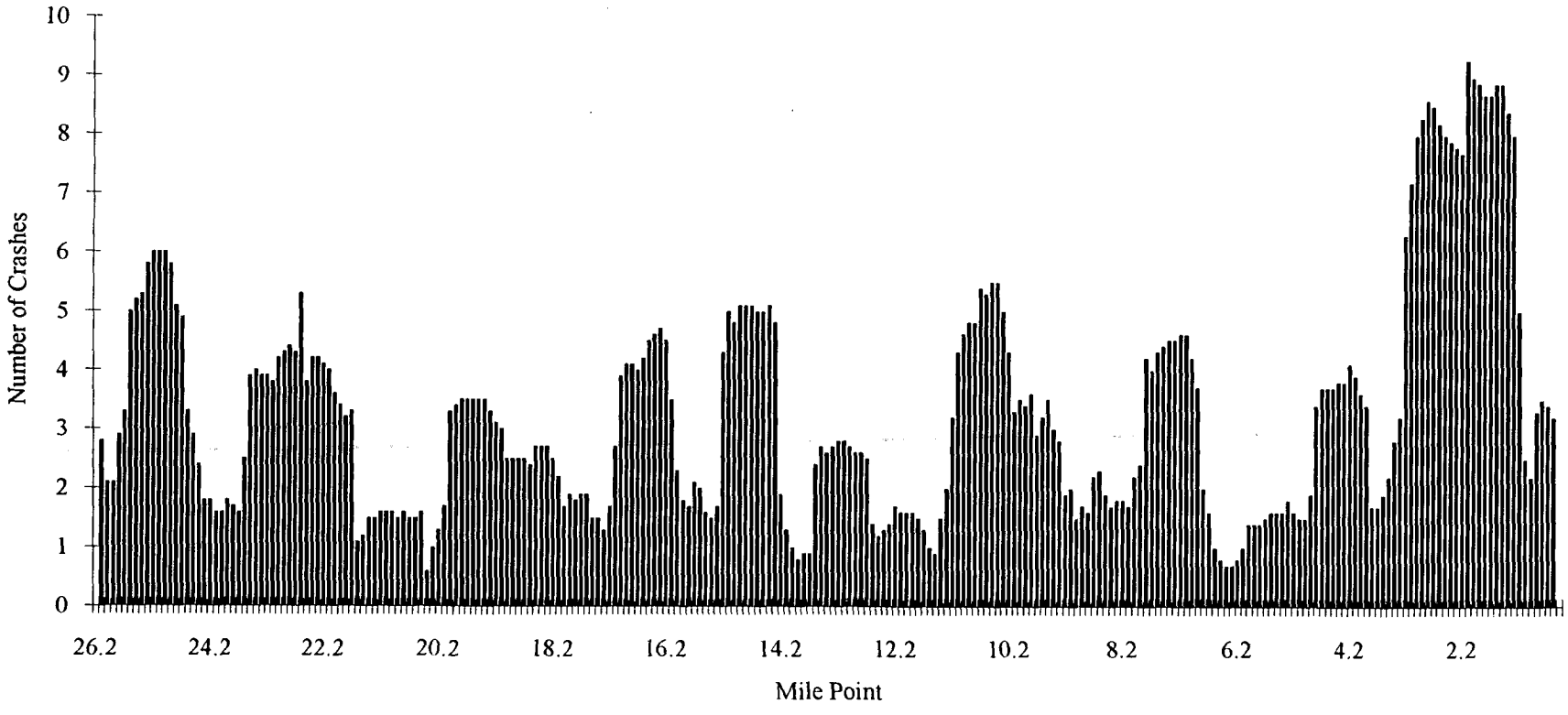
Mile markers ascend as vehicles travel on this roadway; read the graph from left to right.

Average Number of Crashes by Mile Point; Virginia, I-495 Outer Loop



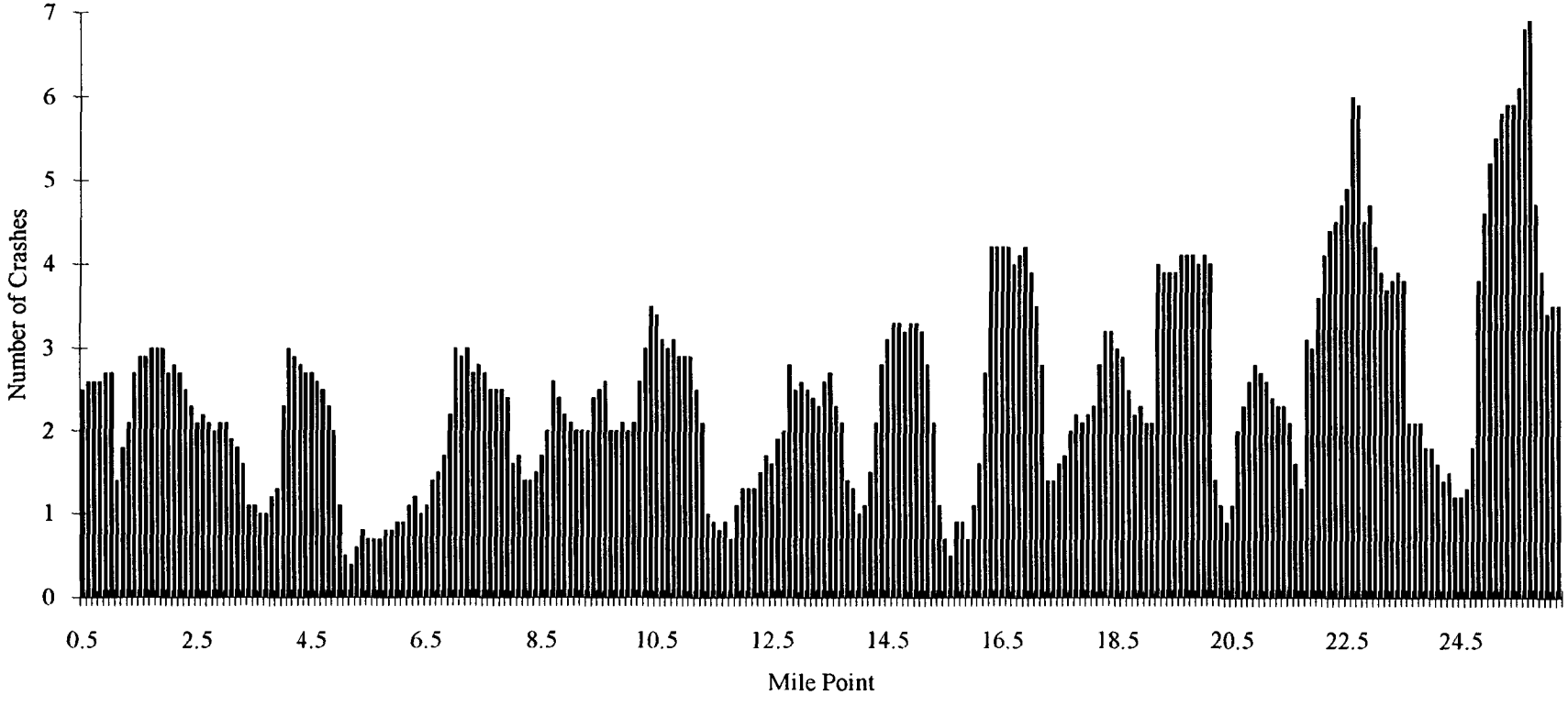
Mile markers descend as vehicles travel on this roadway; read the graph from left to right.

Average Number of Crashes by Mile Point; Maryland, I-95 Inner Loop



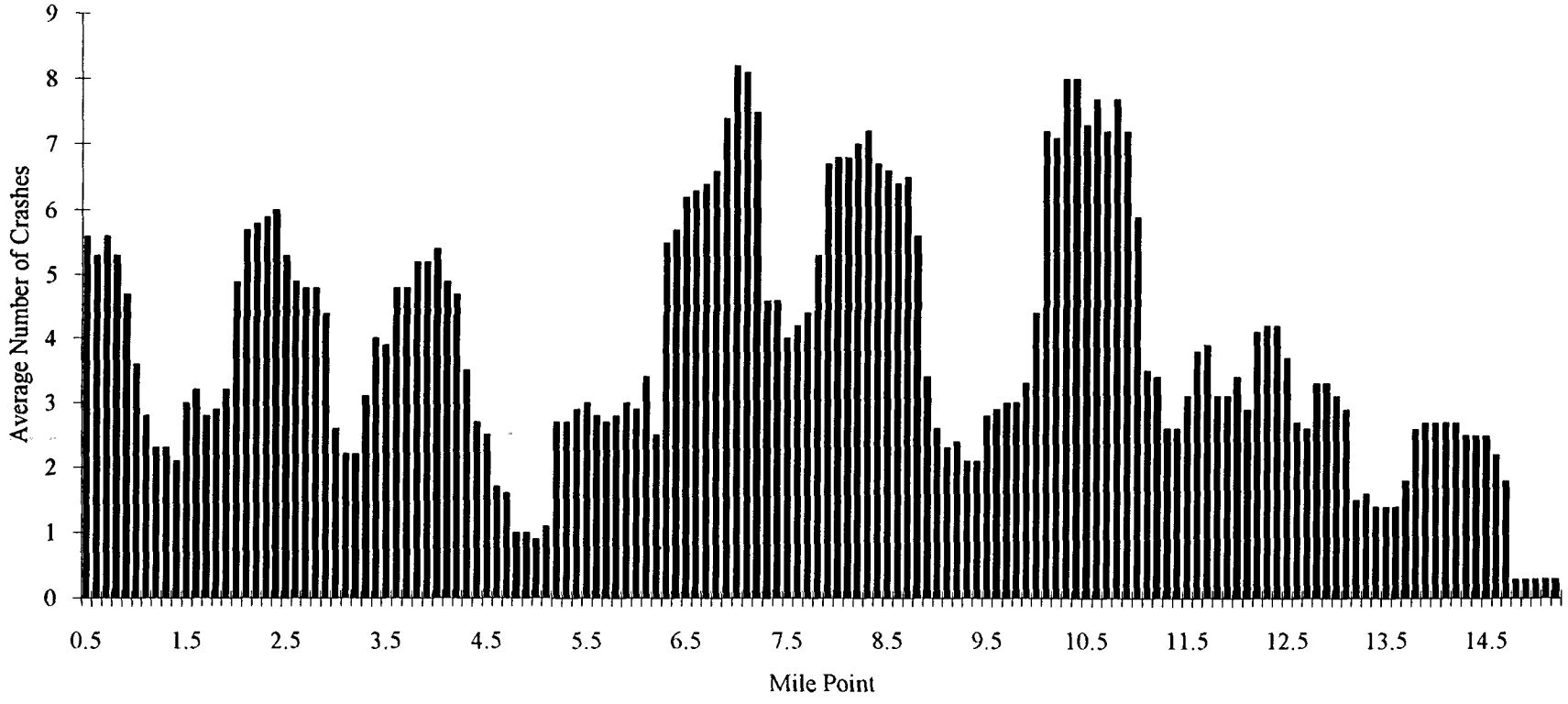
Mile markers descend as vehicles travel on this roadway; read the graph from left to right.

Average Number of Crashes; Maryland, I-95 Outer Loop



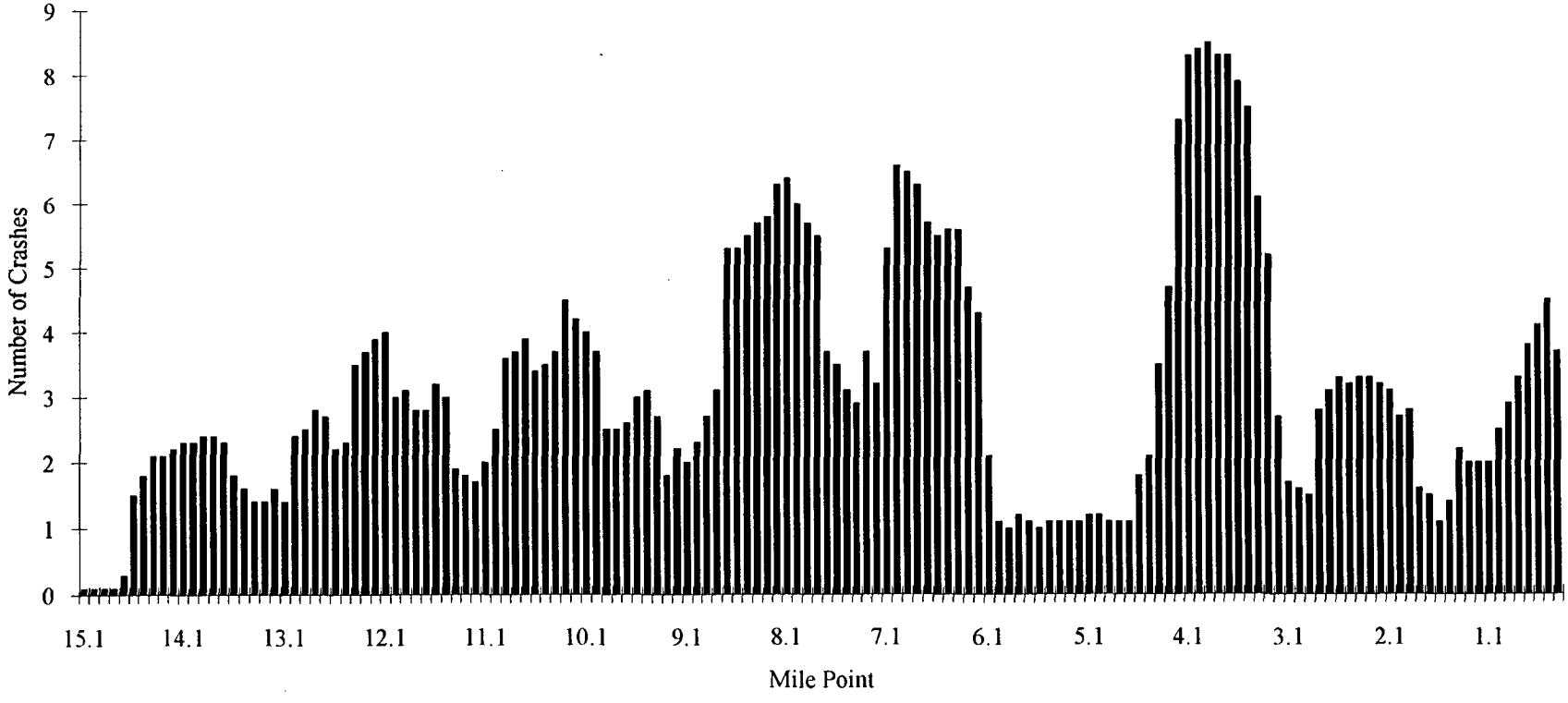
Mile markers ascend as vehicles travel on this roadway; read the graph from left to right.

Average Number of Crashes by Mile Point; Maryland, I-495 Inner Loop



Mile markers ascend as vehicles travel on this roadway; read the graph from left to right.

Average Number of Crashes by Mile Point; Maryland, I-495 Outer Loop



Mile markers descend as vehicles travel on this roadway; read the graph from left to right.

V. Interchange Analysis

Interchanges are the most dynamic locations on the Beltway where drivers must navigate through other vehicles changing lanes, merging into the main travel lanes, and slowing to exit. Changes in speed and direction are often necessary. For some drivers this is a difficult task. Beltway motorists expressed concern for improving conditions at interchanges in a series of focus groups conducted during the summer of 1994. This chapter presents information about the crash characteristics at specific interchange locations.

Mapping crashes by interchange location and number indicates areas of significant crash activity. Identification of crash types provides evidence for how and why these crashes occur.

Because the way the two states recorded information, comprehensive analysis of interchange crashes could be done only with the data provided by Virginia. The reports Maryland provided for analysis did not, generally, include crashes on ramps leading to and from the Capital Beltway. Therefore, Maryland is excluded from this analysis.

Method

For the purpose of this analysis, only the crashes that were interchange related were included. Crashes were classified into three location sub-groups for each interchange location. The following rules applied for the classification of crashes:

Main Line (N=963)

These crashes begin with at least one vehicle on the main line which subsequently collides with another vehicle(s) or object in or out of the main lanes of travel. These crashes must have occurred within a half mile range from the center of the interchange. For each interchange a center point was specified. The interchange center point was established by averaging mile-points where the main line and outer-most ramps of an interchange began or ended merging. Crashes occurring in the half mile from each side of the interchange center point were considered interchange related. Mile points on report forms were used to include or exclude Main Line crashes belonging to any or none of the interchanges. Although the one-mile range is an arbitrary distance, it stood as an equal distance measure in which mainline crashes were counted for each interchange.

Ramp Related (N=61)

These crashes include collisions between one or more vehicles on the main line and one or more vehicles in the acceleration or deceleration lane(s). The numbers of Ramp Related crashes were counted at each interchange.

On Ramp (N=364)

These crashes involve one or more vehicles on the ramp(s) including acceleration or deceleration lanes and collector or distribution lanes. Unlike "Main Line" and "Ramp Related", there is no involvement with a vehicle on the main line. These crashes were counted for each interchange.

Virginia Data Set

On the Virginia portion of the Capital Beltway the total number of crashes found to be interchange related equaled 1,388 for 1993 and 1994. This analysis required the identification of a specific interchange location for every crash. The specific interchange could not be identified for 11 crashes. Of the 11 discarded crashes, 10 were On Ramp crashes and one was Ramp Related. The number of Ramp Related crashes used in this analysis is 60, and the number of On Ramp crashes is 354.

Crashes placed in the Main Line crash group were separated by specific interchange location. For each interchange, the crashes were then sorted by crash type and totaled.

Ramp Related crashes are almost exclusively "Sideswipe/Cutoff" crashes involving one vehicle on the main line and one vehicle on the acceleration or deceleration lane. Because these crashes were few in number and predictable in type, they were not categorized by a crash type definition other than as they already exist. The Ramp Related crashes were separated by interchange location and were totaled.

Crashes in the On Ramp crash group were separated by specific interchange location, sorted by crash type and totaled. From information on the crash report forms and maps provided by the Virginia Department of Transportation, the Virginia On Ramp crashes were pin mapped at the specific location they occurred within each interchange.

Results

The following table gives the number of crashes by crash type for each of the 14 Virginia Beltway interchanges by location sub-group.

