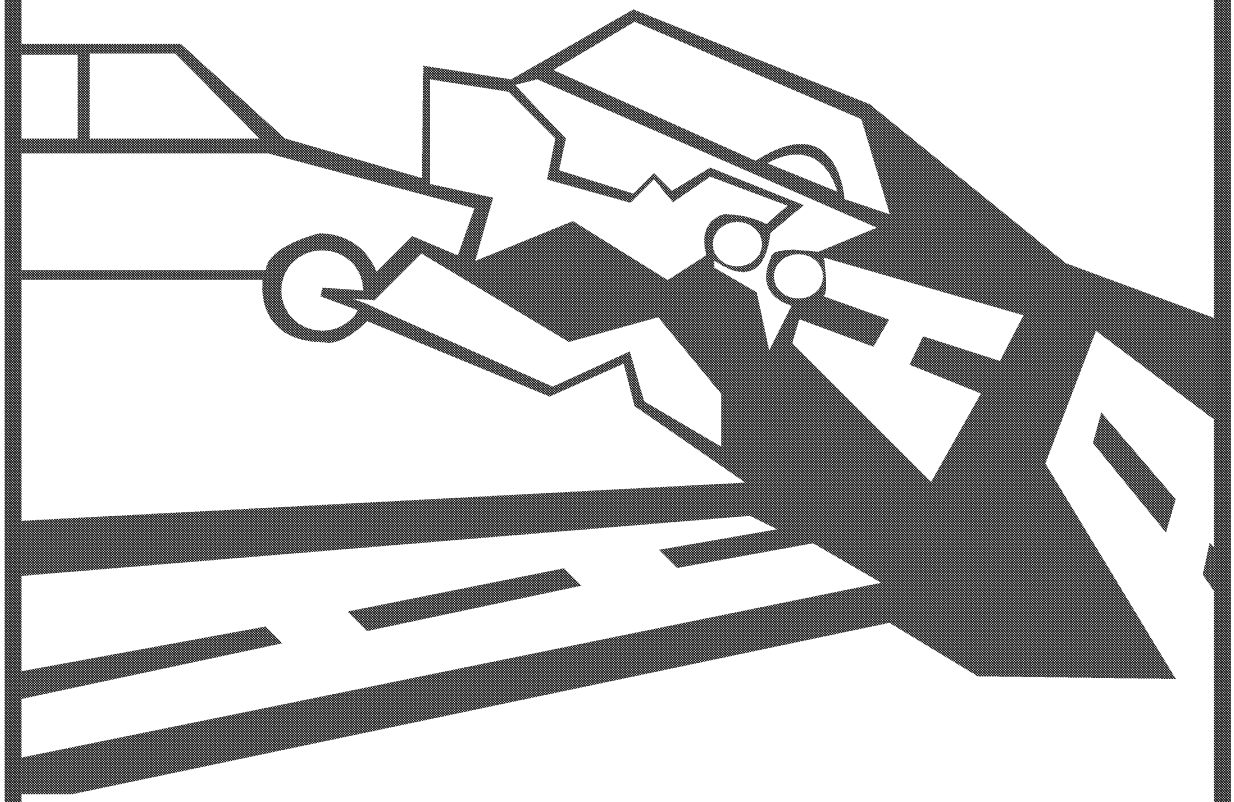
Special Report 17

# Virginia Crash Investigation Team



## Special Report On The Effectiveness Of Safety Belt Use In Traffic Crashes

TRANSPORTATION SAFETY TRAINING CENTER

Virginia Commonwealth University

# Virginia Crash Investigation Team

The Virginia Crash Investigation Team was formed in 1971 by the Highway Safety Division with the cooperation and support of the Virginia Departments of State Police and Transportation and Virginia Commonwealth University. Team members include a Virginia State Trooper, a Highway Engineer, and a Psychologist, with the advisory assistance from medical, engineering, or other personnel when necessary. The Team has the responsibility for determining the circumstances and probable causes of various transportation crashes. This information and the subsequent interpretations are intended to assist in the understanding and prevention of similar tragedies.

In an effort to produce the most objective, unbiased product possible, the Team investigates the human, mechanical, and environmental factors using a variety of techniques. Such techniques include, but are not limited to, personal interviews, on-site examinations, and vehicle inspections. Upon completion of this data-gathering phase of the investigation, conclusions and recommendations are forwarded to federal, state and/or local entities and to individuals who may be concerned with making, implementing, or influencing safety policies, laws, and standards. The primary emphasis of these reports is always placed on understanding the causes and specific characteristics of each case with an eye toward suggesting preventive measures.

We encourage the use of this report by the appropriate officials/individuals as a guide when evaluating the effectiveness of the existing transportation safety programs in their areas as well as when assessing the need for additional programs. In addition, we welcome your comments regarding this or any other Virginia Crash Investigation Team Report.

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** The conclusions and recommendations contained in this report are the opinions of the Crash Investigation Team and are not necessarily those of Virginia Commonwealth University.

**Virginia Commonwealth University**
**Transportation Safety Training Center**

**Crash Investigation Team**

Special Report Number 17 - January 2004

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# ABSTRACT

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This special report illustrates, through the investigation of selected traffic crashes, the benefits of safety belt use. The seven different crashes described in this report, which can be used as comparison studies, resulted in 5 fatalities, 7 injuries and extensive property damage. These seven crashes concluded with six successes for the safety belt wearers and six failures for the individuals not belted. Economic loss for these crashes is estimated at over five million dollars. The huge human suffering and emotional costs associated with these crashes are immeasurable for the family and friends who have lost loved ones.