Virginia Interchange Crashes

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
I-95 & Route 1 (Richmond Highway)					
Main Line	41	9	26	5	81
Ramp Related	*na*	*na*	*na*	10	10
On Ramp	9	19	1	0	29
Total	50	28	27	15	120
I-95 & Route 241 (Telegraph Road)					
Main Line	46	5	9	9	69
Ramp Related	*na*	*na*	*na*	3	3
On Ramp	0	5	0	0	5
Total	46	10	9	12	77
I-95 & Route 613 (Van Dorn Street)					
Main Line	28	12	16	8	64
Ramp Related	*na*	*na*	*na*	6	6
On Ramp	7	9	5	0	21
Total	35	21	21	14	91

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
I-95 & I-495 (Springfield)					
Main Line	24	12	19	8	63
Ramp Related	*na*	*na*	*na*	15	15
On Ramp	29	50	18	4	101
Total	53	62	37	27	179
I-495 & Route 620 (Braddock Road)					
Main Line	46	14	14	14	88
Ramp Related	*na*	*na*	*na*	4	4
On Ramp	11	5	12	0	18
Total	57	19	16	18	110
I-495 & Route 236 (Little River Turnpike)					
Main Line	43	14	12	8	77
Ramp Related	*na*	*na*	*na*	1	1
On Ramp	4	6	1	1	12
Total	47	20	13	10	90
I-495 & Route 650 (Gallows Road)					
Main Line	42	25	13	9	89
Ramp Related	*na*	*na*	*na*	2	2
On Ramp	4	0	0	2	6
Total	46	25	13	13	97
I-495 & Route 50 (Arlington Boulevard)					
Main Line	35	17	8	4	64
Ramp Related	*na*	*na*	*na*	1	1
On Ramp	17	22	8	0	47
Total	52	39	16	5	112
I-495 & I-66					
Main Line	32	24	17	7	80
Ramp Related	*na*	*na*	*na*	9	9
On Ramp	3	11	7	2	23
Total	35	35	24	18	112
I-495 & Route 7 (Leesburg Pike)					
Main Line	25	12	14	3	54
Ramp Related	*na*	*na*	*na*	4	4
On Ramp	34	4	0	1	39
Total	59	16	14	8	97
I-495 & Route 123 (Chain Bridge Road)					
Main Line	18	12	17	15	62
Ramp Related	*na*	*na*	*na*	1	1
On Ramp	4	6	1	0	11
Total	22	18	18	16	74
I-495 & Route 267 (Dulles Toll Road)					
Main Line	27	13	13	12	65
Ramp Related	*na*	*na*	*na*	2	2
On Ramp	0	10	0	0	10
Total	27	23	13	14	77

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
I-495 & Route 193 (Georgetown Pike)					
Main Line	20	14	13	6	53
Ramp Related	*na*	*na*	*na*	1	1
On Ramp	1	4	1	0	6
Total	21	18	14	7	60
I-495 & G. W. Pkway (George Washington Parkway)					
Main Line	18	11	11	14	54
Ramp Related	*na*	*na*	*na*	1	1
On Ramp	1	23	1	1	26
Total	19	34	12	16	81
TOTAL	**569**	**368**	**257**	**193**	**1,387**

Virginia Interchange Crash Discussion

For all but one interchange, there were more Main Line crashes than crashes classified as either Ramp Related or On Ramp. The only exception was the Springfield interchange of I-495 & I-95 where crashes were overwhelmingly in the On Ramp group. Three interchanges had over 80 Main Line crashes within a half mile range of their center within two years time. The Gallows Road interchange of I-495 & Route 650 had the most, followed by the Braddock Road interchange of I-495 & Route 620 and then interchange I-95 & Route 1 in Alexandria. At these interchanges, as well as all others, Stop/Slowing was the dominating crash type for Main Line crashes.

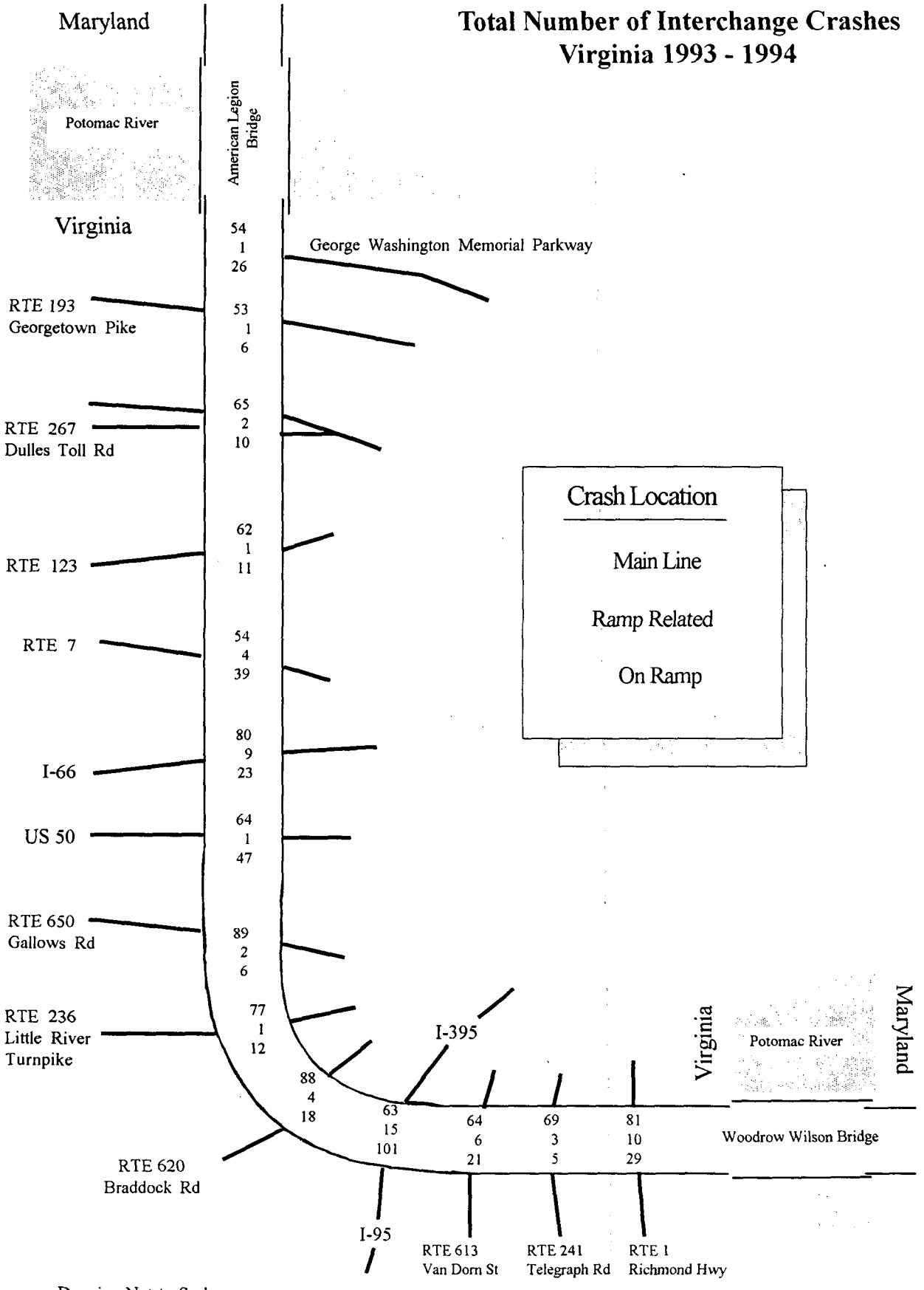
Few Ramp Related crashes occurred in calendar years 1993 and 1994. At most interchanges, less than five Ramp Related crashes were identified. Only two interchanges had ten or more crashes classified Ramp Related. The interchange of I-495 & I-95 had the most. These were scattered widely among different merge locations. Interchange I-95 & Route 1 had several crashes in the area where the ramp from Route 1, North and South, merges into I-95 East.

Three interchange locations had more than 30 On Ramp crashes within the two year period studied; four more had at least 20. Among these, significant clustering of a crash type was evident in three specific ramp locations. Descriptions are given below. Maps showing the location of each cluster are provided on succeeding pages. In the Appendix A, crash activity from 1993 through 1994 is summarized for all Virginia interchange locations.

A large number of Stop/Slowing crashes occurred on the ramp from Route 7 East to I-495 South. Nearly all of these crashes occurred where the ramp and the I-495 South collector/distribution lanes meet. Several more Stop/Slowing crashes occurred between this location and the south end of the collector/ distribution lanes.

Two interchanges had Ran Off Road crashes clustered on a particular ramp. The largest of these clusters was on the ramp entering the Beltway to I-95 East from I-95 North. These crashes were located on the curved portion of the ramp. The second largest cluster occurred on the ramp from the George Washington Memorial Parkway approaching I-495 North. These crashes were centrally located just prior to the merging portion of the ramp and I-495 North.

Total Number of Interchange Crashes
Virginia 1993 - 1994



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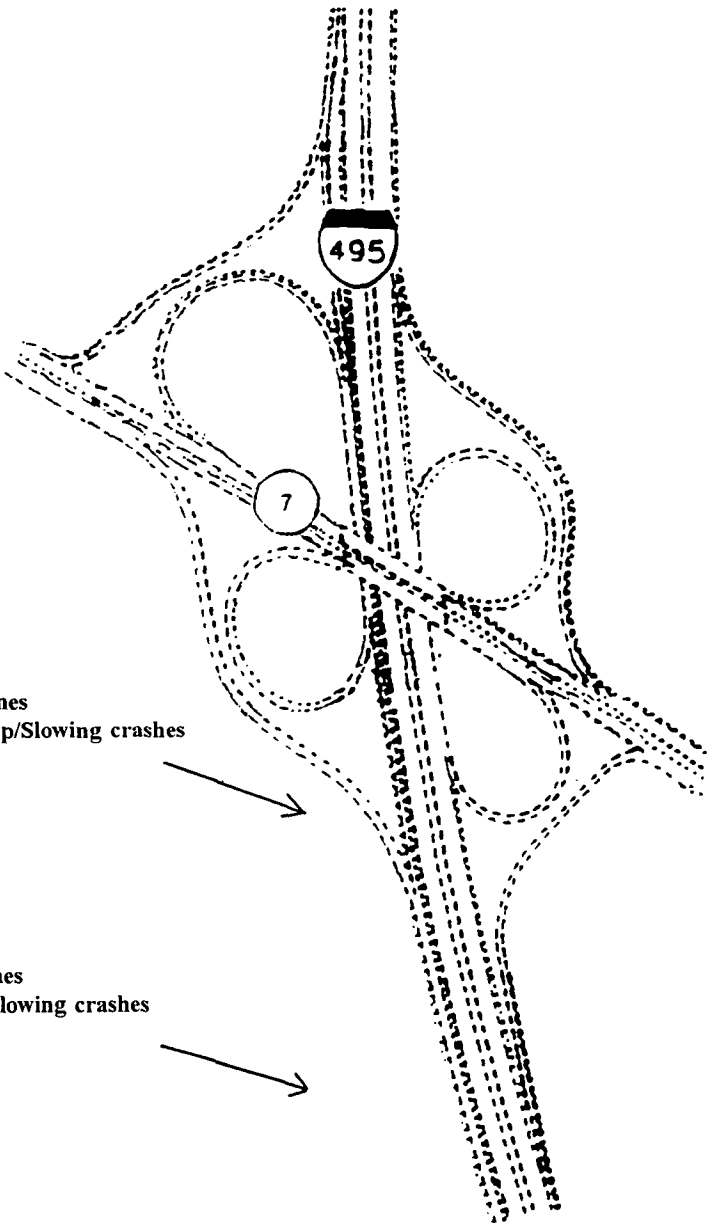
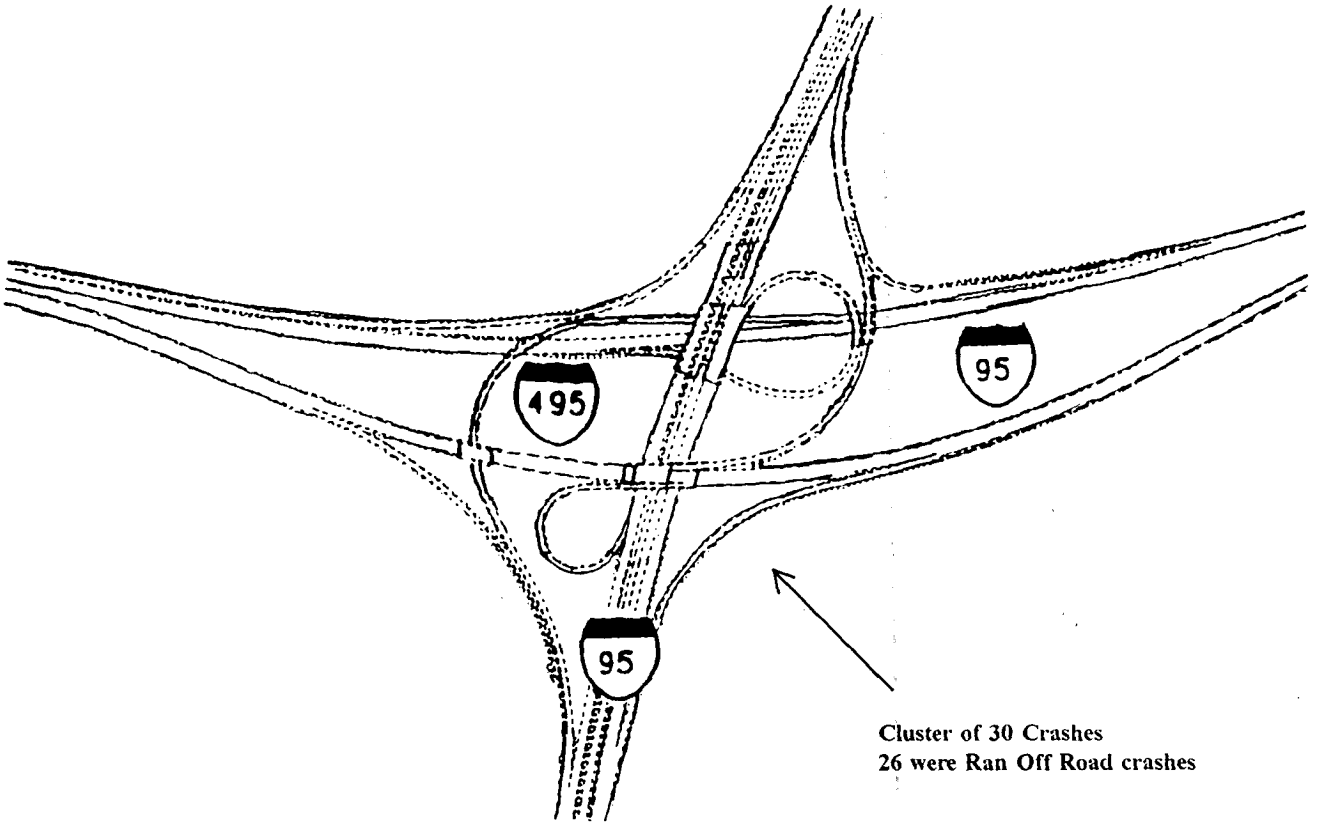


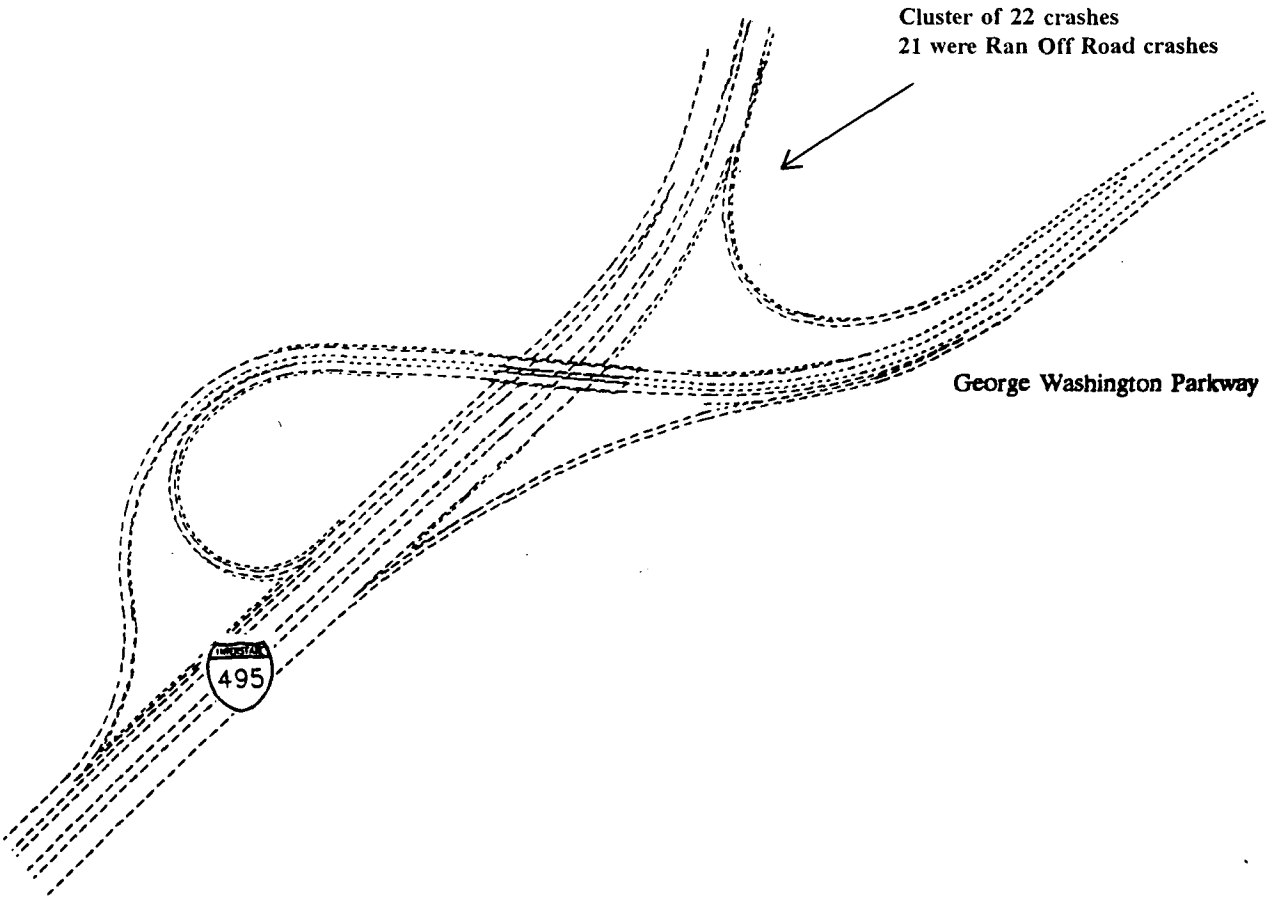
Cluster of 15 crashes
Fourteen were Stop/Slowing crashes

Cluster of 10 crashes
Eight were Stop/Slowing crashes

Virginia Interchange: I-495 & I-95



Virginia Interchange: I-495 & George Washington Memorial Parkway



Maryland Data Set

Because of the way data was recorded, Maryland crashes could only be separated into two location sub-groups, Main Line and Ramp Related. The total number of crashes placed in these two groups equalled 2,344 Mainline and 54 Ramp Related. Two of the 54 Ramp Related crashes could not be placed at a specific interchange and were omitted. Crashes in the Main Line and Ramp Related location groups were totaled for each interchange. Main Line crashes were separated by crash type.

Results

The following tables give the number of crashes by location sub-group for each Maryland Beltway interchange.