The purpose for this special report is to emphasize to the motoring public the life-saving capabilities of safety belt use and to encourage more motorists to buckle-up. Another goal of the report is to encourage the passage of a primary use law in the Commonwealth, which could reduce the losses in Virginia highway mishaps.

Appreciation is extended to the many Virginia law enforcement agencies and officers that assisted the Crash Investigation Team with the notification and investigation of these crashes.

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## INTRODUCTION

The benefits of safety belt use in traffic crashes have been well documented over the past 30 years. When worn, they are one of the most effective safety devices in a motor vehicle. According to national figures, they are effective in reducing the number of deaths and critical injuries by almost 50%. They reduce the chances of being ejected by nearly 99% during rollovers. Statistics indicate that the likelihood a motorist will receive a fatal injury is nearly four times greater during ejection than if he or she remains inside the vehicle. Safety belts are credited with saving hundreds of thousands of lives, eliminating or reducing injury severity to countless crash victims and reducing total lifetime projected economic losses by the billions of dollars.

Public safety groups, educators and others have spent enormous amounts of money and time advertising the benefits of belt use to motorists across the U.S.A. Still, not everyone buckles up. At present, 49 states and the District of Columbia have mandatory belt use laws (only New Hampshire has none for adults). New York and New Jersey were the first states to enact such legislation in 1985, and Virginia's law became effective January 1, 1988. These laws were enacted to promote the wide use of safety belts. While public education and information, insurance premium reductions and countless other incentives encourage motorists to buckle up, the threat of a ticket is seen by some as perhaps the greatest reason motorists wear their safety belts.

As early as 1976, Virginia's Crash Investigation Team recommended to the General Assembly that a safety belt use law be enacted. Team members have testified before various General Assembly committees, citing the benefits of safety belt use and the need for a law. Over eight consecutive years, beginning in 1980, such bills were introduced and each time they were ultimately defeated. However, a belt use law was finally passed by both bodies of the General Assembly and signed by then Governor Gerald L. Baliles on March 27, 1987. The intent of the law was simple: to promote highway safety by encouraging more motorists to buckle up so that a reduction of deaths

and injuries could be realized. If a 70-percent compliance rate was achieved, it was estimated that the lives of as many as 150-200 motorists would be saved annually. During 1987, the last year that Virginia did not have a law, statewide surveys indicated that only 33 percent of front seat occupants were buckled. In 1988, the first year of the belt law's existence, nearly 63 percent of surveyed motorists buckled up. Virginia traffic statistics during the ten years before the belt use law was passed (1978-1987) reflected that no safety restraint was used in nearly 95 percent of the motor vehicle fatalities. During the 15 years since the law (1988-2002), this figure had dropped to 70-percent. During this last time period, 7290 motorists who died on Virginia's highways were not protected by a safety belt.

The National Transportation Safety Board (NTSB) has stated, "The single greatest defense against highway fatalities is the seatbelt." They note that as of January 2003, Virginia and 29 other states allow only secondary enforcement of their seat belt laws. Secondary enforcement means that law enforcement officers cannot issue a citation for a seatbelt violation unless the vehicle has been stopped for another reason. In 1995 and again in 1997, the NTSB recommended that states enact primary enforcement legislation. Of the many safety recommendations that the NTSB would like to see implemented, primary enforcement has the greatest potential to save lives. The Crash Investigation Team first recommended that passage of a primary law be considered in a report released in January 2001.

The Crash Investigation Team concurs with the Board and strongly recommends that the 2004 Virginia General Assembly enact primary enforcement for four main reasons.

First, safety belts have proven to be effective.

Second, primary enforcement laws will encourage more motorists to wear their safety belts. On average, states that have upgraded their laws from secondary to primary enforcement, according to the National Highway Traffic Safety Administration

(NHTSA), coupled with public education/information and strict law enforcement have seen a 15 percent increase in belt use. Presently, Virginia has a 74.6 percent belt use rate. The Commonwealth is ranked 32nd out of 52 U.S. jurisdictions on this statistic. Twenty-two states, the District of Columbia and Puerto Rico have primary enforcement laws. All but two of these jurisdictions have higher belt use rates than Virginia. Of the six jurisdictions that border Virginia: West Virginia, Kentucky and Tennessee – three secondary law states – have lower belt use rates than the Commonwealth. The remaining three jurisdictions have primary laws and their average belt use rate is 86.3%. Nationally, the average belt use rate is 79 percent. In primary enforcement states, the average is 83 percent, while secondary enforcement states average 75 percent. When states enacted primary safety belt laws, they experienced increased safety belt use rates, according to NHTSA, ranging from about 5 percent to 18 percent. The increased use is attributed to the perceived risk of motorists being stopped and ticketed.

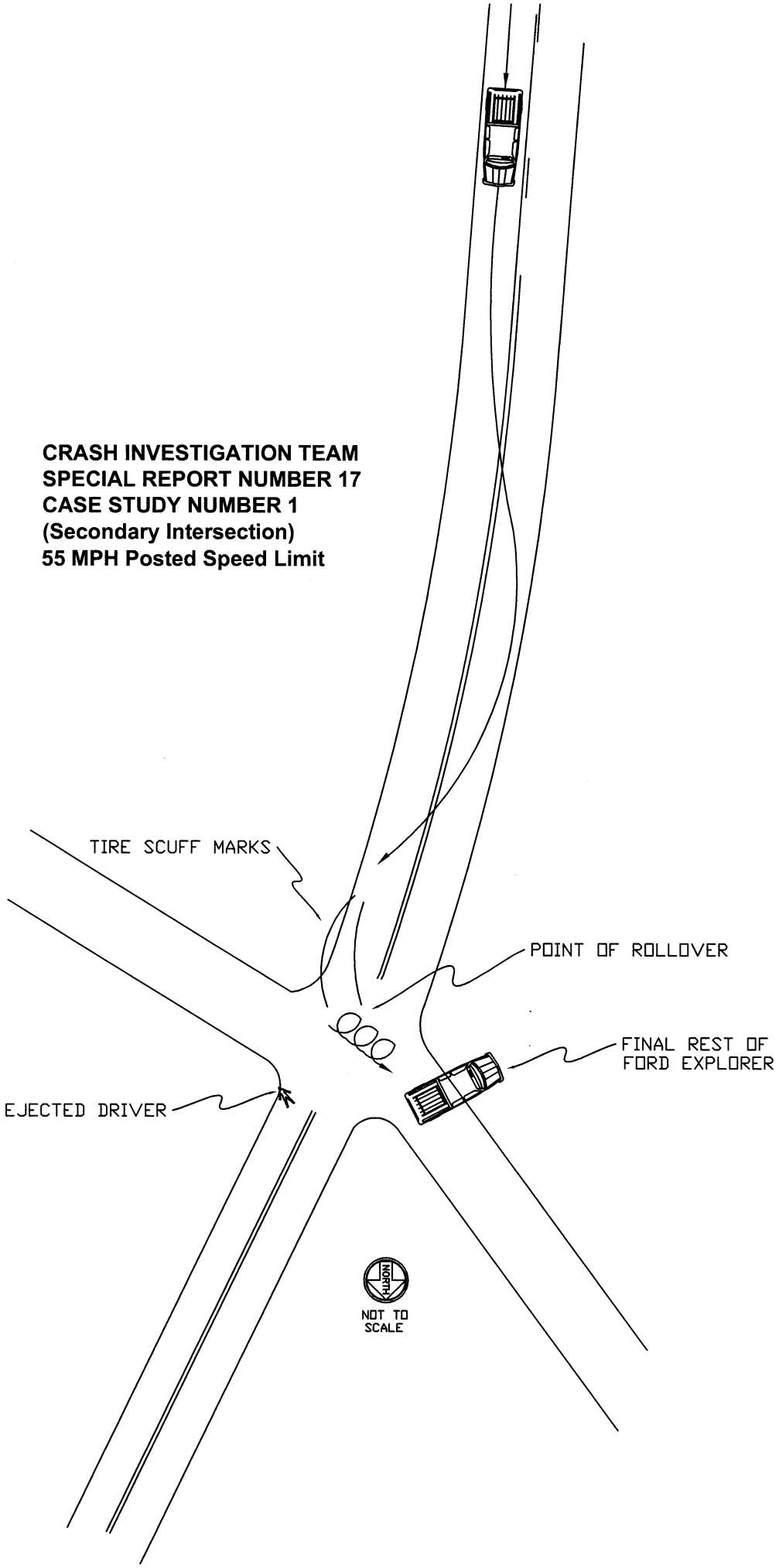
Third, the economic costs resulting from the failure to use safety belts are significant. In a study entitled "The Economic Impact of Motor Vehicle Crashes", NHTSA reported that the lifetime cost to society for each highway fatality is over $977,000. Each critically injured survivor of a motor vehicle crash incurs average costs of $1.1 million. NHTSA also found in a 1996 study that in-patient costs for unbelted crash victims were 55 percent higher than for belted crash victims. Many of the costs associated with motor vehicle crashes are paid with public funds. Overall, those not directly involved in crashes pay for nearly three-quarters of all crash costs, primarily through insurance premiums, taxes and travel delay.

Fourth, the approximately 26 percent of motor vehicle occupants nationwide who choose not to buckle up, according to the National Safety Council, tend to exhibit more high risk behavior than belt wearers. They are more frequently involved in crashes, especially serious ones, often as a result of risky actions such as speeding and impaired driving. Statistics show that people in fatal crashes have even lower safety belt use rates than those obtained in observational surveys of the general population. Alcohol-related crashes comprise approximately 40 percent of motor vehicle fatalities. The majority of

impaired drivers did not use safety belts. Teenagers are generally considered high-risk drivers because of their inexperience and immaturity. Teen drivers and their teen passengers as a group have the lowest seat belt use rates. The enactment of a primary belt law would embrace groups that are already high risk and help reduce their injury and fatality rates.

The Crash Investigation Team hopes that the findings contained in this report will be used to educate and publicize the benefits of safety belt use. Furthermore, this report can be beneficial to legislators when considering the enactment of a primary belt law for motorists in the Commonwealth. Both approaches will ensure that more Virginians will buckle up and fewer lives will be lost on our highways.

**CRASH INVESTIGATION TEAM**
**SPECIAL REPORT NUMBER 17**
**CASE STUDY NUMBER 1**
**(Secondary Intersection)**
**55 MPH Posted Speed Limit**



## CASE STUDY NUMBER 1

**Type of Crash:** Single vehicle rollover

**Vehicle Involved:** 1993 Ford Explorer, four door, two wheel drive

**Roadway:** Rural secondary highway

**Severity:** One fatality **(unbelted driver)**, one minor injury **(belted passenger)**, vehicle totaled

**SUMMARY:**

On a clear, dry Friday afternoon in April at about 2:50 p.m., a 1993 four door Ford Explorer sport utility vehicle (SUV), was traveling north on a two lane, undivided, rural secondary highway. The roadway is asphalt paved in excellent condition and posted with a 55mph speed limit. The pavement is 21 ½ feet wide and marked with typical white edge lines and solid/broken yellow centerlines. Bordering the road are unimproved, narrow shoulders and ditch lines ranging in width/depth of inches to two feet. The Explorer was driven by its unbelted 17-year-old owner who was familiar with both the vehicle and the roadway. Accompanying the driver was her 17-year-old friend seated in the right front who was properly wearing her three-point shoulder and lap safety belt. Both teens had stopped at one of the girls' homes and were en route to a business where one of them worked. They were reportedly not rushed or upset at the time.