Maryland Interchange Crashes

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
I-95 & I-295					
Main Line	74	16	16	34	140
Ramp Related	*na*	*na*	*na*	2	2
Total	74	16	16	36	142
I-95 & Route 210 (Indian Road)					
Main Line	58	27	24	22	131
Ramp Related	*na*	*na*	*na*	3	3
Total	58	27	24	25	134
I-95 & Route 414 (St Barnabas Road)					
Main Line	20	20	21	16	77
Ramp Related	*na*	*na*	*na*	1	1
Total	20	20	21	17	78
I-95 & Highway 5 (Branch Avenue)					
Main Line	14	26	13	26	79
Ramp Related	*na*	*na*	*na*	4	4
Total	14	26	13	30	83
I-95 & Route 337 (Suitland Parkway)					
Main Line	7	22	15	20	64
Ramp Related	*na*	*na*	*na*	2	2
Total	7	22	15	22	66
I-95 & Highway 4 (Pennsylvania Avenue)					
Main Line	20	32	11	23	86
Ramp Related	*na*	*na*	*na*	3	3
Total	20	32	11	26	89
I-95 & Highway 214 (Central Avenue)					
Main Line	21	21	28	27	97
Ramp Related	*na*	*na*	*na*	1	1
Total	21	21	28	28	98
I-95 & Route 202 (Landover Road)					
Main Line	24	21	17	29	91
Ramp Related	*na*	*na*	*na*	2	2
Total	24	21	17	31	93

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
I-95 & U.S. 50 (John Hanson Highway)					
Main Line	12	19	12	17	60
Ramp Related	*na*	*na*	*na*	1	1
Total	12	19	12	18	61
I-95 & Route 450 (Annopolis Road)					
Main Line	26	22	16	23	87
Ramp Related	*na*	*na*	*na*	0	0
Total	26	22	16	23	87
I-95 & Route 295 (Baltimore - Washington Parkway)					
Main Line	32	15	19	27	93
Ramp Related	*na*	*na*	*na*	2	2
Total	32	15	19	29	95
I-95 & Route 201 (Kenilworth Avenue)					
Main Line	22	23	19	15	79
Ramp Related	*na*	*na*	*na*	2	2
Total	22	23	19	17	81
I-95 & U.S. Highway 1 (Baltimore Avenue)					
Main Line	44	27	32	35	138
Ramp Related	*na*	*na*	*na*	7	7
Total	44	27	32	42	145
I-95 & I-95 North					
Main Line	16	19	13	11	59
Ramp Related	*na*	*na*	*na*	2	2
Total	16	19	13	13	61
I-495 & Route 650 (New Hampshire Avenue)					
Main Line	26	12	7	12	57
Ramp Related	*na*	*na*	*na*	1	1
Total	26	12	7	13	58
I-495 & Route 193 (University Boulevard)					
Main Line	20	16	5	9	50
Ramp Related	*na*	*na*	*na*	1	1
Total	20	16	5	10	51
I-495 & U.S. 29 (Colesville Road)					
Main Line	29	12	14	19	74
Ramp Related	*na*	*na*	*na*	1	1
Total	29	12	14	20	75
I-495 & Route 97 (Georgia Avenue)					
Main Line	45	19	22	35	121
Ramp Related	*na*	*na*	*na*	6	6
Total	45	19	22	41	127
I-495 & Route 185 (Connecticut Avenue)					
Main Line	70	31	19	28	148
Ramp Related	*na*	*na*	*na*	2	2
Total	70	31	19	30	150

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
I-495 & I-270 (Wisconsin Avenue)					
Main Line	45	49	21	21	136
Ramp Related	*na*	*na*	*na*	3	3
Total	45	49	21	24	139
I-495 & Route 187 (Old Georgetown Road)					
Main Line	9	15	4	11	39
Ramp Related	*na*	*na*	*na*	0	0
Total	9	15	4	11	39
I-495 & I-270 Spur					
Main Line	24	73	12	18	127
Ramp Related	*na*	*na*	*na*	1	1
Total	24	73	12	19	128
I-495 & Route 190 (River Road)					
Main Line	52	16	18	16	102
Ramp Related	*na*	*na*	*na*	0	0
Total	52	16	18	16	102
I-495 & Cabin John Pkway.					
Main Line	56	15	18	16	105
Ramp Related	*na*	*na*	*na*	2	2
Total	56	15	18	18	107
I-495 & Clara Barton Pkway.					
Main Line	40	26	15	23	104
Ramp Related	*na*	*na*	*na*	3	3
Total	40	26	15	26	107
TOTAL	**806**	**594**	**411**	**585**	**2,396**

Maryland Interchange Crash Discussion

Within the two year period studied, five of Maryland's 25 Beltway interchanges had Main Line crashes numbering more than 130; five more had over 100. The five interchanges having the greatest number, ranked highest to lowest, were: the Connecticut Avenue interchange of I-495 & Route 185, total crashes numbered 150; the Baltimore Avenue interchange of I-95 and U.S. Highway 1, total crashes numbered 145; the interchange of I-495 and I-295, total crashes numbered 142, the Wisconsin Avenue interchange of I-495 and I-270, total crashes numbered 139; and the Indian Road interchange of I-95 and Route 210, total crashes numbered 134.

Close to half (47 percent) of the Main Line crashes at the interchange I-495 & Route 185 and just over half (53 percent) of those at interchange I-95 and I-295 were Stop/Slowing crashes. At interchanges I-95 & U.S. Highway 1, I-495 and I-270, and I-495 and Route 210, the distribution of crashes by type is not as lopsided. The interchange of I-95 and I-295 had the highest number of Stop\Slowing crashes within the half mile range of its center (N=74). Second highest was the interchange of I-95 and Route 185, where there were 70.

Ramp Related crashes were not a common occurrence. All but two interchanges had less than five within the two years. The interchange of I-495 & Route 97 had six. All occurred on the Inner Loop portion of this interchange. The interchange of I-95 and Highway 1 had seven. Two crashes occurred on the Inner Loop and five on the Outer Loop.

VI. Crashes Causing Crashes

Most drivers of busy roadways such as the Beltway have passed crash scenes and felt that the situations are themselves hazardous -- that crashes create the danger of additional crashes. The database of Beltway crashes, nearly all with precise times and places of occurrence, made it possible to formally test this hypothesis -- to determine whether crashes spawned "subsequent crashes."

The analysis proceeded in two stages. First, because there was no clear expectation for how far this effect might extend (i.e., for how many miles around the crash scene and for how much time after the crash), we looked at the possible increase in crash occurrence within five miles and two hours following every crash. When this broad window showed a significant increase in crashes following other crashes, the time-and-distance distribution of the crash increase was examined.

Method

A secondary database was created for all of the crashes that occurred on the Beltway in 1993 and 1994. Crashes with unknown time or place of occurrence were omitted, as were crashes coded as occurring on ramps. Mileage and route indications were used to develop continuous mileage values ranging from zero at the start of I-495 in Virginia on the American Legion Bridge counterclockwise up to a maximum of 64.32 miles at the end of Maryland I-495 on the same bridge. Crashes were also coded as to whether they occurred on the Inner Loop of the Beltway or the Outer Loop. The crash records were then sorted by date and time, and a pre-processing program was run which looked, for each crash, for other crashes occurring within five miles and within two hours after the crash. The roadway around the crash was divided into four sections and the number of subsequent crashes was tabulated separately for each segment. They were: Upstream Same Side (the five miles approaching the crash scene on the same side of the road as the crash, including the crash scene itself); Downstream Same Side (from exiting the crash scene to a point five miles farther on, also on the same side as the crash); Upstream Opposite Side (the five miles approaching the crash scene on the opposite side of the roadway, including the point opposite the crash scene); and Downstream Opposite Side (from just past the crash scene to a point five miles farther on, also on the other-direction roadway). Any increase in subsequent opposite-side crashes represents crashes involving "rubber-necking" motorists. Note that Upstream Same Side and Downstream Opposite Side are parallel roadway segments, as are Downstream Same Side and Upstream Opposite Side.

Two comparison periods were examined. For each crash, "subsequent" crashes occurring in the two-hour period exactly one week earlier were counted for each of the four roadway segments. Also, the same road segments were examined for the two-hour period exactly one week after the crash. To determine whether more crashes occurred following other crashes, the numbers of crashes occurring in the two hours after crashes were compared with the numbers occurring one week earlier and one week later. (Note that, for the comparison periods, there was no adjustment for whether crashes might have occurred just before those periods.)

For the first subsequent crash on each of the four roadway segments, if any, the time lag after the first crash and the distance away from it were captured. This allowed tabulation of the distribution of subsequent crashes around their primary crashes.

Results

A total of 4,223 crashes occurred during 1993 and 1994 on the Beltway main line for which location and time of occurrence were known. Of those, 2,828 (67 percent) occurred "alone" (with no other crash within five miles upstream or downstream, same side or opposite side, within two hours preceding and two hours following); 606 (14 percent) were followed by other crashes (within two hours and five miles); 585 (14 percent) followed other crashes; and 204 (5 percent) both followed and were followed by other crashes.

The table below gives the total numbers of crashes observed in the two-hour, five-mile windows following each crash, in the one-week-prior comparison period, and in the one-week-following comparison period. (Numbers are based on the total of 4,223 crashes; that is, 397 means that nearly 10 percent of the crashes were followed by at least one additional crash within two hours between the crash scene and a point five miles preceding the crash on the same roadway.) There were approximately three times as many Upstream Same-Side crashes following a crash as in either comparison period. For Downstream Same-Side, there were nearly twice as many crashes following a crash. For Upstream Opposite-Side and Downstream Opposite-Side, the frequency of crashes after a crash was about 1 1/2 times that in the comparison periods. Each of these differences was statistically significant (Chi Square = 129.64, 27.44, 13.35, and 11.01, respectively; each 1 d.f., $p < .001$).

Crashes With Subsequent Crashes Within 5 Miles and 2 Hours

	Same Side as Crash		Opposite Side	
Time Period	Upstream	Downstream	Upstream	Downstream
Following Crash	397	208	175	136
Comparison:				
Week Before	127	121	118	80
Week After	142	107	108	93

The distribution of subsequent crashes in time and space around the primary crashes is shown in Figure 1 for same-roadway crashes and Figure 2 for opposite-side crashes. In the two figures, the distribution of crashes along the roadway from 90 to 120 minutes and from 60 to 89 minutes after the primary crash can be viewed as "background level" crash activity, since they show little variation from point to point and a level of activity similar to that seen in the comparison periods. For the other time periods, crash activity rising above the "background level" most likely represents additional crashes due to the congestion and activity around the primary crashes.

Additional subsequent same-side crashes were strongly concentrated at the point of the primary crash, and most of them occurred within the first five minutes after the first crash. Additional same-side crashes were also seen at the crash site in the next 30 and 60 minutes. Also, although it is not as clear in the figures, crashes in the first 30 and 60 minutes increased in at least the mile closest to the primary crash site on the upstream side, as, to a lesser extent, did crashes in the first mile past the primary crash site. (The upstream differences were statistically significant by a Chi-Square test of the time-and-distance distribution of subsequent crash frequencies, $p < .001$; the overall test for the downstream pattern approached significance, $p < .10$.)

The distribution of subsequent opposite-side crashes is shown in Figure 2. As compared to same-side crashes, the opposite-side crashes were not concentrated at the time and location of the primary crash but, rather, were evenly distributed across the two hours and ten miles. (The overall Chi-Square test was not statistically significant.)

Discussion

Crashes do follow crashes on the Capital Beltway. Although estimates are extremely crude, these data suggest that up to 10 percent of crashes are followed by subsequent crashes. Most of the subsequent crashes occur extremely close to the primary crash. Within the accuracy of the report information, it can be stated that most occur within the first five minutes and within 0.1 mile of the primary crash. The effect was observed to extend at least one mile on the approach to the primary crash for the first hour. A smaller effect was also observed for up to one mile and up to one hour downstream of the crash.

Although opposite-side crashes were somewhat more frequent following primary crashes than in the week-before or week-after comparison periods, the increase was not concentrated around the site and time of the primary crash. That is, these data provided no evidence for large numbers of opposite-side, or "rubber-necking," crashes caused by the primary crashes.

The increase in same-side subsequent crashes could be caused by a number of factors. Some subsequent crashes were probably caused by environmental conditions that precipitated the primary crashes, including extra traffic and congestion plus factors such as rain or snow, wet or snowy or icy roads. However, the concentration of subsequent crashes at the time and place of the primary crash and on the upstream same-side roadway, the places where the disruptions caused by the primary crash would be most severe, suggests that most of the additional subsequent crashes were truly "caused" by the primary crashes. Crashes, with their distracting scenes and activities and producing increased congestion and abrupt driver maneuvers, create increased hazards which result in more crashes.

Figure 1

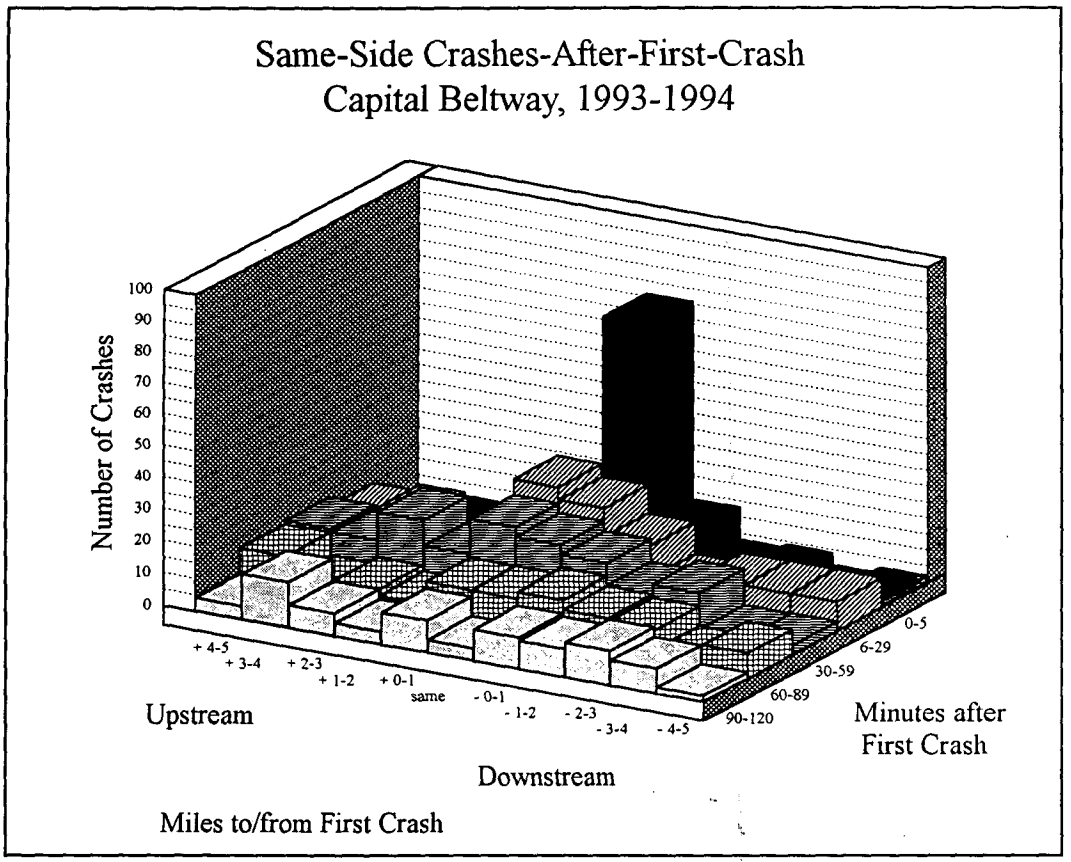
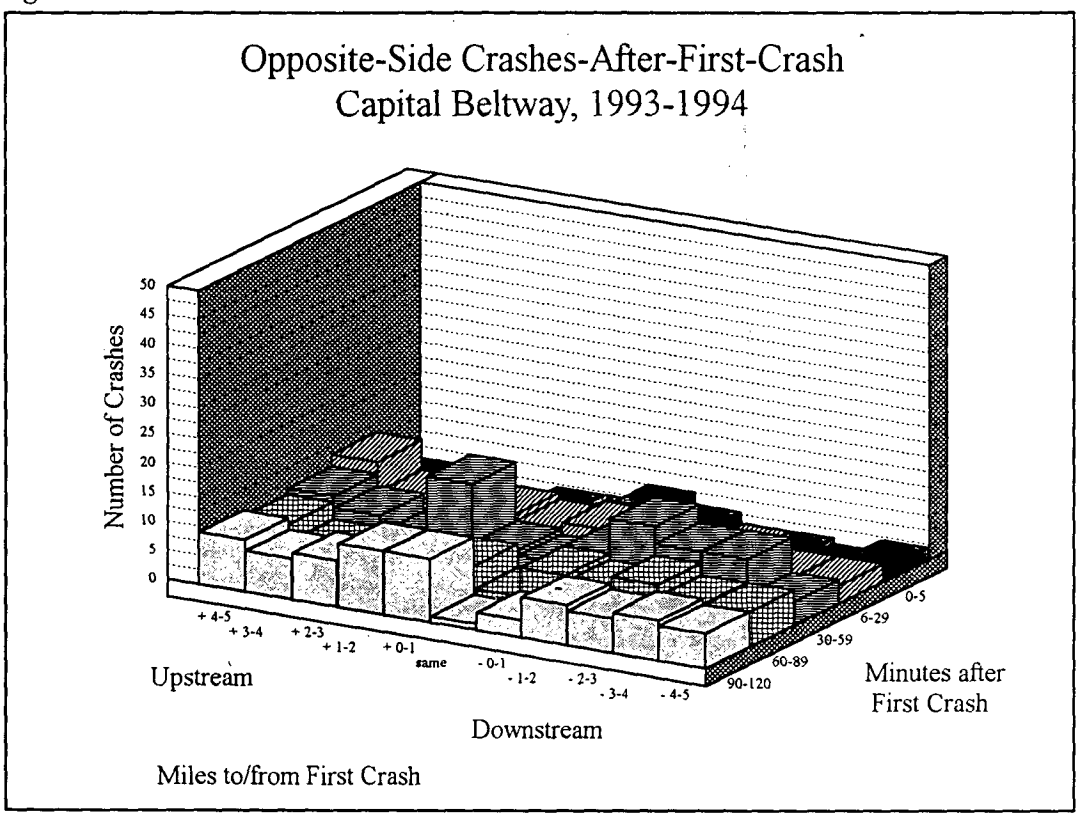


Figure 2



VII. Discussion

The majority of Beltway crashes in calendar years 1993 and 1994 were classified in three crash types. This is important because crash type suggests crash avoidance measures. Since a large number of crashes (77.8 percent) are accounted for in a small number of crash types, there is an opportunity to use highly focused countermeasures to deal with the majority of crashes.

Stop/Slowing is the most common crash type to occur on the Beltway. Its occurrence is directly related to level of traffic on the roadway. The increase in these crashes during hours of peak traffic density clearly indicates congestion is a factor.

Ran Off Road crashes typically are not congestion related. Any roadway will have its share. They are prone to be single-vehicle events that take place regardless of driving environment. These crashes are induced by numerous factors including: driving drunk, tired or reckless; paying too little attention to the road; and bad road weather conditions. Ran Off Road crashes occur at all hours of the day.

Congestion is also a common factor for Sideswipe/Cutoff crashes. Sideswipe/Cutoff crashes are the third most likely type of crash to occur on the Beltway. This crash type is rare when traffic is minimal. These crashes are density-related, at least to the extent that a certain amount of traffic is necessary for them to occur.

The present analysis suggests that congestion is a frequent and primary factor for crashes on the Beltway. Immediate efforts should be devoted to reducing overall congestion on the Beltway and helping drivers cope with congested roadways. Crashes that are not related to congestion require countermeasures that deal with the specific factors that contribute to these events (e.g. alcohol, fatigue and excessive speed. These may be designed and implemented specifically for the Beltway or as part of larger state and/or regional efforts.

Several Beltway interchanges were identified as having a large number of crashes. In several specific locations a particular crash type was clustered. Here, countermeasures may be focused and targeted to alleviate the problem.