As the Ford was traveling down the highway on a slight grade entering a relatively sharp, five-degree, 600-foot long right hand curve, it continued straight ahead and crossed the pavement's center lines where it entered the opposite lane. The driver, aware of her situation, steered sharply to her right in an attempt to regain the proper lane. This steering action caused the Ford to re-enter the lane but more sharply than the driver intended. The Ford was now headed toward the ditch line, thus causing its' young driver to counter steer, this time to her left. This over-corrective steering action caused the Ford to swerve back into the southbound lane while leaving tire yaw marks across the

pavement. The driver again steered hard to her right in another attempt to regain control of her vehicle, but she over-steered a third time as the Ford re-entered the northbound lane. The SUV diagonally crossed the pavement and, with its left tires leaving 101 feet of yaw marks on the roadway, it sharply re-entered the proper northbound lane. With the Ford heading sharply off the road, the driver steered a fourth and final time to her left in a futile attempt to control her vehicle. The Ford was now decelerating and yawing in a very sharp, counter clockwise rotation. This movement caused the Ford to partially run off the pavement's edge at a sharp 25-degree angle, its right tires entering the gravel and grass shoulder. As the vehicle continued forward while simultaneously rotating and tipping, the right rear tire and wheel began to dig into the sod and furrow along the shoulder until it regained the pavement. Upon re-entering the highway, the two right side wheel rims dug into the asphalt causing the Ford to go completely airborne and begin the first of its two complete rollovers onto its right, passenger side.

Based on the physical evidence left on the pavement, it was determined that as the Ford was beginning to roll over, it had slowed to about 40 mph from its initial speed of nearly 60 mph. However, since it still had sufficient speed and momentum, it crossed the pavement and traveled 75 feet and then began its second roll. The entire rollover distance that the SUV traveled across the pavement up to its final rest off the edge of the southbound lane was nearly 110 feet. The total distance that the Ford had traveled while out of control to final rest was about 300 feet – the length of a football field.

At final rest, the Ford was upright on its wheels facing southwest, with only the belted passenger remaining inside the vehicle. She was seated upright in her normal position in the right front seat. The unbelted driver, who was unable to hold onto the steering wheel during the rollover, was initially thrown to her right and partially on top of her passenger as the Ford tipped onto its right side. Because the Ford was turning over toward its right side, the driver found herself above her passenger and against the roof's headliner as the vehicle was rolling around her. As is typical in rollover crashes, she was then thrown against the left side window and, when the Ford bounced back onto its wheels after completing the first rollover, she was forced out through the driver's

window. As the Ford began its second roll, the unbelted driver's body was ejected through the driver's window and was flung like a missile ahead of the vehicle. Her head violently struck the asphalt pavement, immediately causing a fractured skull and a broken neck. She came to rest on the edge of the roadway about 63 feet beyond where the Ford first began to roll.

Two witnesses at a golf course adjacent to the roadway first heard the squealing tires and looked up to see the Ford "fishtail" and then roll over. One of the eyewitnesses stated that the SUV rolled over at least two times, and he noticed something "flying" out of the vehicle during the first roll. When he ran to the scene, he realized it was one of the occupants.

Although dazed and shaken up, the passenger was otherwise physically unharmed. Upon realizing that she had been involved in a rollover crash, she looked around inside the vehicle for the whereabouts of the driver. She remembered calling out her name and looking first in the floor area in the front seat, then in the Ford's rear, but with no success. She recalls seeing what she thought was smoke coming from the engine and, fearing a fire, was in a rush to get out of the Explorer. The smoke was actually steam from a cracked radiator and hoses. Upon exiting the vehicle, she observed a "clump" out in the road and began to run toward it. When she was about 10 feet away from it, she realized it was her best friend, the driver who had been ejected. By this time, several witnesses and bystanders had stopped to assist the driver. The passenger became hysterical and was led back to the Ford to await help.

Within minutes emergency medical personnel arrived, followed closely by the investigating officer. The ejected driver was examined at the scene and a helicopter was flown in. However, her massive head and neck injuries were determined to be fatal and she was transported to a nearby hospital by ambulance. Within two hours after the driver was pronounced dead, police officers went to her parent's house to notify them of the crash and the loss of their daughter. The surviving passenger gave a statement to the investigating officer at the scene. Once calmed, she confirmed that she was indeed

wearing her safety belt but the driver was not wearing one. She advised that they were "going about 55-60 mph" prior to the crash and she did not know what happened to cause the crash. The 17-year-old passenger received only minor bruises to her head in the crash and, after being examined and observed at the scene by medical personnel, she was released and taken home. That evening, when her parents arrived home from a short trip, they took her to a local hospital where she was examined again and released.

**DISCUSSION:**

This tragic incident illustrates the hazards of being involved in a traffic crash when not belted. It also illustrates the life saving and injury reducing benefits of safety belt use, especially in rollover crashes. The young driver, had she been wearing her safety belt, would not have been ejected and would have survived this multiple rollover crash with few or no injuries – just like the surviving passenger. Although the Explorer's left or drivers side received the most exterior damage, the interior was relatively undamaged. As is typical in rollover crashes on level surfaces, the vehicle's trailing side during the rollover usually receives the highest deceleration energy forces while the leading side, since it is closer to the rollover, receives the lowest energy forces. The roof area just to the left and above the driver's head was pushed downward about four inches from contact with the pavement. However, had the driver been belted, she would have remained in her seat and not have contacted the roof's interior above her.

In all likelihood, had the passenger also been unbelted, she would have suffered the same fate as the driver. She certainly would have been tossed around inside the vehicle, striking the interior components, and she probably would have been ejected onto the pavement. By being belted, she not only rode down the hostile forces in a safe place inside the vehicle but she remained inside. Her risk for ejection was increased by the nature of this crash – a rollover – and by the type of vehicle involved. National studies have indicated that motorists who are ejected are four times more likely to be fatally injured than those who remain inside the vehicle. The design of most sport utility vehicles such as this Explorer include a truck-like frame that has a higher center of

gravity, stiff suspension, a relatively short wheelbase and a narrow wheel track. As a result, SUV's as a group are two to three times more likely to rollover in a crash than a passenger car.

The reason the 17-year-old driver chose not to wear her safety belt is speculative. Although her parents taught her to wear a belt when riding in a car and enforced the rule when she was with them, she reportedly did not use a belt regularly when apart from her parents. Her father indicated that her actions may have been partly an act of youthful defiance. She also had a fatalistic or deterministic view of life that psychologically distanced her from connecting her chosen actions to responsibility for any consequences that might follow. It was rumored she occasionally commented that safety belts would not make any difference if it was "your time to go". The Crash Team has heard similar comments attributed to other crash victims.

Whatever her reasoning, the driver's behavior demonstrates that teen drivers and passengers tend to wear their safety belts less often than do older and more experienced motorists. According to a recent National Highway Traffic Safety Administration study, belt use among teens was observed to be only 45% compared to about 70% with older motorists.

This driver received her instructional permit at age 15 and her driver's license 17 months before the fatal crash. Her DMV record was clean and she had a balance of two safe driving points at the time of her crash. She had completed an approved driver's education course, which emphasized the importance of wearing safety belts. The course also emphasized that Virginia has a mandatory belt use law. If the Commonwealth had a primary belt use law verses a secondary one, perhaps this driver would have been more prone to wear her safety belt for fear of being stopped. It is possible that, had she known that she could have been ticketed for not wearing her belt (while not in violation of another traffic law) or had she been stopped by a law enforcement officer who saw her unbelted, she might have been motivated to wear her safety belt.

The death of this 17-year-old had immediate and long-term consequences for her family and friends. While still reeling from the shock of their loss, her parents had to make decisions about donating her organs and tissue. To deal with their grief, her mother and brother both attended counseling sessions, with her mother requiring medication to help with symptoms of both depression and anxiety. Four years later, she continues to take anti-depressant medications. For a period of over six months the driver's father reported experiencing some decreases in his job performance, especially with regard to distractibility and his ability to handle work related stress. These types of reactions are not uncommon during the grieving process. However, the family also experienced more pain and grief a year later, when they discovered that the tissue donations from their daughter's body had never been used and had been destroyed. As her father commented, "It was like losing our daughter all over again."

The passenger in this crash was also affected deeply by the death of her friend. She briefly attended counseling sessions and was treated for depression. She kept in touch with her friend's parents, who reported that it took her about a year to recover psychologically from the crash. She has since graduated from high school and attends a local community college part time, but she has no clear goals for the future.

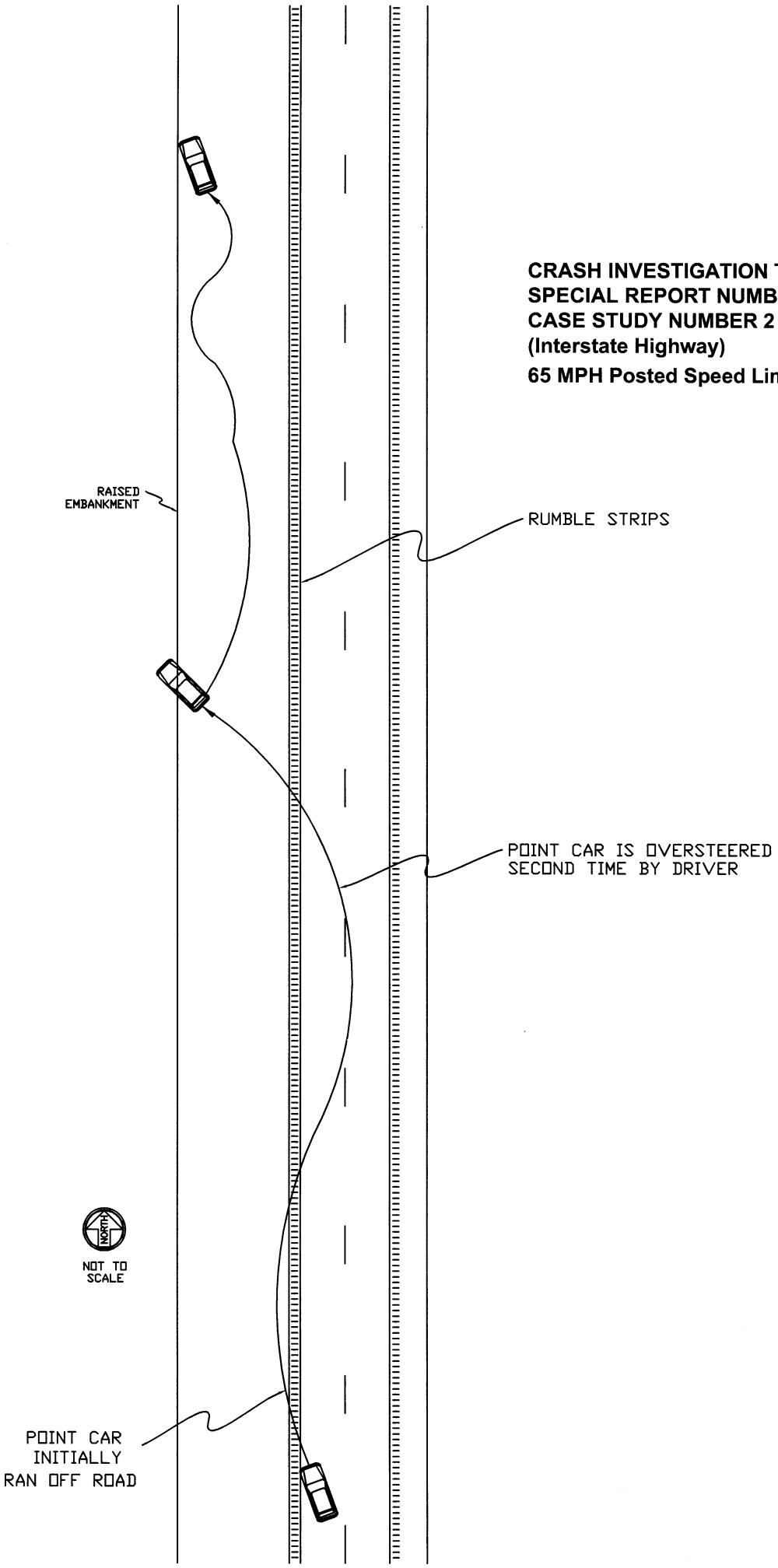
To some extent, the financial costs of this crash can be ascertained. The county paid the costs for the helicopter and emergency medical service; the family was not charged. The automobile insurance company assumed responsibility for payment of the hospital bill of approximately $2500. This carrier also paid the passenger $10,000 and the driver's family $10,000, the amount still owed on the destroyed Explorer. A $10,000 life insurance benefit with this automobile policy was forfeited because the driver was unbelted. Neither the driver nor her parents were aware of this benefit or it's requirements prior to the crash. However, two other life insurance policies on the driver resulted in an additional $20,000 benefit to the family and they received a $1000 gift from a professional organization. These insurance payments and gifts covered the funeral expenses, but the economic losses projected over this driver's normal life expectancy are estimated at $900,000 dollars.