The present analysis found that some Virginia ramp locations had an inordinate number of Ran Off Road crashes, and some had a large number of Stop/Slowing crashes. For the locations prone to Ran Off Road crashes, it is recommended that each of the ramps be reviewed with respect to posted speed limits, advance warnings of curve and potential engineering improvements. For ramp locations that have a high number of Stop/Slowing crashes, it is recommended that they be reviewed with respect to posted speed limits, advance warning of congestion (variable message), sight distance to choke points and potential engineering improvements. A comparable ramp analysis was not possible in Maryland.

Up to ten percent of Beltway crashes are followed by subsequent crashes. While subsequent crashes mostly occur within five minutes and within 0.1 mile of the primary crash event, the effect of crashes causing crashes was observed to extend at least one mile on the approach to the primary crash event for one hour. A smaller effect was observed for downstream crashes occurring up to one mile and one hour from the primary crash.

The concentration of subsequent crashes at the time and place of the primary crash events suggests that most subsequent crashes are actually caused by primary crash events. Crashes cause distractions, congestion, and the need for adrupt driver maneuvers. These hazzardous situations will cause crashes.

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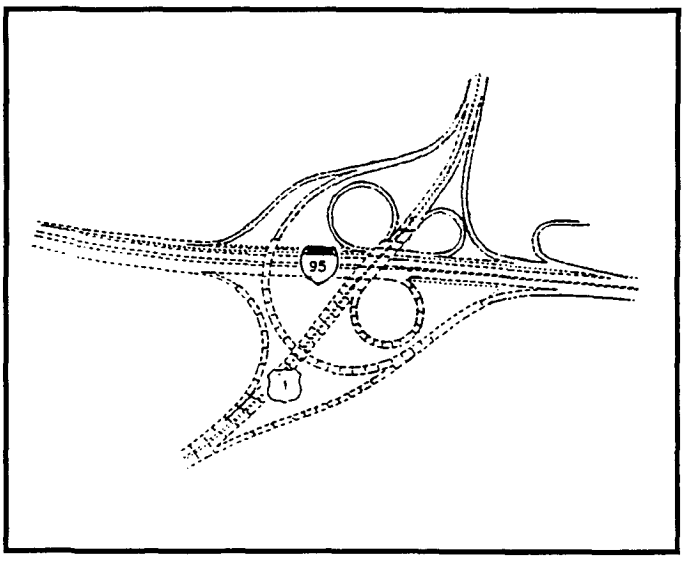
APPENDIX A

Interchange 1: I-95 & Route 1
Richmond Highway

Interchange Crash Summary



This interchange had a significantly higher than average number of interchange related crashes (N=120). This total was second highest among all interchanges. Most crashes in this total belong to the Main Line group (68 percent), yet a signifcant number of crashes were in the Ramp Related group (N=10) and in the On Ramp group (N=29). In fact, this interchange had the second highest number of crashes in the Ramp Related group and the fourth highest number in the On Ramp group.

When mapped, the majority of crashes in the On Ramp group involved drivers exiting from I-95, East or West, attempting to go north on Route 1. Seven Ran Off Road crashes were clustered on the I-95 West exit ramp to Route 1 North. The other On Ramp crashes at this interchange provided no evidence of clustering.

Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	41	9	26	5	81
Ramp Related	*na*	*na*	*na*	10	10
On Ramp	9	19	1	0	29
Total	50	28	27	15	120

Location of On Ramp Crashes

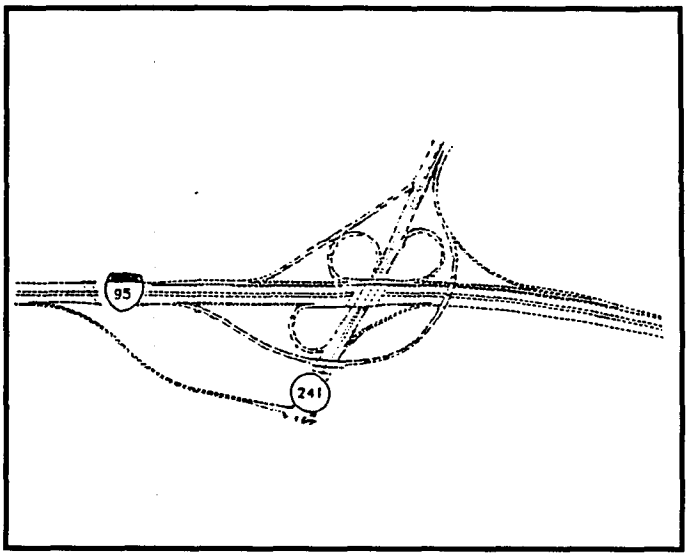
Entering Beltway onto I-95 East	**Crashes**	**Exiting Beltway from I-95 East**	**Crashes**
Route 1 North\South to I-95 East	5	I-95 East to Route 1 North	7
		I-95 East to Route 1 South	1
Entering Beltway onto I-95 West	**Crashes**	**Exiting Beltway from I-95 West**	**Crashes**
Route 1 North to I-95 West	2	I-95 West to Route 1 North	7
Route 1 South to I-95 West	2	I-95 West to Route 1 South	1
I-95 West Service Ramp	0	I-95 West to Church Street	2
Specific location Unknown	1		

Interchange 2: I-95 & Route 241 Telegraph Road

Interchange Crash Summary

This interchange was one of the least active in terms of crash activity (N=77). Crashes in the Main Line Crash group accounted for 90 percent of Interchange related crashes, two-thirds of these were Stop/Slowing.

All five On Ramp crashes were the Ran Off Road crash type. When mapped, the locations of these crashes were spread widely.



Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	46	5	9	9	69
Ramp Related	*na*	*na*	*na*	3	3
On Ramp	0	5	0	0	5
Total	46	10	9	12	77

Location of On Ramp Crashes

Entering Beltway onto I-95 East	**Crashes**	**Exiting Beltway from I-95 East**	**Crashes**
Route 241 North to I-95 East	0	I-95 East to Route 241 North	2
Route 241 South to I-95 East	0	I-95 East to Route 241 South	0

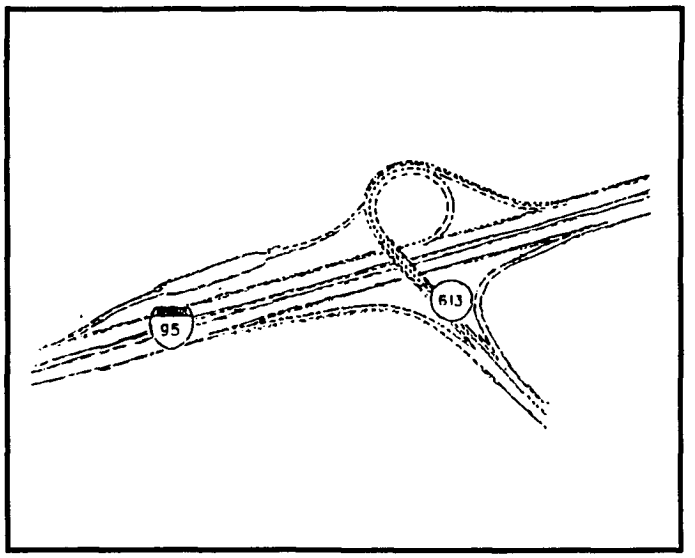
Entering Beltway onto I-95 West	**Crashes**	**Exiting Beltway from I-95 West**	**Crashes**
Route 241 North to I-95 West	1	I-95 West to Route 241 North	0
Route 241 South to I-95 West	2	I-95 West to Route 241 South	0
I-95 West Service Ramp	0		

Interchange 3: I-95 & Route 613 Van Dorn Street

Interchange Crash Summary

This interchange had a near average number of interchange related crashes (N=91). The proportion of interchange related crashes in the Main Line group was also near average (70 percent).

No one crash type was prevalent in the On Ramp crashes nor did any section of roadway have any significant clustering of crashes when mapped.



Crash Type by Location Group

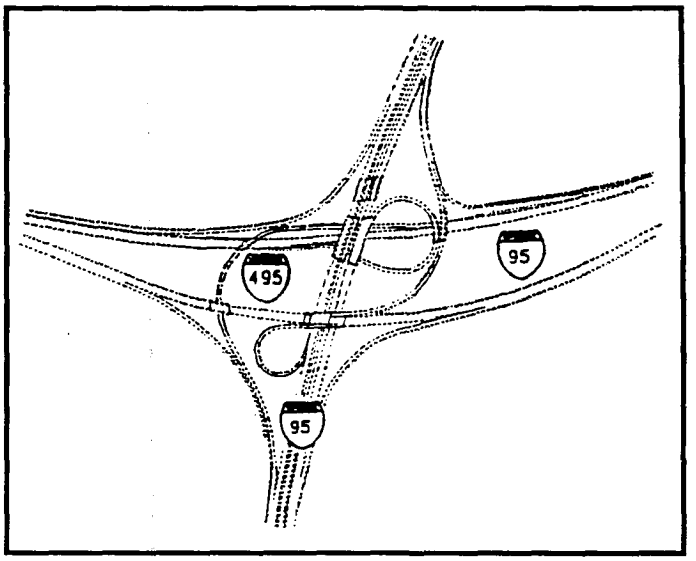
	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	28	12	16	8	64
Ramp Related	*na*	*na*	*na*	6	6
On Ramp	7	9	5	0	21
Total	35	21	21	14	91

Location of On Ramp Crashes

Entering Beltway onto I-95 East	**Crashes**	**Exiting Beltway from I-95 East**	**Crashes**
Route 613 to I-95 East	3	I-95 East to Route 613	5
Entering Beltway onto I-95 West	**Crashes**	**Exiting Beltway from I-95 West**	**Crashes**
Route 613 to I-95 West	5	I-95 West to Route 613	7
Specific location unknown	1		

Interchange 4: I-495 & I-95
Springfield

Interchange Crash Summary



This location had the highest crash activity of any interchange. Interchange related crashes equaled 179. The proportion of interchange related crashes that were Ramp Related and On Ramp (60 percent) was significantly higher than any other interchange. In fact, nine other interchanges had a higher number of Main Line crashes within one-half mile of their center.

This location had more than twice as many crashes in the On Ramp group than any other interchange. The largest number of crashes occurred on the ramp from I-95 West to I-95 South (N=31). Two crash types dominated this cluster; 15 were Stop/Slowing; 10 were Ran Off Road. I-95 North to I-95 East had almost as many crashes (N=30). This cluster was almost exclusively Ran Off Road Crashes (N=26). The two other ramps showing a significant number of crashes were more varied in crash type. This was also true for all other On Ramp crashes at this interchange.

Crash Type by Location Group

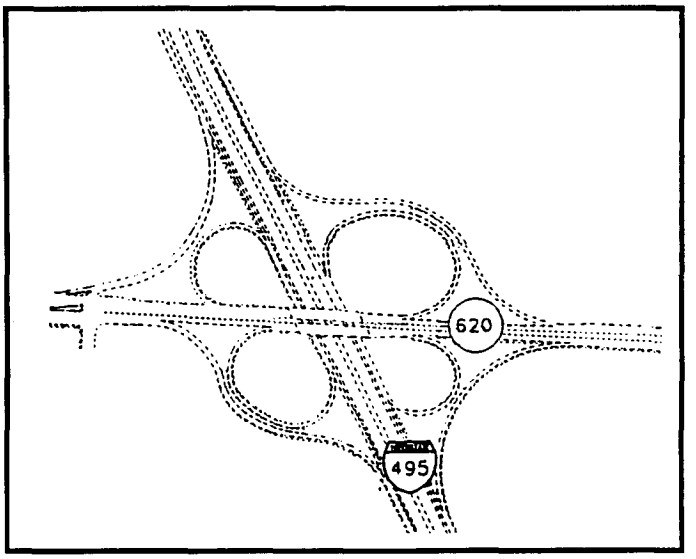
	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	24	12	19	8	63
Ramp Related	*na*	*na*	*na*	15	15
On Ramp	29	50	18	4	101
Total	53	62	37	27	179

Location of On Ramp Crashes

Entering Beltway onto I-95 East	**Crashes**	**Exiting Beltway from I-95 West**	**Crashes**
I-95 North to I-95 East	30	I-95 West to I-95 South	31
I-395 South to I-95 East	2	I-95 West to I-395 North	3
Entering Beltway onto I-495 North	**Crashes**	**Exiting Beltway from I-495 South**	**Crashes**
I-95 North to I-495 North	17	I-495 South to I-95 South	14
I-395 South to I-495 North	2	I-495 South to I-395 North	2
Specific location unknown	1		

Interchange 5: I-495 & Route 620 Braddock Road

Interchange Crash Summary



This interchange had a higher than average number of crashes that were coded as interchange related. It had the second highest number of Main Line crashes (N=88) in the half mile range from its center point.

Of its On Ramp crashes, 16 of 18 were on the northbound side of I-495. These 16 crash events were most often Stop/Slowing (N=10). Six crashes, five Stop/Slowing and one Sideswipe/Cutoff, occurred on the northbound side shared acceleration/deceleration lane. The frequency of Stop/Slowing crashes on the northbound side suggests that congestion is a crash factor.

Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	46	14	14	14	88
Ramp Related	*na*	*na*	*na*	4	4
On Ramp	11	5	12	0	18
Total	57	19	26	18	120

Location of On Ramp Crashes

Entering Beltway onto I-495 North	Crashes
Route 620 East to I-495 North	6
Route 620 West to I-495 North	0
I-495 North Service Ramp	4

Exiting Beltway from I-495 North	Crashes
I-495 North to Route 620 East	5
I-495 North to Route 620 West	1

Entering Beltway onto I-495 South	Crashes
Route 620 East to I-495 South	0
Route 620 West to I-495 South	0
I-495 South Service Ramp	0

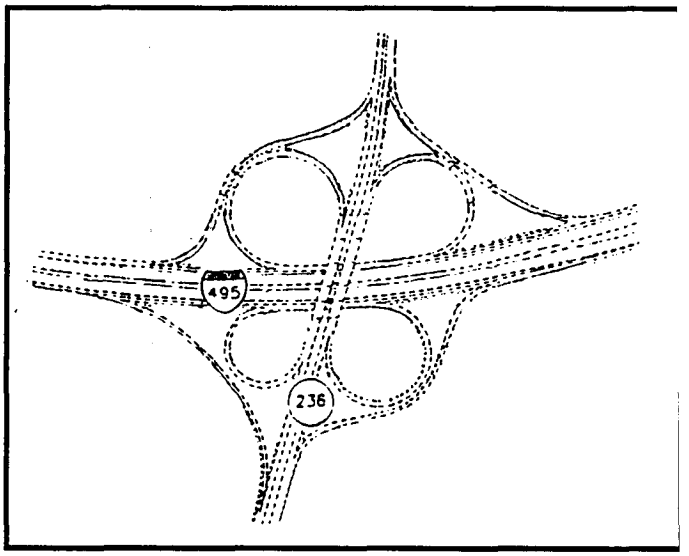
Exiting Beltway from I-495 South	Crashes
I-495 South to Route 620 East	1
I-495 South to Route 620 West	1

Interchange 6: I-495 & Route 236
Little River Turnpike

Interchange Crash Summary

A less than average number of crashes occurred on or in close proximity to this interchange. Eighty-five percent of these crashes were mainline crashes: over half (N=43) of these were Stop/Slowing; 14 were Ran Off Road; 12 were Sideswipe/Cutoff; and 8 were Other.

On Ramp crashes were small in number (N=12) and varied in crash type. Mapping these crashes showed no indication of significant clustering.



Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	43	14	12	8	77
Ramp Related	*na*	*na*	*na*	1	1
On Ramp	4	6	1	1	12
Total	47	20	13	10	90

Location of On Ramp Crashes

Entering Beltway onto I-495 North	**Crashes**	**Exiting Beltway from I-495 North**	**Crashes**
Route 236 East to I-495 North	0	I-495 North to Route 236 East	1
Route 236 West to I-495 North	0	I-495 North to Route 236 West	0
I-495 North Service Ramp	3		

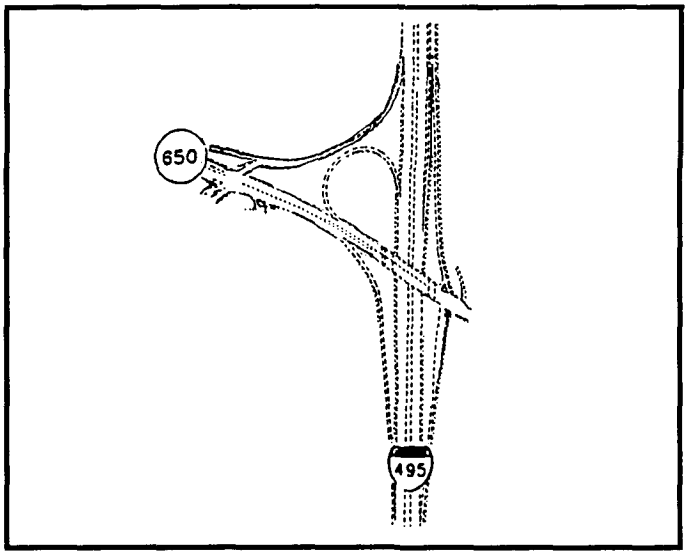
Entering Beltway onto I-495 South	**Crashes**	**Exiting Beltway from I-495 South**	**Crashes**
Route 236 East to I-495 South	1	I-495 South to Route 236 East	0
Route 236 West to I-495 South	0	I-495 South to Route 236 West	4
I-495 South Service Ramp	2		
Specific location unknown	1		

Interchange 7: I-495 & Route 650
Gallows Road

Interchange Crash Summary

At this location, the number of interchange related crashes was average (N=97). The overwhelming majority of this number was made up of Main Line crashes (92 percent).

Only a small number of the crashes recognized as interchange related were On Ramp (N=6), and fewer were Ramp Related (N=2). Mapping the few On Ramp crashes showed no indication of significant clustering.



Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	42	25	13	9	89
Ramp Related	*na*	*na*	*na*	2	2
On Ramp	4	0	0	2	6
Total	46	25	13	13	97

Location of On Ramp Crashes

Entering Beltway onto I-495 North	**Crashes**
Route 650 East\West to I-495 North	0
I-495 North Service Ramp	2

Exiting Beltway from I-495 North	**Crashes**
I-495 North to Route 650 East\West	1

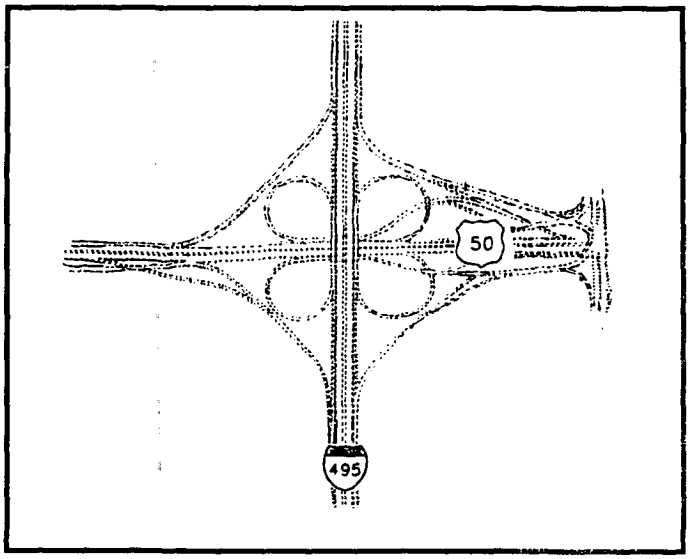
Entering Beltway onto I-495 South	**Crashes**
Route 650 East to I-495 South	1
Route 650 West to I-495 South	0

Exiting Beltway from I-495 South	**Crashes**
I-495 South to Route 650 East\West	1

Specific location unknown 1

Interchange 8: of I-495 & Route 50 Arlington Boulevard

Interchange Crash Summary



This interchange had a higher than average number of crashes (N=112). A large proportion of On Ramp crashes (N=47) contributed to this total. In fact, this interchange was second in number of On Ramp crashes.

When mapped, On Ramp crashes revealed no indication of clustering by crash type in any specific location. However, 13 of 17 Stop/Slowing crashes, normally associated with congestion related problems, were spread over the southbound side of the interstate. This suggests that congestion and congestion-related problems are likely to exist in this area. Sixteen of the 22 Ran Off Road crashes occurring on ramps were on the northbound side of the Beltway. These crashes were not clustered but spread throughout this side of the Beltway.

Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	35	17	8	4	64
Ramp Related	*na*	*na*	*na*	1	1
On Ramp	17	22	8	0	47
Total	52	39	16	5	112

Location of On Ramp Crashes

Entering Beltway onto I-495 North	**Crashes**
Route 50 East to I-495 North	2
Route 50 West to I-495 North	4
I-495 North Service Ramp	9

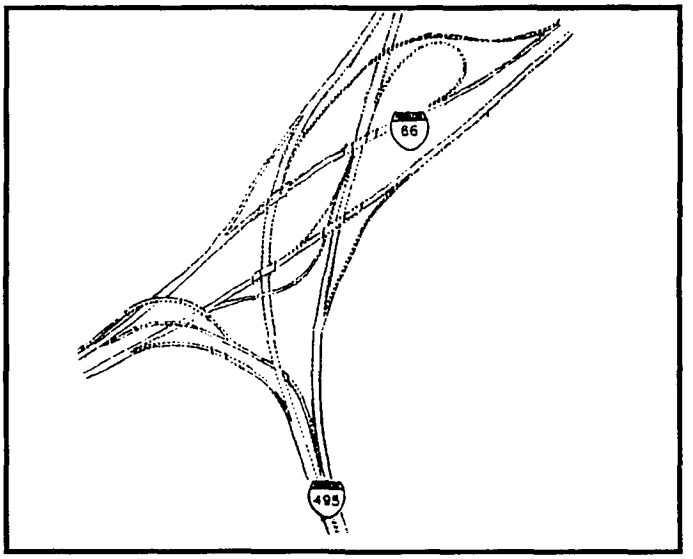
Exiting Beltway from I-495 North	**Crashes**
I-495 North to Route 50 East	10
I-495 North to Route 50 West	1

Entering Beltway onto I-495 South	**Crashes**
Route 50 East to I-495 South	5
Route 50 West to I-495 South	2
I-495 South Service Ramp	11

Exiting Beltway from I-495 South	**Crashes**
I-495 South to Route 50 East	1
I-495 South to Route 50 West	2

Interchange 9: I-495 & I-66

Interchange Crash Summary



This interchange had a higher than average number of interchange related crashes (N=112). This interchange also proved to have the second highest number of Ramp Related crashes (N=9) and the fourth highest number of Main Line crashes (N=80).

Most of the On Ramp crashes were located on one ramp. The left exit for I-495 North to I-66 West had a cluster of crashes of varied crash types: eight were Ran Off Road; five were Sideswipe/ Cutoff; two were Other; and one was Stop/Slowing. The other seven On Ramp crashes at this location were varied in crash type and not significantly clustered.

Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	32	24	17	7	80
Ramp Related	*na*	*na*	*na*	9	9
On Ramp	3	11	7	2	23
Total	35	35	24	18	112

Location of On Ramp Crashes

Entering Beltway onto I-495 North	**Crashes**
I-66 East to I-495 North	1

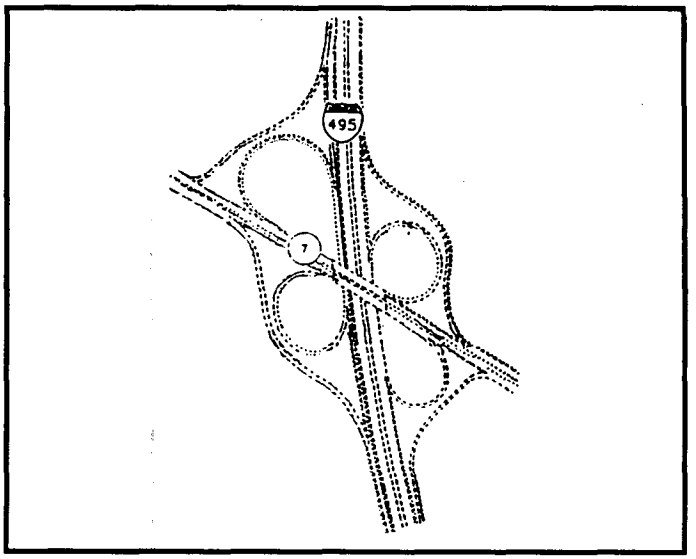
Exiting Beltway from I-495 North	**Crashes**
I-495 North to I-66 East	0
I-495 North to I-66 West	16

Entering Beltway onto I-495 South	**Crashes**
I-66 East to I-495 South	1
I-66 West to I-495 South	1

Exiting Beltway from I-495 South	**Crashes**
I-495 South to I-66 West	4

Interchange 10: I-495 & Route 7
Leesburg Pike

Interchange Crash Summary



The interchange of Route 7 and I-495 had an average number of interchange related crashes (N=97). An interesting characteristic of this interchange was that it had the second highest number of any interchange for On Ramp crashes (N=39). These crashes were overwhelmingly the Stop/Slowing crash type and fell into large clusters when mapped.

The largest cluster of On Ramp Stop/Slowing crashes (N=14) occurred on the entrance ramp to I-495 South from Route 7 East. Eight more Stop/Slowing crashes occurred between the end of this ramp and the south end of the collector/distribution lane. The total number of Stop/Slowing crashes on the south side of I-495 equaled 26.

The shared acceleration/deceleration lane entering and exiting I-495 North proved troublesome for some drivers. Eight Stop/Slowing crashes occurred within this segment of roadway.

Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	25	12	14	3	54
Ramp Related	*na*	*na*	*na*	4	4
On Ramp	34	4	0	1	39
Total	59	16	14	8	97

Location of On Ramp Crashes

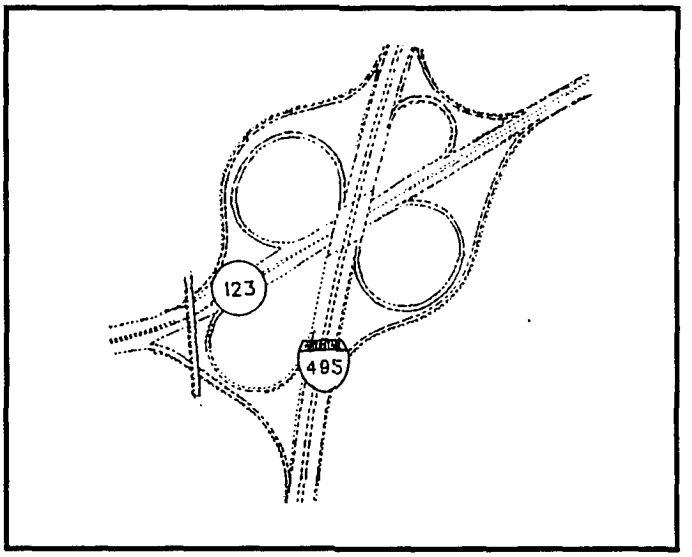
Entering Beltway onto I-495 North	**Crashes**	**Exiting Beltway from I-495 North**	**Crashes**
Route 7 East to I-495 North	8	I-495 North to Route 7 East	0
Route 7 West to I-495 North	0	I-495 North to Route 7 West	3

Entering Beltway onto I-495 South	**Crashes**	**Exiting Beltway from I-495 South**	**Crashes**
Route 7 East to I-495 South	15	I-495 South to Route 7 East	1
Route 7 West to I-495 South	1	I-495 South to Route 7 West	1
I-495 South Service Ramp	10		

Interchange 11: I-495 & Route 123
Chain Bridge Road

Interchange Crash Summary

This interchange had a less than average number of interchange related crashes. The proportion of this total which was Main Line crashes was very high (84 percent) and the number of On Ramp crashes was much less than average for Beltway interchanges. When mapped, the few On Ramp crashes showed no clustering.



Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	18	12	17	15	62
Ramp Related	*na*	*na*	*na*	1	1
On Ramp	4	6	1	0	11
Total	22	18	18	16	74

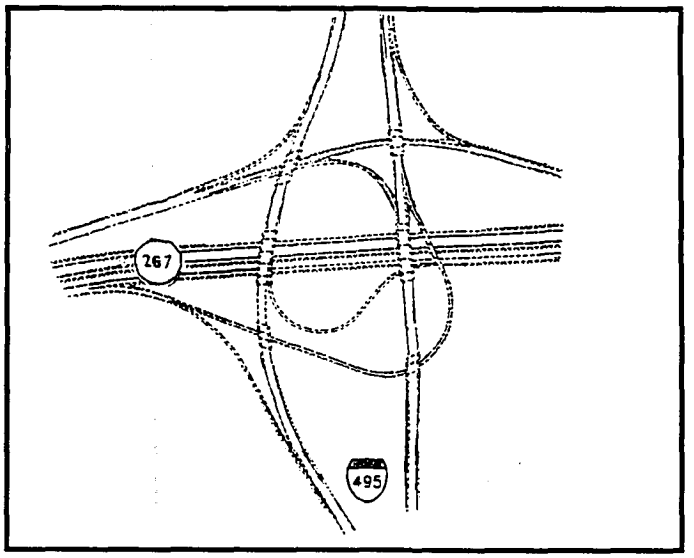
Location of On Ramp Crashes

Entering Beltway onto I-495 North	Crashes	Exiting Beltway from I-495 North	Crashes
Route 123 East to I-495 North	2	I-495 North to Route 123 East	3
Route 123 West to I-495 North	0	I-495 North to Route 123 West	3

Entering Beltway onto I-495 South	Crashes	Exiting Beltway from I-495 South	Crashes
Route 123 East to I-495 South	2	I-495 South to Route 123 East	0
Route 123 West to I-495 South	0	I-495 South to Route 123 West	0
Specific location unknown	1		

Interchange 12: I-495 & Route 267 Dulles Toll Road

Interchange Crash Summary



This interchange had a slightly less than average number of interchange related crashes (N=77). There was an average number of Main Line crashes (N=65),. few On Ramp crashes (N=10) and even fewer Ramp Related crashes (N=2) within the two year period studied.

All On Ramp crashes were the Ran Off Road crash type. The left lane ramp exiting to Route 267 West from I-495 North had the highest number of On Ramp crashes (N=6). This ramp had a cluster of four Ran Off Road crashes that occurred near the split of the exit ramp and I-495 . Two more were within the first curve of this exit.

Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	27	13	13	12	65
Ramp Related	*na*	*na*	*na*	2	2
On Ramp	0	10	0	0	10
Total	27	23	13	14	77

Location of On Ramp Crashes

Entering Beltway onto I-495 North	**Crashes**
Route 267 East to I-495 North	1
Route 267 West to I-495 North	2

Exiting Beltway from I-495 North	**Crashes**
I-495 North to Route 267 West	6

Entering Beltway onto I-495 South	**Crashes**
Route 267 East to I-495 South	0

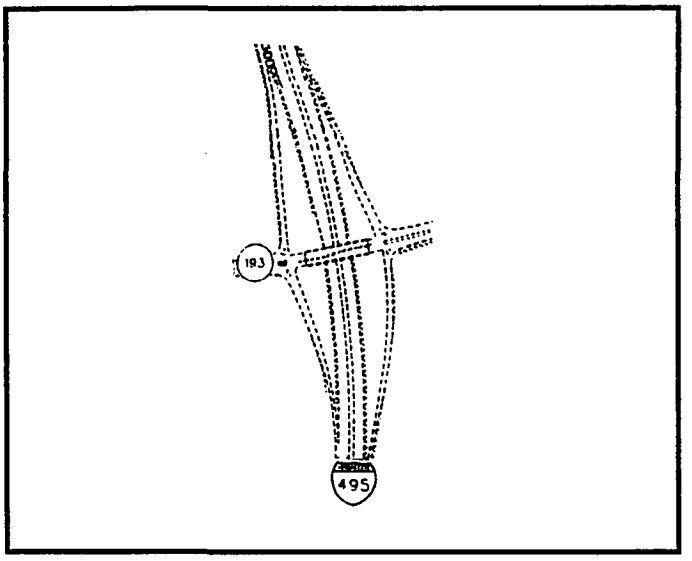
Exiting Beltway from I-495 South	**Crashes**
I-495 South to Route 267 East	0
I-495 South to Route 267 West	1

Interchange 13: I-495 & Route 193 Georgetown Pike

Interchange Crash Summary

This interchange had the fewest interchange related crashes (N=60). Eighty-eight percent (N=53) of these crashes were in the Main Line group of crashes and were not dominated by any one crash type.

This interchange had only one Ramp Related crash and only six On Ramp crashes. These few crashes were spread out with no signs of clustering.



Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	20	14	13	6	53
Ramp Related	*na*	*na*	*na*	1	1
On Ramp	1	4	1	0	6
Total	21	18	14	7	60

Location of On Ramp Crashes

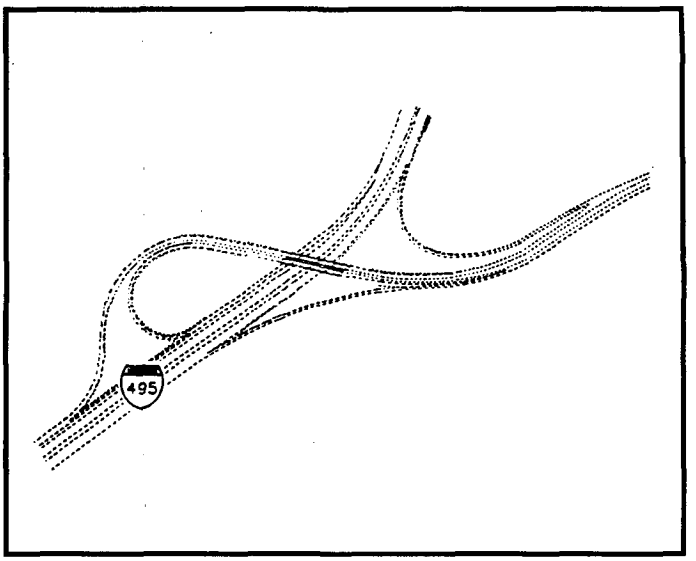
Entering Beltway onto I-495 North	**Crashes**
Route 193 East\West to I-495 North	2

Entering Beltway onto I-495 South	**Crashes**
Route 193 East\West to I-495 South	0

Exiting Beltway from I-495 North	**Crashes**
I-495 North to Route 193 East\West	1
I-495 South to Route 193 East\West	3

Interchange 14: I-495 & George Washington Memorial Parkway

Interchange Crash Summary



This interchange had nearly the average number of interchange related crashes (N=81). Nearly two-thirds (N=54) of these crashes were in the Main Line group; All but one other crash was in the On Ramp group.

A disproportionate number of On Ramp crashes occurred on one of the five entrance/exitways of this interchange. Mapping the On Ramp crashes indicated that 22 crashes occurred at or near the entrance point to I-495 North from the G. W. Memorial Parkway; 21 of these crashes, at or near the entrance point to I-495, were the Ran Off Road crash type.

Crash Type by Location Group

	Stop/Slowing	Ran Off Road	Sideswipe/Cutoff	Other	All
Main Line	18	11	11	14	54
Ramp Related	*na*	*na*	*na*	1	1
On Ramp	1	23	1	1	26
Total	19	34	12	16	81

Location of On Ramp Crashes

Entering Beltway onto I-495 North	**Crashes**	**Exiting Beltway from I-495 North**	**Crashes**
G.W. Pkway to I-495 North	22	I-495 North to G.W. Pkway East	0
Entering Beltway onto I-495 South	**Crashes**	**Exiting Beltway from I-495 South**	**Crashes**
G.W. Pkway to I-495 South	2	I-495 South to G.W. Pkway East	0
I-495 South Service Ramp	2		

APPENDIX B

DPCZCATS Crash Type Categories

DPCZCATS	CZSTATE Count / Row Pct / Col Pct	Maryland (2)	Virginia (3)	Row Total
1 Stop/Slowing	Count	819	792	1611
	Row Pct	50.8	49.2	36.2
	Col Pct	31.2	43.4	
3 Sideswipe Cutoff	Count	440	369	809
	Row Pct	54.4	45.6	18.2
	Col Pct	16.8	20.2	
4 Ran Off Road	Count	713	328	1041
	Row Pct	68.5	31.5	23.4
	Col Pct	27.2	18.0	
5 Other	Count	652	334	986
	Row Pct	66.1	33.9	22.2
	Col Pct	24.8	18.3	
Column Total		2624	1823	4447
		59.0	41.0	100.0

Chi-Square	Value	DF	Significance
Pearson	110.95310	3	.00000
Likelihood Ratio	111.86507	3	.00000
Mantel-Haenszel test for linear association	91.33072	1	.00000

Minimum Expected Frequency - 331.641
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by CZMONTH Month

DPCZCATS / Count / Row Pct / Col Pct	Jan (0)	Feb (1)	March (2)	April (3)	May (4)	June (5)	July (6)	Aug (7)	Sept (8)	Row Total
1 Stop/Slowing	2	103	101	119	138	148	160	126	137	138	1611
	.1	6.4	6.3	7.4	8.6	9.2	9.9	7.8	8.5	8.6	36.2
	14.3	28.5	30.5	29.7	38.0	39.1	45.2	37.5	34.8	37.7	
3 Sideswipe Cutoff	1	67	50	75	72	69	75	79	60	54	809
	.1	8.3	6.2	9.3	8.9	8.5	9.3	9.8	7.4	6.7	18.2
	7.1	18.6	15.1	18.7	19.8	18.2	21.2	23.5	15.2	14.8	
4 Ran Off Road	4	100	81	100	76	82	69	75	98	87	1041
	.4	9.6	7.8	9.6	7.3	7.9	6.6	7.2	9.4	8.4	23.4
	28.6	27.7	24.5	24.9	20.9	21.6	19.5	22.3	24.9	23.8	
5 Other	7	91	99	107	77	80	50	56	99	87	986
	.7	9.2	10.0	10.9	7.8	8.1	5.1	5.7	10.0	8.8	22.2
	50.0	25.2	29.9	26.7	21.2	21.1	14.1	16.7	25.1	23.8	
Column Total	14	361	331	401	363	379	354	336	394	366	4447
(Continued)	.3	8.1	7.4	9.0	8.2	8.5	8.0	7.6	8.9	8.2	100.0

DPCZCATS / Count / Row Pct / Col Pct	Oct (10)	Nov (11)	Dec (12)	Row Total
1 Stop/Slowing	150	165	124	1611
	9.3	10.2	7.7	36.2
	41.3	38.5	34.8	
3 Sideswipe Cutoff	68	78	61	809
	8.4	9.6	7.5	18.2
	18.7	18.2	17.1	
4 Ran Off Road	78	109	82	1041
	7.5	10.5	7.9	23.4
	21.5	25.4	23.0	
5 Other	67	77	89	986
	6.8	7.8	9.0	22.2
	18.5	17.9	25.0	
Column Total	363	429	356	4447
	8.2	9.6	8.0	100.0