On an average, nearly 500 unbelted motorists die each year in crashes in the Commonwealth. In economic terms, these losses are staggering, especially when many of them could have been prevented had the motorists simply worn their safety belts. The tragic loss of the 17-year-old killed in this crash is incalculable to her family and friends. Her death will forever leave a void in their lives.

***Photo #1- Damage to the left side of the 1993 Ford Explorer. This was the trailing side of the SUV during the two rollovers. The right side was less damaged.***

***Photo #2- Closer view of the Explorer's damaged left side. The fatally injured, unbelted driver was ejected through this window opening. The SUV's interior was undamaged.***

**CRASH INVESTIGATION TEAM**
**SPECIAL REPORT NUMBER 17**
**CASE STUDY NUMBER 2**
**(Interstate Highway)**
**65 MPH Posted Speed Limit**



## CASE STUDY NUMBER 2

**Type of Crash:** Single vehicle embankment collision/rollover

**Vehicle Involved:** 2000 Chevrolet Cavalier, two door sedan

**Roadway:** Rural interstate highway

**Severity:** Driver **(belted)** received minor injuries, car totaled

**SUMMARY:**

On a clear, dry Sunday afternoon in October at 4:25 p.m., a 2000 Chevrolet Cavalier Z-24, two door sedan, was traveling south on a rural, four lane, divided interstate highway. The asphalt-paved roadway is posted for 65 mph and is in excellent condition. Bordering the 24 foot wide pavement on the right is a 10 foot wide emergency shoulder and, on the left, a paved 3 foot wide shoulder equipped with milled rumble strips. The roadway generally follows the contour of the landscape, consisting of gentle curves and grades cutting through median/shoulder embankments. The Cavalier was driven by its lone 18-year-old owner, who was very familiar with the car and somewhat familiar with the area. The driver was a college student who was returning from her home, out-of-state, to her school. She had traveled about three hours and nearly 150 miles, and she was about 40 miles from her destination when the crash occurred. She was reportedly in good health, not under the influence of drugs/alcohol, and not upset at the time. The traffic conditions were described as heavy on this busy stretch of highway.

As the Cavilier was traveling along a straight and level section of roadway in the left, inside lane, it gradually ran off the pavement on the left side. It diagonally crossed the inside shoulder, running across the rumble strips and entered the gently sloped, grassy shoulder. As a result, the driver turned the steering wheel sharply to her right in an attempt to regain the pavement. The car came back onto the roadway, where it entered the left lane. However, due to the young driver realizing that she was about to enter the right lane, she steered hard again, this time to her left. This second steering action caused

the Cavalier to swerve back across the left lane and run off the left side of the pavement a second time, this time more sharply than the first. While crossing the roadway, the car's right side tires initially made yaw marks, followed quickly by skid marks due to the driver slamming on her brakes as the car left the pavement. The car then crossed the shoulder at a sharp angle and entered the grassy median where its' left front corner collided with a raised earthen embankment. The car's front end climbed several feet onto the embankment while simultaneously furrowing through the grass with its right side tires. This collision stopped the forward movement of the car; however, because the vehicle still had sufficient speed and momentum, it then began to roll over onto its right side. The car traveled a total distance of approximately 150 feet from the first time it entered the median and crossed the roadway up to the initial contact with the embankment.