Chi-Square	Value	DF	Significance
Pearson	95.79129	36	.00000
Likelihood Ratio	96.46454	36	.00000
Mantel-Haenszel test for linear association	14.69021	1	.00013

Minimum Expected Frequency - 2.547
Cells with Expected Frequency < 5 - 3 OF 52 (5.8%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by CZHOUR Hour of Day

DPCZCATS	CZHOUR Mid-12:59am 0	1	2	3	4	5	6	7	8	9	Row Total
1 Stop/Slowing	10	4	5	3	6	3	52	103	169	103	1605
	.6	.2	.3	.2	.4	.2	3.2	6.4	10.5	6.4	36.4
	10.3	5.1	4.9	4.6	8.8	3.9	30.4	47.5	53.1	43.6	
3 Sideswipe Cutoff	18	11	16	6	7	6	30	37	44	43	806
	2.2	1.4	2.0	.7	.9	.7	3.7	4.6	5.5	5.3	18.3
	18.6	13.9	15.7	9.2	10.3	7.8	17.5	17.1	13.8	18.2	
4 Ran Off Road	36	42	51	44	39	45	52	39	52	47	1027
	3.5	4.1	5.0	4.3	3.8	4.4	5.1	3.8	5.1	4.6	23.3
	37.1	53.2	50.0	67.7	57.4	58.4	30.4	18.0	16.4	19.9	
5 Other	33	22	30	12	16	23	37	38	53	43	975
	3.4	2.3	3.1	1.2	1.6	2.4	3.8	3.9	5.4	4.4	22.1
	34.0	27.8	29.4	18.5	23.5	29.9	21.6	17.5	16.7	18.2	
Column Total	97	79	102	65	68	77	171	217	318	236	4413
(Continued)	2.2	1.8	2.3	1.5	1.5	1.7	3.9	4.9	7.2	5.3	100.0

DPCZCATS	CZHOUR Noon-12:59pm 10	11	12	13	14	15	16	17	18	19	Row Total
1 Stop/Slowing	47	47	48	52	55	112	153	253	179	96	1605
	2.9	2.9	3.0	3.2	3.4	7.0	9.5	15.8	11.2	6.0	36.4
	26.9	25.8	25.3	27.4	25.9	43.8	49.8	63.3	55.8	42.9	
3 Sideswipe Cutoff	36	39	41	49	48	46	57	58	57	42	806
	4.5	4.8	5.1	6.1	6.0	5.7	7.1	7.2	7.1	5.2	18.3
	20.6	21.4	21.6	25.8	22.6	18.0	18.6	14.5	17.8	18.8	
4 Ran Off Road	46	37	45	37	60	52	45	33	46	37	1027
	4.5	3.6	4.4	3.6	5.8	5.1	4.4	3.2	4.5	3.6	23.3
	26.3	20.3	23.7	19.5	28.3	20.3	14.7	8.3	14.3	16.5	
5 Other	46	59	56	52	49	46	52	56	39	49	975
	4.7	6.1	5.7	5.3	5.0	4.7	5.3	5.7	4.0	5.0	22.1
	26.3	32.4	29.5	27.4	23.1	18.0	16.9	14.0	12.1	21.9	
Column Total	175	182	190	190	212	256	307	400	321	224	4413
(Continued)	4.0	4.1	4.3	4.3	4.8	5.8	7.0	9.1	7.3	5.1	100.0

DPCZCATS	CZHOUR Unknown 20	21	22	23	99	Row Total
1 Stop/Slowing	23	16	38	26	2	1605
	1.4	1.0	2.4	1.6	.1	36.4
	21.9	11.9	26.0	19.3	33.3	
3 Sideswipe Cutoff	28	33	19	34	1	806
	3.5	4.1	2.4	4.2	.1	18.3
	26.7	24.6	13.0	25.2	16.7	
4 Ran Off Road	22	42	45	33		1027
	2.1	4.1	4.4	3.2		23.3
	21.0	31.3	30.8	24.4		
5 Other	32	43	44	42	3	975
	3.3	4.4	4.5	4.3	.3	22.1
	30.5	32.1	30.1	31.1	50.0	
Column Total	105	134	146	135	6	4413
	2.4	3.0	3.3	3.1	.1	100.0

Chi-Square	Value	DF	Significance
Pearson	787.66497	72	.00000
Likelihood Ratio	805.41321	72	.00000
Mantel-Haenszel test for linear association	46.17008	1	.00000

Minimum Expected Frequency - 1.096
Cells with Expected Frequency < 5 - 4 OF 100 (4.0%)
Number of Missing Observations: 34

DPCZCATS Crash Type Categories (PRG) by DAYWEEK Day of Week

DPCZCATS	Count / Row Pct / Col Pct	Sunday 1	Monday 2	Tuesday 3	Wednsday 4	Thursday 5	Friday 6	Saturday 7	Unknown 9	Row Total
1 Stop/Slowing		68	220	242	284	285	380	129	3	1611
		4.2	13.7	15.0	17.6	17.7	23.6	8.0	.2	36.2
		17.3	36.2	38.2	42.6	41.5	42.3	24.1	12.0	
3 Sideswipe Cutoff		61	116	114	119	122	175	99	3	809
		7.5	14.3	14.1	14.7	15.1	21.6	12.2	.4	18.2
		15.5	19.1	18.0	17.8	17.8	19.5	18.5	12.0	
4 Ran Off Road		166	138	134	122	133	166	173	9	1041
		15.9	13.3	12.9	11.7	12.8	15.9	16.6	.9	23.4
		42.2	22.7	21.1	18.3	19.4	18.5	32.3	36.0	
5 Other		98	134	144	142	147	177	134	10	986
		9.9	13.6	14.6	14.4	14.9	18.0	13.6	1.0	22.2
		24.9	22.0	22.7	21.3	21.4	19.7	25.0	40.0	
Column Total		393	608	634	667	687	898	535	25	4447
		8.8	13.7	14.3	15.0	15.4	20.2	12.0	.6	100.0

Chi-Square	Value	DF	Significance
Pearson	202.85602	21	.00000
Likelihood Ratio	202.81412	21	.00000
Mantel-Haenszel test for linear association	4.95526	1	.02601

Minimum Expected Frequency - 4.548
Cells with Expected Frequency < 5 - 1 OF 32 (3.1%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by CZSEVER Injury Severity, Overall

DPCZCATS	Count / Row Pct / Col Pct	Fatal 1	Injury 2	Prop Dmg 3	Unknown 9	Row Total
1 Stop/Slowing		4	685	876	46	1611
		.2	42.5	54.4	2.9	36.2
		12.5	36.7	37.3	22.8	
3 Sideswipe Cutoff		2	295	450	62	809
		.2	36.5	55.6	7.7	18.2
		6.3	15.8	19.2	30.7	
4 Ran Off Road		13	466	532	30	1041
		1.2	44.8	51.1	2.9	23.4
		40.6	25.0	22.6	14.9	
5 Other		13	418	491	64	986
		1.3	42.4	49.8	6.5	22.2
		40.6	22.4	20.9	31.7	
Column Total		32	1864	2349	202	4447
		.7	41.9	52.8	4.5	100.0

Chi-Square	Value	DF	Significance
Pearson	70.62685	9	.00000
Likelihood Ratio	70.23172	9	.00000
Mantel-Haenszel test for linear association	5.77423	1	.01626

Minimum Expected Frequency - 5.821
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by V1TYPE Vehicle Type, Veh 1

DPCZCATS	V1TYPE Car etc. 1	Van/pick up 2	Straight truck 3	Tractor-trailer 4	Schl bus 5	Othr bus 6	Any emer g veh 7	Motorcyc 8	Othr veh 9	Non-veh 10	Row Total
1 Stop/Slowing	1090	264	98	72	1	2	4	4	2		1598
	68.2	16.5	6.1	4.5	.1	.1	.3	.3	.1		36.4
	36.4	46.4	35.6	19.7	33.3	22.2	22.2	14.3	28.6		
3 Sideswipe Cutoff	480	72	50	160		2	3	4	2		794
	60.5	9.1	6.3	20.2		.3	.4	.5	.3		18.1
	16.0	12.7	18.2	43.7		22.2	16.7	14.3	28.6		
4 Ran Off Road	775	124	58	44	1	2	1	10	2	1	1032
	75.1	12.0	5.6	4.3	.1	.2	.1	1.0	.2	.1	23.5
	25.9	21.8	21.1	12.0	33.3	22.2	5.6	35.7	28.6	100.0	
5 Other	653	109	69	90	1	3	10	10	1		970
	67.3	11.2	7.1	9.3	.1	.3	1.0	1.0	.1		22.1
	21.8	19.2	25.1	24.6	33.3	33.3	55.6	35.7	14.3		
Column Total	2998	569	275	366	3	9	18	28	7	1	4394
(Continued)	68.2	12.9	6.3	8.3	.1	.2	.4	.6	.2	.0	100.0

DPCZCATS	V1TYPE Unknown 99	Row Total
1 Stop/Slowing	61	1598
	3.8	36.4
	50.8	
3 Sideswipe Cutoff	21	794
	2.6	18.1
	17.5	
4 Ran Off Road	14	1032
	1.4	23.5
	11.7	
5 Other	24	970
	2.5	22.1
	20.0	
Column Total	120	4394
	2.7	100.0

Chi-Square	Value	DF	Significance
Pearson	267.85138	30	.00000
Likelihood Ratio	239.78753	30	.00000
Mantel-Haenszel test for linear association	8.14259	1	.00432

Minimum Expected Frequency - .181
Cells with Expected Frequency < 5 - 19 OF 44 (43.2%)
Number of Missing Observations: 53

DPCZCATS Crash Type Categories (PRG) by CZALC Any Alcohol in Crash?

DPCZCATS	CZALC: No alc/drugs (1)	Alcohol (2)	Drugs (3)	Row Total
1 Stop/Slowing	1581	30		1611
	98.1	1.9		36.2
	37.2	15.9		
3 Sideswipe Cutoff	776	31	2	809
	95.9	3.8	.2	18.2
	18.3	16.4	33.3	
4 Ran Off Road	964	75	2	1041
	92.6	7.2	.2	23.4
	22.7	39.7	33.3	
5 Other	931	53	2	986
	94.4	5.4	.2	22.2
	21.9	28.0	33.3	
Column Total	4252	189	6	4447
	95.6	4.3	.1	100.0

Chi-Square	Value	DF	Significance
Pearson	51.99872	6	.00000
Likelihood Ratio	55.81616	6	.00000
Mantel-Haenszel test for linear association	38.74267	1	.00000

Minimum Expected Frequency - 1.092
Cells with Expected Frequency < 5 - 4 OF 12 (33.3%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by ROADWTHR 'Weather' on Road

DPCZCATS	ROADWTHR: Dry (1)	Wet (2)	Snowy (3)	Icy (4)	Other (5)	Unknown (9)	Row Total
1 Stop/Slowing	1238	336	11	19	1	6	1611
	76.8	20.9	.7	1.2	.1	.4	36.2
	39.1	32.9	11.7	12.8	20.0	46.2	
3 Sideswipe Cutoff	657	127	11	10	1	3	809
	81.2	15.7	1.4	1.2	.1	.4	18.2
	20.8	12.4	11.7	6.8	20.0	23.1	
4 Ran Off Road	622	322	32	62	1	2	1041
	59.8	30.9	3.1	6.0	.1	.2	23.4
	19.7	31.5	34.0	41.9	20.0	15.4	
5 Other	648	237	40	57	2	2	986
	65.7	24.0	4.1	5.8	.2	.2	22.2
	20.5	23.2	42.6	38.5	40.0	15.4	
Column Total	3165	1022	94	148	5	13	4447
	71.2	23.0	2.1	3.3	.1	.3	100.0

Chi-Square	Value	DF	Significance
Pearson	207.49966	15	.00000
Likelihood Ratio	212.72450	15	.00000
Mantel-Haenszel test for linear association	77.85065	1	.00000

Minimum Expected Frequency - .910
Cells with Expected Frequency < 5 - 8 OF 24 (33.3%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by NVEHCATS No. of Vehicles

DPCZCATS	NVEHCATS One (1)	Two (2)	Three (3)	Four+ (4)	Row Total
1 Stop/Slowing	37	966	425	182	1610
	2.3	60.0	26.4	11.3	36.2
	3.4	40.0	62.0	70.3	
3 Sideswipe Cutoff	34	624	123	28	809
	4.2	77.1	15.2	3.5	18.2
	3.1	25.8	17.9	10.8	
4 Ran Off Road	845	159	27	10	1041
	81.2	15.3	2.6	1.0	23.4
	77.8	6.6	3.9	3.9	
5 Other	170	665	111	39	985
	17.3	67.5	11.3	4.0	22.2
	15.7	27.5	16.2	15.1	
Column Total	1086	2414	686	259	4445
	24.4	54.3	15.4	5.8	100.0

Chi-Square	Value	DF	Significance
Pearson	2648.29391	9	.00000
Likelihood Ratio	2565.16733	9	.00000
Mantel-Haenszel test for linear association	708.19530	1	.00000

Minimum Expected Frequency - 47.139

Number of Missing Observations: 2

DPCZCATS Crash Type Categories (PRG) by V1TYPE Vehicle Type, Veh 1

DPCZCATS	Car etc. 1	Van/pick up 2	Straight truck 3	Tractor-trailer 4	Schl bus 5	Othr bus 6	Any emerg veh 7	Motorcyc 8	Othr veh 9	Non-veh 10	Row Total
1 Stop/Slowing	1090	264	98	72	1	2	4	4	2		1598
	68.2	16.5	6.1	4.5	.1	.1	.3	.3	.1		36.4
	36.4	46.4	35.6	19.7	33.3	22.2	22.2	14.3	28.6		
3 Sideswipe Cutoff	480	72	50	160		2	3	4	2		794
	60.5	9.1	6.3	20.2		.3	.4	.5	.3		18.1
	16.0	12.7	18.2	43.7		22.2	16.7	14.3	28.6		
4 Ran Off Road	775	124	58	44	1	2	1	10	2	1	1032
	75.1	12.0	5.6	4.3	.1	.2	.1	1.0	.2	.1	23.5
	25.9	21.8	21.1	12.0	33.3	22.2	5.6	35.7	28.6	100.0	
5 Other	653	109	69	90	1	3	10	10	1		970
	67.3	11.2	7.1	9.3	.1	.3	1.0	1.0	.1		22.1
	21.8	19.2	25.1	24.6	33.3	33.3	55.6	35.7	14.3		
Column Total	2998	569	275	366	3	9	18	28	7	1	4394
	68.2	12.9	6.3	8.3	.1	.2	.4	.6	.2	.0	100.0

(Continued)

DPCZCATS	Unknown 99	Row Total
1 Stop/Slowing	61	1598
	3.8	36.4
	50.8	
3 Sideswipe Cutoff	21	794
	2.6	18.1
	17.5	
4 Ran Off Road	14	1032
	1.4	23.5
	11.7	
5 Other	24	970
	2.5	22.1
	20.0	
Column Total	120	4394
	2.7	100.0

Chi-Square	Value	DF	Significance
Pearson	267.85138	30	.00000
Likelihood Ratio	239.78753	30	.00000
Mantel-Haenszel test for linear association	8.14259	1	.00432

Minimum Expected Frequency - .181
Cells with Expected Frequency < 5 - 19 OF 44 (43.2%)
Number of Missing Observations: 53

DPCZCATS Crash Type Categories (PRG) by O1PROXIM Residence, re Beltway, Op. 1

DPCZCATS	O1PROXIM: Inside beltway (1)	Beltway + 3 mi (2)	Beltway + 10 mi (3)	Other MD or VA (4)	Outside MD or VA (5)	Unknown (9)	Row Total
1 Stop/Slowing	275	202	222	566	244	89	1598
	17.2	12.6	13.9	35.4	15.3	5.6	36.4
	38.0	36.6	41.1	35.2	32.8	39.4	
3 Sideswipe Cutoff	112	88	93	258	183	60	794
	14.1	11.1	11.7	32.5	23.0	7.6	18.1
	15.5	15.9	17.2	16.0	24.6	26.5	
4 Ran Off Road	189	125	119	406	159	34	1032
	18.3	12.1	11.5	39.3	15.4	3.3	23.5
	26.1	22.6	22.0	25.2	21.4	15.0	
5 Other	147	137	106	380	157	43	970
	15.2	14.1	10.9	39.2	16.2	4.4	22.1
	20.3	24.8	19.6	23.6	21.1	19.0	
Column Total	723	552	540	1610	743	226	4394
	16.5	12.6	12.3	36.6	16.9	5.1	100.0

Chi-Square	Value	DF	Significance
Pearson	62.73183	15	.00000
Likelihood Ratio	61.01010	15	.00000
Mantel-Haenszel test for linear association	.16789	1	.68199

Minimum Expected Frequency - 40.838
Number of Missing Observations: 53

DPCZCATS Crash Type Categories (PRG) by O1STATE State of Residence, Op. 1

DPCZCATS	O1STATE: DC (1)	MD (2)	VA (3)	Other US (4)	Canada (5)	Oth/Unkn (9)	Row Total
1 Stop/Slowing	38	590	628	250		92	1598
	2.4	36.9	39.3	15.6		5.8	36.4
	23.5	34.2	41.7	32.7		39.3	
3 Sideswipe Cutoff	30	264	254	184	1	61	794
	3.8	33.2	32.0	23.2	.1	7.7	18.1
	18.5	15.3	16.9	24.1	50.0	26.1	
4 Ran Off Road	55	445	330	166		36	1032
	5.3	43.1	32.0	16.1		3.5	23.5
	34.0	25.8	21.9	21.7		15.4	
5 Other	39	427	294	164	1	45	970
	4.0	44.0	30.3	16.9	.1	4.6	22.1
	24.1	24.7	19.5	21.5	50.0	19.2	
Column Total	162	1726	1506	764	2	234	4394
	3.7	39.3	34.3	17.4	.0	5.3	100.0

Chi-Square	Value	DF	Significance
Pearson	91.83751	15	.00000
Likelihood Ratio	91.05652	15	.00000
Mantel-Haenszel test for linear association	11.18879	1	.00082

Minimum Expected Frequency - .361
Cells with Expected Frequency < 5 - 4 OF 24 (16.7%)
Number of Missing Observations: 53

DPCZCATS Crash Type Categories (PRG) by CZMONTH Month

DPCZCATS	Count / Row Pct / Col Pct	Jan (1)	Feb (2)	March (3)	April (4)	May (5)	June (6)	July (7)	Aug (8)	Sept (9)	Oct (10)	Row Total
1 Stop/Slowing		52	41	56	55	66	87	69	79	64	71	792
		6.6	5.2	7.1	6.9	8.3	11.0	8.7	10.0	8.1	9.0	43.4
		33.5	33.3	35.4	42.0	44.9	52.4	40.4	47.6	46.4	47.3	
3 Sideswipe Cutoff		28	26	30	32	29	31	38	28	26	35	369
		7.6	7.0	8.1	8.7	7.9	8.4	10.3	7.6	7.0	9.5	20.2
		18.1	21.1	19.0	24.4	19.7	18.7	22.2	16.9	18.8	23.3	
4 Ran Off Road		40	27	31	20	24	30	35	26	28	23	328
		12.2	8.2	9.5	6.1	7.3	9.1	10.7	7.9	8.5	7.0	18.0
		25.8	22.0	19.6	15.3	16.3	18.1	20.5	15.7	20.3	15.3	
5 Other		35	29	41	24	28	18	29	33	20	21	334
		10.5	8.7	12.3	7.2	8.4	5.4	8.7	9.9	6.0	6.3	18.3
		22.6	23.6	25.9	18.3	19.0	10.8	17.0	19.9	14.5	14.0	
(Continued)	Column Total	155	123	158	131	147	166	171	166	138	150	1823
		8.5	6.7	8.7	7.2	8.1	9.1	9.4	9.1	7.6	8.2	100.0

Continued

DPCZCATS	Count / Row Pct / Col Pct	Nov (11)	Dec (12)	Row Total
1 Stop/Slowing		83	69	792
		10.5	8.7	43.4
		51.6	43.9	
3 Sideswipe Cutoff		31	35	369
		8.4	9.5	20.2
		19.3	22.3	
4 Ran Off Road		25	19	328
		7.6	5.8	18.0
		15.5	12.1	
5 Other		22	34	334
		6.6	10.2	18.3
		13.7	21.7	
	Column Total	161	157	1823
		8.8	8.6	100.0

Chi-Square	Value	DF	Significance
Pearson	52.97990	33	.01515
Likelihood Ratio	53.44476	33	.01362
Mantel-Haenszel test for linear association	18.54100	1	.00002

Minimum Expected Frequency - 22.131
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by CZHOUR Hour of Day

DPCZCATS	CZHOUR Mid-12:59am 0	1	2	3	4	5	6	7	8	9	Row Total
1 Stop/Slowing	3	1		1			19	50	90	55	792
	.4	.1		.1			2.4	6.3	11.4	6.9	43.5
	8.8	4.5		7.7			33.3	54.9	62.9	51.4	
3 Sideswipe Cutoff	6	5	8	1	2	2	14	14	19	21	369
	1.6	1.4	2.2	.3	.5	.5	3.8	3.8	5.1	5.7	20.3
	17.6	22.7	23.5	7.7	9.5	10.0	24.6	15.4	13.3	19.6	
4 Ran Off Road	16	10	18	6	10	8	11	15	15	19	327
	4.9	3.1	5.5	1.8	3.1	2.4	3.4	4.6	4.6	5.8	17.9
	47.1	45.5	52.9	46.2	47.6	40.0	19.3	16.5	10.5	17.8	
5 Other	9	6	8	5	9	10	13	12	19	12	334
	2.7	1.8	2.4	1.5	2.7	3.0	3.9	3.6	5.7	3.6	18.3
	26.5	27.3	23.5	38.5	42.9	50.0	22.8	13.2	13.3	11.2	
Column Total	34	22	34	13	21	20	57	91	143	107	1822
(Continued)	1.9	1.2	1.9	.7	1.2	1.1	3.1	5.0	7.8	5.9	100.0

DPCZCATS	CZHOUR Noon-12:59pm 10	11	12	13	14	15	16	17	18	19	Row Total
1 Stop/Slowing	27	29	19	30	35	41	84	134	96	40	792
	3.4	3.7	2.4	3.8	4.4	5.2	10.6	16.9	12.1	5.1	43.5
	37.0	35.4	27.9	34.1	36.1	43.6	56.4	70.5	58.5	40.8	
3 Sideswipe Cutoff	15	14	17	25	26	19	27	31	37	22	369
	4.1	3.8	4.6	6.8	7.0	5.1	7.3	8.4	10.0	6.0	20.3
	20.5	17.1	25.0	28.4	26.8	20.2	18.1	16.3	22.6	22.4	
4 Ran Off Road	13	17	13	14	20	19	17	6	14	17	327
	4.0	5.2	4.0	4.3	6.1	5.8	5.2	1.8	4.3	5.2	17.9
	17.8	20.7	19.1	15.9	20.6	20.2	11.4	3.2	8.5	17.3	
5 Other	18	22	19	19	16	15	21	19	17	19	334
	5.4	6.6	5.7	5.7	4.8	4.5	6.3	5.7	5.1	5.7	18.3
	24.7	26.8	27.9	21.6	16.5	16.0	14.1	10.0	10.4	19.4	
Column Total	73	82	68	88	97	94	149	190	164	98	1822
(Continued)	4.0	4.5	3.7	4.8	5.3	5.2	8.2	10.4	9.0	5.4	100.0

(Continued)

DPCZCATS	CZHOUR 20	21	22	23	Row Total
1 Stop/Slowing	11	8	10	9	792
	1.4	1.0	1.3	1.1	43.5
	28.2	16.0	22.7	20.5	
3 Sideswipe Cutoff	9	13	9	13	369
	2.4	3.5	2.4	3.5	20.3
	23.1	26.0	20.5	29.5	
4 Ran Off Road	11	18	10	10	327
	3.4	5.5	3.1	3.1	17.9
	28.2	36.0	22.7	22.7	
5 Other	8	11	15	12	334
	2.4	3.3	4.5	3.6	18.3
	20.5	22.0	34.1	27.3	
Column Total	39	50	44	44	1822
	2.1	2.7	2.4	2.4	100.0

Chi-Square	Value	DF	Significance
Pearson	352.71649	69	.00000
Likelihood Ratio	380.64429	69	.00000
Mantel-Haenszel test for linear association	23.83533	1	.00000

Minimum Expected Frequency - 2.333
Cells with Expected Frequency < 5 - 12 OF 96 (12.5%)
Number of Missing Observations: 1

DPCZCATS Crash Type Categories (PRG) by DAYWEEK Day of Week

DPCZCATS	DAYWEEK: Sunday (1)	Monday (2)	Tuesday (3)	Wednsday (4)	Thursday (5)	Friday (6)	Saturday (7)	Unknown (9)	Row Total
1 Stop/Slowing	28	112	117	152	128	192	63		792
	3.5	14.1	14.8	19.2	16.2	24.2	8.0		43.4
	19.2	41.6	42.2	53.5	47.4	51.6	30.9		
3 Sideswipe Cutoff	33	52	60	51	54	73	46		369
	8.9	14.1	16.3	13.8	14.6	19.8	12.5		20.2
	22.6	19.3	21.7	18.0	20.0	19.6	22.5		
4 Ran Off Road	47	54	50	26	43	55	52	1	328
	14.3	16.5	15.2	7.9	13.1	16.8	15.9	.3	18.0
	32.2	20.1	18.1	9.2	15.9	14.8	25.5	100.0	
5 Other	38	51	50	55	45	52	43		334
	11.4	15.3	15.0	16.5	13.5	15.6	12.9		18.3
	26.0	19.0	18.1	19.4	16.7	14.0	21.1		
Column Total	146	269	277	284	270	372	204	1	1823
	8.0	14.8	15.2	15.6	14.8	20.4	11.2	.1	100.0

Chi-Square	Value	DF	Significance
Pearson	96.04399	21	.00000
Likelihood Ratio	98.97541	21	.00000
Mantel-Haenszel test for linear association	9.66969	1	.00187

Minimum Expected Frequency - .180
Cells with Expected Frequency < 5 - 4 OF 32 (12.5%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by CZSEVER Injury Severity, Overall

DPCZCATS	CZSEVER: Fatal (1)	Injury (2)	Prop Dmg (3)	Unknown (9)	Row Total
1 Stop/Slowing	1	280	510	1	792
	.1	35.4	64.4	.1	43.4
	10.0	43.6	43.6	50.0	
3 Sideswipe Cutoff	1	107	261		369
	.3	29.0	70.7		20.2
	10.0	16.7	22.3		
4 Ran Off Road	4	136	188		328
	1.2	41.5	57.3		18.0
	40.0	21.2	16.1		
5 Other	4	119	210	1	334
	1.2	35.6	62.9	.3	18.3
	40.0	18.5	18.0	50.0	
Column Total	10	642	1169	2	1823
	.5	35.2	64.1	.1	100.0

Chi-Square	Value	DF	Significance
Pearson	22.91025	9	.00640
Likelihood Ratio	23.33083	9	.00549
Mantel-Haenszel test for linear association	1.43218	1	.23141

Minimum Expected Frequency - .360
Cells with Expected Frequency < 5 - 8 OF 16 (50.0%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by CZALC Any Alcohol in Crash?

DPCZCATS	CZALC: No alc/ drugs (1)	CZALC: Alcohol (2)	Row Total
1 Stop/Slowing	775	17	792
	97.9	2.1	43.4
	45.0	17.2	
3 Sideswipe Cutoff	352	17	369
	95.4	4.6	20.2
	20.4	17.2	
4 Ran Off Road	290	38	328
	88.4	11.6	18.0
	16.8	38.4	
5 Other	307	27	334
	91.9	8.1	18.3
	17.8	27.3	
Column Total	1724	99	1823
	94.6	5.4	100.0

Chi-Square	Value	DF	Significance
Pearson	45.89191	3	.00000
Likelihood Ratio	44.42870	3	.00000
Mantel-Haenszel test for linear association	33.90421	1	.00000

Minimum Expected Frequency - 17.812
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by ROADWTHR 'Weather' on Road

DPCZCATS	ROADWTHR: Dry (1)	Wet (2)	Snowy (3)	Icy (4)	Other (5)	Unknown (9)	Row Total
1 Stop/Slowing	654	114	7	13	1	3	792
	82.6	14.4	.9	1.6	.1	.4	43.4
	46.9	38.4	16.3	16.0	33.3	60.0	
3 Sideswipe Cutoff	308	49	5	5	1	1	369
	83.5	13.3	1.4	1.4	.3	.3	20.2
	22.1	16.5	11.6	6.2	33.3	20.0	
4 Ran Off Road	205	69	14	38	1	1	328
	62.5	21.0	4.3	11.6	.3	.3	18.0
	14.7	23.2	32.6	46.9	33.3	20.0	
5 Other	227	65	17	25			334
	68.0	19.5	5.1	7.5			18.3
	16.3	21.9	39.5	30.9			
Column Total	1394	297	43	81	3	5	1823
	76.5	16.3	2.4	4.4	.2	.3	100.0

Chi-Square	Value	DF	Significance
Pearson	121.70098	15	.00000
Likelihood Ratio	116.81837	15	.00000
Mantel-Haenszel test for linear association	47.72052	1	.00000

Minimum Expected Frequency - .540
Cells with Expected Frequency < 5 - 8 OF 24 (33.3%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by NVEHCATS No. of Vehicles

DPCZCATS	NVEHCATS One (1)	Two (2)	Three (3)	Four+ (4)	Row Total
1 Stop/Slowing	1	468	224	98	791
	.1	59.2	28.3	12.4	43.4
	.4	42.4	63.6	74.2	
3 Sideswipe Cutoff		291	68	10	369
		78.9	18.4	2.7	20.3
		26.3	19.3	7.6	
4 Ran Off Road	207	100	16	5	328
	63.1	30.5	4.9	1.5	18.0
	89.2	9.0	4.5	3.8	
5 Other	24	246	44	19	333
	7.2	73.9	13.2	5.7	18.3
	10.3	22.3	12.5	14.4	
Column Total	232	1105	352	132	1821
	12.7	60.7	19.3	7.2	100.0

Chi-Square	Value	DF	Significance
Pearson	1016.55056	9	.00000
Likelihood Ratio	861.58329	9	.00000
Mantel-Haenszel test for linear association	231.16170	1	.00000

Minimum Expected Frequency - 23.776
Number of Missing Observations: 2

DPCZCATS Crash Type Categories (PRG) by V1TYPE Vehicle Type, Veh 1

DPCZCATS	Count / Row Pct / Col Pct	Car etc. (1)	Van/pick up (2)	Straight truck (3)	Tractor-trailer (4)	Othr bus (6)	Motorcyc (8)	Othr veh (9)	Unknown (99)	Row Total
1 Stop/Slowing	Count	529	166	23	25				49	792
	Row Pct	66.8	21.0	2.9	3.2				6.2	43.4
	Col Pct	42.9	52.9	46.9	18.0				58.3	
3 Sideswipe Cutoff	Count	240	43	13	59			1	13	369
	Row Pct	65.0	11.7	3.5	16.0			.3	3.5	20.2
	Col Pct	19.4	13.7	26.5	42.4			100.0	15.5	
4 Ran Off Road	Count	238	58	7	13	1	1		10	328
	Row Pct	72.6	17.7	2.1	4.0	.3	.3		3.0	18.0
	Col Pct	19.3	18.5	14.3	9.4	100.0	100.0		11.9	
5 Other	Count	227	47	6	42				12	334
	Row Pct	68.0	14.1	1.8	12.6				3.6	18.3
	Col Pct	18.4	15.0	12.2	30.2				14.3	
Column Total		1234	314	49	139	1	1	1	84	1823
		67.7	17.2	2.7	7.6	.1	.1	.1	4.6	100.0

Chi-Square	Value	DF	Significance
Pearson	110.97688	21	.00000
Likelihood Ratio	105.76117	21	.00000
Mantel-Haenszel test for linear association	6.02724	1	.01409

Minimum Expected Frequency - .180
Cells with Expected Frequency < 5 - 12 OF 32 (37.5%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by O1AGECAT Age Category, Op. 1

DPCZCATS	O1AGECAT: 17 yrs (4)	18 - 20 (5)	21 - 24 (6)	25 - 29 (7)	30 - 44 (8)	45 - 59 (9)	60 - 69 (10)	70 + (11)	Unknown (12)	Row Total
1 Stop/Slowing	2	72	112	139	271	146	34	8	8	792
	.3	9.1	14.1	17.6	34.2	18.4	4.3	1.0	1.0	43.4
	25.0	46.2	44.1	44.0	41.1	49.2	51.5	32.0	19.0	
3 Sideswipe Cutoff	3	21	34	58	152	71	15	10	5	369
	.8	5.7	9.2	15.7	41.2	19.2	4.1	2.7	1.4	20.2
	37.5	13.5	13.4	18.4	23.1	23.9	22.7	40.0	11.9	
4 Ran Off Road	2	36	74	60	98	30	5	3	20	328
	.6	11.0	22.6	18.3	29.9	9.1	1.5	.9	6.1	18.0
	25.0	23.1	29.1	19.0	14.9	10.1	7.6	12.0	47.6	
5 Other	1	27	34	59	138	50	12	4	9	334
	.3	8.1	10.2	17.7	41.3	15.0	3.6	1.2	2.7	18.3
	12.5	17.3	13.4	18.7	20.9	16.8	18.2	16.0	21.4	
Column Total	8	156	254	316	659	297	66	25	42	1823
	.4	8.6	13.9	17.3	36.1	16.3	3.6	1.4	2.3	100.0

Chi-Square	Value	DF	Significance
Pearson	99.41763	24	.00000
Likelihood Ratio	95.21113	24	.00000
Mantel-Haenszel test for linear association	.22766	1	.63327

Minimum Expected Frequency - 1.439
Cells with Expected Frequency < 5 - 6 OF 36 (16.7%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by O2AGECAT Age Category, Op. 2

DPCZCATS	O2AGECAT: 17 yrs (4)	18 - 20 (5)	21 - 24 (6)	25 - 29 (7)	30 - 44 (8)	45 - 59 (9)	60 - 69 (10)	70 + (11)	Unknown (12)	Row Total
1 Stop/Slowing		56	93	153	318	112	20	9	30	791
		7.1	11.8	19.3	40.2	14.2	2.5	1.1	3.8	49.7
		53.8	52.2	59.5	54.8	46.9	46.5	64.3	17.2	
3 Sideswipe Cutoff	1	21	43	39	129	64	15	3	54	369
	.3	5.7	11.7	10.6	35.0	17.3	4.1	.8	14.6	23.2
	50.0	20.2	24.2	15.2	22.2	26.8	34.9	21.4	31.0	
4 Ran Off Road		4	9	10	19	11	2		66	121
		3.3	7.4	8.3	15.7	9.1	1.7		54.5	7.6
		3.8	5.1	3.9	3.3	4.6	4.7		37.9	
5 Other	1	23	33	55	114	52	6	2	24	310
	.3	7.4	10.6	17.7	36.8	16.8	1.9	.6	7.7	19.5
	50.0	22.1	18.5	21.4	19.7	21.8	14.0	14.3	13.8	
Column Total	2	104	178	257	580	239	43	14	174	1591
	.1	6.5	11.2	16.2	36.5	15.0	2.7	.9	10.9	100.0

Chi-Square	Value	DF	Significance
Pearson	308.18726	24	.00000
Likelihood Ratio	224.91473	24	.00000
Mantel-Haenszel test for linear association	33.10799	1	.00000

Minimum Expected Frequency - .152
Cells with Expected Frequency < 5 - 8 OF 36 (22.2%)
Number of Missing Observations: 232

DPCZCATS Crash Type Categories (PRG) by O1PROXIM Residence, re Beltway, Op. 1

DPCZCATS	O1PROXIM: Inside beltway (1)	Beltway + 3 mi (2)	Beltway + 10 mi (3)	Other MD or VA (4)	Outside MD or VA (5)	Unknown (9)	Row Total
1 Stop/Slowing	220	119	120	163	110	60	792
	27.8	15.0	15.2	20.6	13.9	7.6	43.4
	42.0	44.7	46.0	41.7	37.4	69.0	
3 Sideswipe Cutoff	88	52	56	83	78	12	369
	23.8	14.1	15.2	22.5	21.1	3.3	20.2
	16.8	19.5	21.5	21.2	26.5	13.8	
4 Ran Off Road	119	44	42	66	46	11	328
	36.3	13.4	12.8	20.1	14.0	3.4	18.0
	22.7	16.5	16.1	16.9	15.6	12.6	
5 Other	97	51	43	79	60	4	334
	29.0	15.3	12.9	23.7	18.0	1.2	18.3
	18.5	19.2	16.5	20.2	20.4	4.6	
Column Total	524	266	261	391	294	87	1823
	28.7	14.6	14.3	21.4	16.1	4.8	100.0

Chi-Square	Value	DF	Significance
Pearson	48.44439	15	.00002
Likelihood Ratio	50.04335	15	.00001
Mantel-Haenszel test for linear association	9.35458	1	.00222

Minimum Expected Frequency - 15.653
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by O1STATE State of Residence, Op. 1

DPCZCATS	O1STATE: DC (1)	MD (2)	VA (3)	Other US Oth/Unkn (4)	Unknown (9)	Row Total
1 Stop/Slowing	11	136	475	110	60	792
	1.4	17.2	60.0	13.9	7.6	43.4
	29.7	40.2	44.5	37.4	69.0	
3 Sideswipe Cutoff	11	78	190	78	12	369
	3.0	21.1	51.5	21.1	3.3	20.2
	29.7	23.1	17.8	26.5	13.8	
4 Ran Off Road	10	63	198	46	11	328
	3.0	19.2	60.4	14.0	3.4	18.0
	27.0	18.6	18.6	15.6	12.6	
5 Other	5	61	204	60	4	334
	1.5	18.3	61.1	18.0	1.2	18.3
	13.5	18.0	19.1	20.4	4.6	
Column Total	37	338	1067	294	87	1823
	2.0	18.5	58.5	16.1	4.8	100.0

Chi-Square	Value	DF	Significance
Pearson	46.55517	12	.00001
Likelihood Ratio	48.34517	12	.00000
Mantel-Haenszel test for linear association	19.75996	1	.00001