During the rollover, the car's right front corner and roof dug into the ground at the foot of the embankment, causing the car to rollover a second time. While beginning its second roll, the right rear wheel dug into the sod, broke off at its' axle connection and was thrown behind the car as the vehicle continued rolling. During this time, the Cavalier was also rotating in a counter-clockwise direction across the median and along the embankment. After tumbling a distance of nearly 100 feet, the car came to a rest on its wheels facing northwest. It had rotated more than 180 degrees from its original direction of travel. The young driver remained buckled in her seat at final rest and was not ejected in the crash. Due to the rollover, the car's side and rear windows were broken and numerous contents originally inside were thrown out. No other vehicles were involved in the crash.

Several minutes after the crash and while the driver was still seated in her car, two motorists stopped to offer aid to the young driver. Since the battery had become dislodged and the cables were disconnected, the car's engine was not running. The threat of fire was not imminent, although steam was coming from the engine due to the ruptured water/fluid hoses. The driver was conscious but she was somewhat dazed and initially confused. While the safety belt kept her from being tossed about inside the car and/or

ejected, she still struck her head on the left side glass, causing a slight contusion and laceration. She also received other cuts and abrasions from flying glass and from being struck by dislodged contents from inside the vehicle during the two rollovers. The motorists helped unbuckle the driver and, after seeing that she was not seriously injured, assisted her out of the car through the passenger side door. The rollover damage to the car had buckled the frame, and the driver's door was jammed closed. She was placed in the grassy median and, with help from the bystanders, awaited medical and emergency personnel's arrival.

Approximately 10 minutes after the crash occurred, the investigating State Trooper arrived on the scene, followed closely by two rescue vehicles with several attendants. The 18-year-old driver was examined at the scene and then taken via ambulance to the local hospital's emergency room for further observations. She was released about one hour later with no complaints or problems. The road's left lane was closed nearly one hour while the Trooper completed his on-scene investigation and had the car towed from the site. The Trooper interviewed the driver at the hospital and she explained that no other vehicles caused her to run off the road. She said she was just riding along and suddenly she was in the median. After trying to regain the roadway, her car rolled over. She estimates her speed at about "65-70 mph" and she had the car's cruise control activated. When asked by the Trooper if she could have fallen asleep, she said that she did not think so. She confirmed wearing her safety belt and said there was nothing wrong with the car that may have caused her to lose control. The Trooper had examined the car while at the scene and found nothing defective with the tires, suspension or steering components. The driver was later charged with reckless driving. The Cavilier was deemed a total loss and sold to a salvage company for parts.

**DISCUSSION:**

This traffic crash is an excellent success story illustrating the benefits of safety belt use during fixed object collisions and rollovers. The young driver was wearing her safety belt properly, as she normally had since learning to drive three years earlier. She

was told of the life saving benefits of belt use during high school driver education, and the need to wear belts was strictly reinforced by her family. Her resident state of Maryland has a primary belt use law that, when enforced, subjects the violator to a ticket without the presence of another driving violation. The driver was aware of this law and stated that she thought Virginia had the same law. When questioned why she wears her safety belt, she said she felt unsafe without it and that she obviously did not want to get a ticket for not wearing her belt. The importance of wearing a safety belt in this crash cannot be over-emphasized. The use of the combined lap and shoulder belt protected the driver from colliding with the steering wheel when the car initially struck the embankment and from being ejected during the two rollovers. It also kept her in her seat and from tumbling around inside the vehicle, where she would have no doubt contacted the interior components. An examination of the car's interior indicated that it was still remarkably intact, with little damage. Considering the estimated speed of the car (65-70 mph) and the multiple exterior impacts with the embankment during the rollovers, it is probable that numerous strike points would have occurred inside the car had the driver not been belted. Any one of these collision points could have been life threatening and/or seriously debilitating.

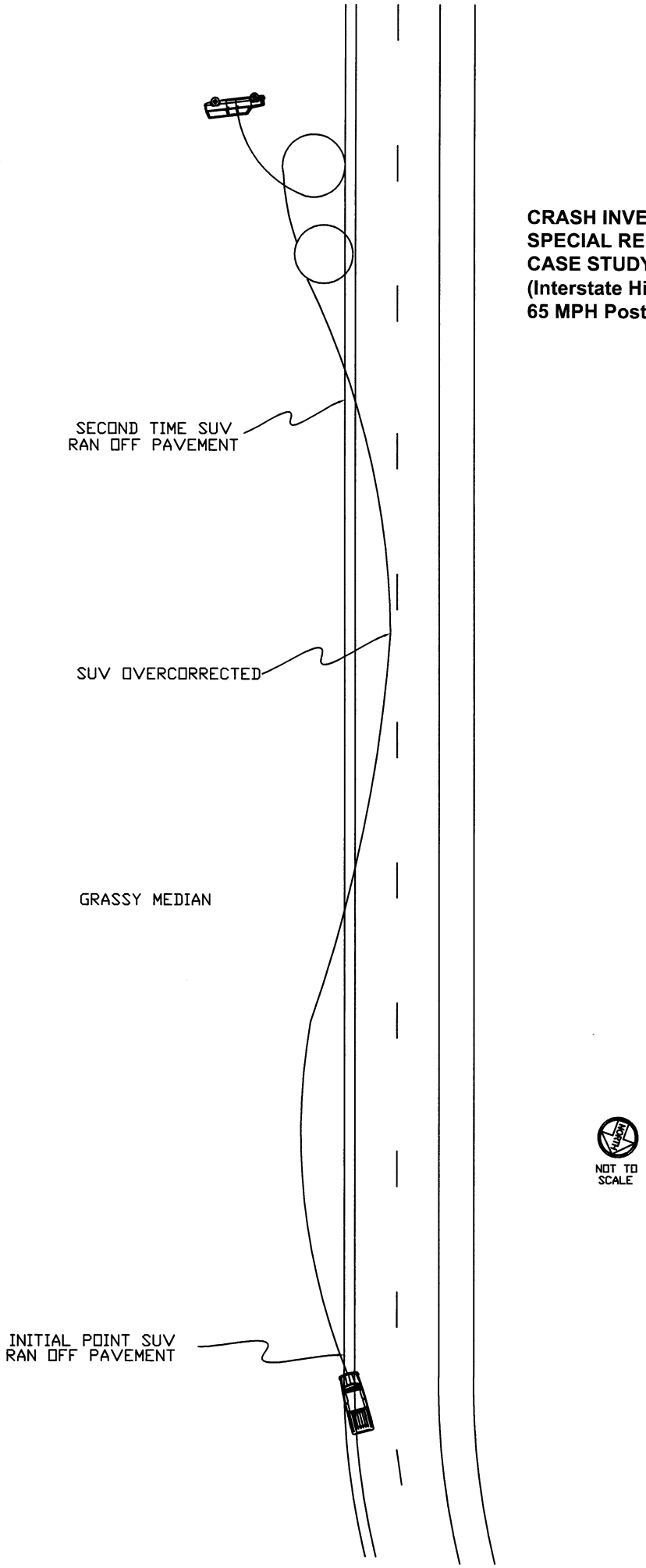
The nature of this crash was such that the car's two front airbags did not deploy. Airbags are not designed to activate in rollover crashes, and there were probably insufficient energy forces generated when the car initially struck the embankment, because the impact was a non-direct or sideswiping action.