Minimum Expected Frequency - 6.657
Number of Missing Observations: 0

This procedure was completed at 17:07:38

DPCZCATS Crash Type Categories (PRG) by CZMONTH Month

DPCZCATS	CZMONTH Jan (0)	Feb (1)	March (2)	April (3)	May (4)	June (5)	July (6)	Aug (7)	Sept (8)	Row Total
1 Stop/Slowing	2	51	60	63	83	82	73	57	58	74	819
	.2	6.2	7.3	7.7	10.1	10.0	8.9	7.0	7.1	9.0	31.2
	14.3	24.8	28.8	25.9	35.8	35.3	38.8	34.5	25.4	32.5	
3 Sideswipe Cutoff	1	39	24	45	40	40	44	41	32	28	440
	.2	8.9	5.5	10.2	9.1	9.1	10.0	9.3	7.3	6.4	16.8
	7.1	18.9	11.5	18.5	17.2	17.2	23.4	24.8	14.0	12.3	
4 Ran Off Road	4	60	54	69	56	58	39	40	72	59	713
	.6	8.4	7.6	9.7	7.9	8.1	5.5	5.6	10.1	8.3	27.2
	28.6	29.1	26.0	28.4	24.1	25.0	20.7	24.2	31.6	25.9	
5 Other	7	56	70	66	53	52	32	27	66	67	652
	1.1	8.6	10.7	10.1	8.1	8.0	4.9	4.1	10.1	10.3	24.8
	50.0	27.2	33.7	27.2	22.8	22.4	17.0	16.4	28.9	29.4	
Column Total	14	206	208	243	232	232	188	165	228	228	2624
	.5	7.9	7.9	9.3	8.8	8.8	7.2	6.3	8.7	8.7	100.0

(Continued)

DPCZCATS	CZMONTH Oct (10)	Nov (11)	Dec (12)	Row Total
1 Stop/Slowing	79	82	55	819
	9.6	10.0	6.7	31.2
	37.1	30.6	27.6	
3 Sideswipe Cutoff	33	47	26	440
	7.5	10.7	5.9	16.8
	15.5	17.5	13.1	
4 Ran Off Road	55	84	63	713
	7.7	11.8	8.8	27.2
	25.8	31.3	31.7	
5 Other	46	55	55	652
	7.1	8.4	8.4	24.8
	21.6	20.5	27.6	
Column Total	213	268	199	2624
	8.1	10.2	7.6	100.0

Chi-Square	Value	DF	Significance
Pearson	80.09803	36	.00003
Likelihood Ratio	79.95681	36	.00004
Mantel-Haenszel test for linear association	1.62634	1	.20221

Minimum Expected Frequency - 2.348
Cells with Expected Frequency < 5 - 4 OF 52 (7.7%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by CZHOUR Hour of Day

DPCZCATS	CZHOUR Mid-12:59am 0	1	2	3	4	5	6	7	8	9	Row Total
1 Stop/Slowing	7	3	5	2	6	3	33	53	79	48	813
	.9	.4	.6	.2	.7	.4	4.1	6.5	9.7	5.9	31.4
	11.1	5.3	7.4	3.8	12.8	5.3	28.9	42.1	45.1	37.2	
3 Sideswipe Cutoff	12	6	8	5	5	4	16	23	25	22	437
	2.7	1.4	1.8	1.1	1.1	.9	3.7	5.3	5.7	5.0	16.9
	19.0	10.5	11.8	9.6	10.6	7.0	14.0	18.3	14.3	17.1	
4 Ran Off Road	20	32	33	38	29	37	41	24	37	28	700
	2.9	4.6	4.7	5.4	4.1	5.3	5.9	3.4	5.3	4.0	27.0
	31.7	56.1	48.5	73.1	61.7	64.9	36.0	19.0	21.1	21.7	
5 Other	24	16	22	7	7	13	24	26	34	31	641
	3.7	2.5	3.4	1.1	1.1	2.0	3.7	4.1	5.3	4.8	24.7
	38.1	28.1	32.4	13.5	14.9	22.8	21.1	20.6	19.4	24.0	
Column Total	63	57	68	52	47	57	114	126	175	129	2591
(Continued)	2.4	2.2	2.6	2.0	1.8	2.2	4.4	4.9	6.8	5.0	100.0

DPCZCATS	CZHOUR Noon-12:59pm 10	11	12	13	14	15	16	17	18	19	Row Total
1 Stop/Slowing	20	18	29	22	20	71	69	119	83	56	813
	2.5	2.2	3.6	2.7	2.5	8.7	8.5	14.6	10.2	6.9	31.4
	19.6	18.0	23.8	21.6	17.4	43.8	43.7	56.7	52.9	44.4	
3 Sideswipe Cutoff	21	25	24	24	22	27	30	27	20	20	437
	4.8	5.7	5.5	5.5	5.0	6.2	6.9	6.2	4.6	4.6	16.9
	20.6	25.0	19.7	23.5	19.1	16.7	19.0	12.9	12.7	15.9	
4 Ran Off Road	33	20	32	23	40	33	28	27	32	20	700
	4.7	2.9	4.6	3.3	5.7	4.7	4.0	3.9	4.6	2.9	27.0
	32.4	20.0	26.2	22.5	34.8	20.4	17.7	12.9	20.4	15.9	
5 Other	28	37	37	33	33	31	31	37	22	30	641
	4.4	5.8	5.8	5.1	5.1	4.8	4.8	5.8	3.4	4.7	24.7
	27.5	37.0	30.3	32.4	28.7	19.1	19.6	17.6	14.0	23.8	
Column Total	102	100	122	102	115	162	158	210	157	126	2591
(Continued)	3.9	3.9	4.7	3.9	4.4	6.3	6.1	8.1	6.1	4.9	100.0

DPCZCATS	CZHOUR Unknown 20	21	22	23	99	Row Total
1 Stop/Slowing	12	8	28	17	2	813
	1.5	1.0	3.4	2.1	.2	31.4
	18.2	9.5	27.5	18.7	33.3	
3 Sideswipe Cutoff	19	20	10	21	1	437
	4.3	4.6	2.3	4.8	.2	16.9
	28.8	23.8	9.8	23.1	16.7	
4 Ran Off Road	11	24	35	23		700
	1.6	3.4	5.0	3.3		27.0
	16.7	28.6	34.3	25.3		
5 Other	24	32	29	30	3	641
	3.7	5.0	4.5	4.7	.5	24.7
	36.4	38.1	28.4	33.0	50.0	
Column Total	66	84	102	91	6	2591
	2.5	3.2	3.9	3.5	.2	100.0

Chi-Square	Value	DF	Significance
Pearson	479.79443	72	.00000
Likelihood Ratio	477.96165	72	.00000
Mantel-Haenszel test for linear association	22.69798	1	.00000

Minimum Expected Frequency - 1.012
Cells with Expected Frequency < 5 - 4 OF 100 (4.0%)
Number of Missing Observations: 33

DPCZCATS Crash Type Categories (PRG) by DAYWEEK Day of Week

DPCZCATS	DAYWEEK 1 Sunday	2 Monday	3 Tuesday	4 Wednsday	5 Thursday	6 Friday	7 Saturday	9 Unknown	Row Total
1 Stop/Slowing	40	108	125	132	157	188	66	3	819
	4.9	13.2	15.3	16.1	19.2	23.0	8.1	.4	31.2
	16.2	31.9	35.0	34.5	37.6	35.7	19.9	12.5	
3 Sideswipe Cutoff	28	64	54	68	68	102	53	3	440
	6.4	14.5	12.3	15.5	15.5	23.2	12.0	.7	16.8
	11.3	18.9	15.1	17.8	16.3	19.4	16.0	12.5	
4 Ran Off Road	119	84	84	96	90	111	121	8	713
	16.7	11.8	11.8	13.5	12.6	15.6	17.0	1.1	27.2
	48.2	24.8	23.5	25.1	21.6	21.1	36.6	33.3	
5 Other	60	83	94	87	102	125	91	10	652
	9.2	12.7	14.4	13.3	15.6	19.2	14.0	1.5	24.8
	24.3	24.5	26.3	22.7	24.5	23.8	27.5	41.7	
Column Total	247	339	357	383	417	526	331	24	2624
	9.4	12.9	13.6	14.6	15.9	20.0	12.6	.9	100.0

Chi-Square	Value	DF	Significance
Pearson	125.82145	21	.00000
Likelihood Ratio	124.28283	21	.00000
Mantel-Haenszel test for linear association	.49936	1	.47978

Minimum Expected Frequency - 4.024
Cells with Expected Frequency < 5 - 1 OF 32 (3.1%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by CZSEVER Injury Severity, Overall

DPCZCATS	CZSEVER 1 Fatal	2 Injury	3 Prop Dmg	9 Unknown	Row Total
1 Stop/Slowing	3	405	366	45	819
	.4	49.5	44.7	5.5	31.2
	13.6	33.1	31.0	22.5	
3 Sideswipe Cutoff	1	188	189	62	440
	.2	42.7	43.0	14.1	16.8
	4.5	15.4	16.0	31.0	
4 Ran Off Road	9	330	344	30	713
	1.3	46.3	48.2	4.2	27.2
	40.9	27.0	29.2	15.0	
5 Other	9	299	281	63	652
	1.4	45.9	43.1	9.7	24.8
	40.9	24.5	23.8	31.5	
Column Total	22	1222	1180	200	2624
	.8	46.6	45.0	7.6	100.0

Chi-Square	Value	DF	Significance
Pearson	56.99809	9	.00000
Likelihood Ratio	55.28911	9	.00000
Mantel-Haenszel test for linear association	2.84083	1	.09190

Minimum Expected Frequency - 3.689
Cells with Expected Frequency < 5 - 1 OF 16 (6.3%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by CZALC Any Alcohol in Crash?

DPCZCATS	CZALC: No alc/ drugs (1)	Alcohol (2)	Drugs (3)	Row Total
1 Stop/Slowing	806	13		819
	98.4	1.6		31.2
	31.9	14.4		
3 Sideswipe Cutoff	424	14	2	440
	96.4	3.2	.5	16.8
	16.8	15.6	33.3	
4 Ran Off Road	674	37	2	713
	94.5	5.2	.3	27.2
	26.7	41.1	33.3	
5 Other	624	26	2	652
	95.7	4.0	.3	24.8
	24.7	28.9	33.3	
Column Total	2528	90	6	2624
	96.3	3.4	.2	100.0

Chi-Square	Value	DF	Significance
Pearson	18.95993	6	.00423
Likelihood Ratio	21.71844	6	.00136
Mantel-Haenszel test for linear association	13.23446	1	.00028

Minimum Expected Frequency - 1.006

DPCZCATS Crash Type Categories (PRG) by ROADWTHR 'Weather' on Road

DPCZCATS	ROADWTHR: Dry (1)	Wet (2)	Snowy (3)	Icy (4)	Other (5)	Unknown (9)	Row Total
1 Stop/Slowing	584	222	4	6		3	819
	71.3	27.1	.5	.7		.4	31.2
	33.0	30.6	7.8	9.0		37.5	
3 Sideswipe Cutoff	349	78	6	5		2	440
	79.3	17.7	1.4	1.1		.5	16.8
	19.7	10.8	11.8	7.5		25.0	
4 Ran Off Road	417	253	18	24		1	713
	58.5	35.5	2.5	3.4		.1	27.2
	23.5	34.9	35.3	35.8		12.5	
5 Other	421	172	23	32	2	2	652
	64.6	26.4	3.5	4.9	.3	.3	24.8
	23.8	23.7	45.1	47.8	100.0	25.0	
Column Total	1771	725	51	67	2	8	2624
	67.5	27.6	1.9	2.6	.1	.3	100.0

Chi-Square	Value	DF	Significance
Pearson	108.80431	15	.00000
Likelihood Ratio	113.41583	15	.00000
Mantel-Haenszel test for linear association	29.05966	1	.00000

Minimum Expected Frequency - .335
Cells with Expected Frequency < 5 - 8 OF 24 (33.3%)
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by NVEHCATS No. of Vehicles

DPCZCATS	NVEHCATS One (1)	Two (2)	Three (3)	Four+ (4)	Row Total
1 Stop/Slowing	36	498	201	84	819
	4.4	60.8	24.5	10.3	31.2
	4.2	38.0	60.2	66.1	
3 Sideswipe Cutoff	34	333	55	18	440
	7.7	75.7	12.5	4.1	16.8
	4.0	25.4	16.5	14.2	
4 Ran Off Road	638	59	11	5	713
	89.5	8.3	1.5	.7	27.2
	74.7	4.5	3.3	3.9	
5 Other	146	419	67	20	652
	22.4	64.3	10.3	3.1	24.8
	17.1	32.0	20.1	15.7	
Column Total	854	1309	334	127	2624
	32.5	49.9	12.7	4.8	100.0

Chi-Square	Value	DF	Significance
Pearson	1608.86802	9	.00000
Likelihood Ratio	1683.79568	9	.00000
Mantel-Haenszel test for linear association	420.19321	1	.00000

Minimum Expected Frequency - 21.296
Number of Missing Observations: 0

DPCZCATS Crash Type Categories (PRG) by V1TYPE Vehicle Type, Veh 1

DPCZCATS	Count / Row Pct / Col Pct	Car etc. (1)	Van/pick up (2)	Straight truck (3)	Tractor-trailer (4)	Schl bus (5)	Othr bus (6)	Any emer g veh (7)	Motorcyc (8)	Othr veh (9)	Non-veh (10)	Row Total
1 Stop/Slowing	Count	561	98	75	47	1	2	4	4	2		806
	Row Pct	69.6	12.2	9.3	5.8	.1	.2	.5	.5	.2		31.3
	Col Pct	31.8	38.4	33.2	20.7	33.3	25.0	22.2	14.8	33.3		
3 Sideswipe Cutoff	Count	240	29	37	101		2	3	4	1		425
	Row Pct	56.5	6.8	8.7	23.8		.5	.7	.9	.2		16.5
	Col Pct	13.6	11.4	16.4	44.5		25.0	16.7	14.8	16.7		
4 Ran Off Road	Count	537	66	51	31	1	1	1	9	2	1	704
	Row Pct	76.3	9.4	7.2	4.4	.1	.1	.1	1.3	.3	.1	27.4
	Col Pct	30.4	25.9	22.6	13.7	33.3	12.5	5.6	33.3	33.3	100.0	
5 Other	Count	426	62	63	48	1	3	10	10	1		636
	Row Pct	67.0	9.7	9.9	7.5	.2	.5	1.6	1.6	.2		24.7
	Col Pct	24.1	24.3	27.9	21.1	33.3	37.5	55.6	37.0	16.7		
Column Total		1764	255	226	227	3	8	18	27	6	1	2571
		68.6	9.9	8.8	8.8	.1	.3	.7	1.1	.2	.0	100.0

(Continued)

DPCZCATS	Count / Row Pct / Col Pct	Unknown (99)	Row Total
1 Stop/Slowing	Count	12	806
	Row Pct	1.5	31.3
	Col Pct	33.3	
3 Sideswipe Cutoff	Count	8	425
	Row Pct	1.9	16.5
	Col Pct	22.2	
4 Ran Off Road	Count	4	704
	Row Pct	.6	27.4
	Col Pct	11.1	
5 Other	Count	12	636
	Row Pct	1.9	24.7
	Col Pct	33.3	
Column Total		36	2571
		1.4	100.0

Chi-Square	Value	DF	Significance
Pearson	184.75611	30	.00000
Likelihood Ratio	157.32662	30	.00000
Mantel-Haenszel test for linear association	.00174	1	.96670

Minimum Expected Frequency - .165
Cells with Expected Frequency < 5 - 20 OF 44 (45.5%)
Number of Missing Observations: 53

DPCZCATS Crash Type Categories (PRG) by O1AGCAT2 Age Category, Op. 1

DPCZCATS	O1AGCAT2 Count / Row Pct / Col Pct	1 20 or younger	2 21 - 24	3 25 - 29	4 30 - 44	5 45 - 59	6 60 +	7 Unknown	Row Total
1 Stop/Slowing	Count	60	107	150	269	138	56	26	806
	Row Pct	7.4	13.3	18.6	33.4	17.1	6.9	3.2	31.3
	Col Pct	25.1	29.2	34.2	31.4	35.6	37.1	19.8	
3 Sideswipe Cutoff	Count	32	39	64	146	71	21	52	425
	Row Pct	7.5	9.2	15.1	34.4	16.7	4.9	12.2	16.5
	Col Pct	13.4	10.6	14.6	17.0	18.3	13.9	39.7	
4 Ran Off Road	Count	97	136	111	230	86	30	14	704
	Row Pct	13.8	19.3	15.8	32.7	12.2	4.3	2.0	27.4
	Col Pct	40.6	37.1	25.3	26.8	22.2	19.9	10.7	
5 Other	Count	50	85	113	212	93	44	39	636
	Row Pct	7.9	13.4	17.8	33.3	14.6	6.9	6.1	24.7
	Col Pct	20.9	23.2	25.8	24.7	24.0	29.1	29.8	
Column Total	Count	239	367	438	857	388	151	131	2571
		9.3	14.3	17.0	33.3	15.1	5.9	5.1	100.0

Chi-Square	Value	DF	Significance
Pearson	121.60170	18	.00000
Likelihood Ratio	113.00505	18	.00000
Mantel-Haenszel test for linear association	2.95105	1	.08582

Minimum Expected Frequency - 21.655
Number of Missing Observations: 53

DPCZCATS Crash Type Categories (PRG) by O1SEX Sex, Op. 1

DPCZCATS	O1SEX: 1 Male	2 Female	9 Unknown	Row Total
1 Stop/Slowing	569	226	11	806
	70.6	28.0	1.4	31.3
	32.0	31.6	14.5	
3 Sideswipe Cutoff	288	102	35	425
	67.8	24.0	8.2	16.5
	16.2	14.2	46.1	
4 Ran Off Road	496	199	9	704
	70.5	28.3	1.3	27.4
	27.9	27.8	11.8	
5 Other	426	189	21	636
	67.0	29.7	3.3	24.7
	23.9	26.4	27.6	
Column Total	1779	716	76	2571
	69.2	27.8	3.0	100.0

Chi-Square	Value	DF	Significance
Pearson	58.01309	6	.00000
Likelihood Ratio	48.45199	6	.00000
Mantel-Haenszel test for linear association	2.34922	1	.12535

Minimum Expected Frequency - 12.563
Number of Missing Observations: 53

DPCZCATS Crash Type Categories (PRG) by O2SEX Sex, Op. 2

DPCZCATS	O2SEX: 1 Male	2 Female	9 Unknown	Row Total
1 Stop/Slowing	520	259	6	785
	66.2	33.0	.8	43.8
	43.2	47.3	13.6	
3 Sideswipe Cutoff	272	123	20	415
	65.5	29.6	4.8	23.1
	22.6	22.5	45.5	
4 Ran Off Road	59	17	2	78
	75.6	21.8	2.6	4.3
	4.9	3.1	4.5	
5 Other	352	148	16	516
	68.2	28.7	3.1	28.8
	29.3	27.1	36.4	
Column Total	1203	547	44	1794
	67.1	30.5	2.5	100.0

Chi-Square	Value	DF	Significance
Pearson	24.86817	6	.00036
Likelihood Ratio	26.24146	6	.00020
Mantel-Haenszel test for linear association	4.84094	1	.02779

Minimum Expected Frequency - 1.913
Cells with Expected Frequency < 5 - 1 OF 12 (8.3%)
Number of Missing Observations: 830