In conclusion, this crash had the potential of producing fatal or serious injuries to the driver. Based on the "The Economic Impact of Motor Vehicle Crashes" produced by the National Highway Traffic Safety Administration in 2000, this crash produced a total economic loss estimated at $12,000. Had the driver not been wearing her safety belt and incurred a serious to fatal injury, the economic loss could be estimated at between $67,000 to nearly 1.1 million dollars. This of course does not include the incalculable tragedy and loss that would have been forever felt by her family and friends.

***Photo #3- Damage to the right side of the 2000 Chevrolet Cavalier Z-24. This was the leading side of the car during the two rollovers. The axle, wheels, frame and roof sustained structural damage in the collision.***

***Photo #4- Damage to the left side of the Cavalier. The roof and frame were buckled and the driver's door was jammed shut. The car was totaled in the crash however, the interior was completely intact and not damaged. The belted driver stayed inside the car during the rollovers and was uninjured.***

**CRASH INVESTIGATION TEAM**
**SPECIAL REPORT NUMBER 17**
**CASE STUDY NUMBER 3**
**(Interstate Highway)**
**65 MPH Posted Speed Limit**



## CASE STUDY NUMBER 3

**Type of Crash:** Single vehicle embankment collision/rollover

**Vehicle Involved:** 1995 Mitsubishi Montero, four door, four-wheel drive

**Roadway:** Rural interstate highway

**Severity:** One fatality **(unbelted passenger),** one minor injury **(belted driver),** vehicle totaled

**SUMMARY:**

On a sunny, Tuesday afternoon in September at about 3:20 p.m., two college students driving through Virginia from New York and en route to their Texas homes were southbound an a rural, four lane divided interstate highway. The asphalt-paved roadway is posted for 65 mph and is in excellent condition. Bordering the travel lanes on the right is a ten foot wide emergency shoulder and on the left, a paved three foot wide shoulder.

The Montero's driver was a belted 18-year-old female and she was accompanied by the vehicle owner, a 20-year-old female. The two occupants had been driving for several hours and had stopped several times for rest breaks and to change drivers. Inside the SUV were clothing and light furniture items being taken back home. At a point where a slight roadway curve to the right ended and began a straight, gentle downgrade, the SUV gradually ran-off the left side of the pavement. The speed was estimated by witnesses and the driver to be about 70 mph. The Montero traveled with it's left side tires in the grassy median along a straight line for nearly 100 feet and then it was abruptly steered back to the right. The vehicle regained the pavement and was again steered hard to the left, and entered the median a second time. The vehicle was then steered hard a third time by the driver attempting to regain control of her vehicle. The Montero began to rotate counter-clockwise with its' front facing the edge of the pavement. Due to the soft grassy median allowing the vehicle's left side wheels to furrow, compounded by its' sharp broadside angle, the SUV began to roll onto its' left side. Because of its' relatively

high speed and the Montero's high center of gravity, the vehicle rolled at least 2-¾ times. It came to a stop resting on the right side 155 feet from where it ran off the pavement the second time, and nearly 400 feet from the initial point where it entered the median. The SUV was facing the roadway at a right angle with its final resting point partially over the paved, inside shoulder.

The driver was held inside the vehicle by her lap and shoulder safety belt, and she rode down the collision with only minor bruising to her neck, shoulder and lower stomach from contact with the belt. She was also struck by loose items in the vehicle that had been dislodged during the rollover. The 20-year-old passenger was not wearing her safety belt. She was lifted off her seat and thrown around inside the vehicle during the crash sequence, much like the loose items inside the vehicle. She was then ejected through the passenger side window as the Montero was beginning its second rollover. Her 5 foot 6 inch, 120 pound body was flung ahead of the overturning vehicle and violently struck and tumbled along the grassy and rocky median. She came to rest about 50 feet beyond the vehicle and was found lying in the median by a motorist who had stopped to offer assistance. She sustained numerous massive chest, head and extremity injuries, which would later prove fatal. Because several southbound motorists witnessed the crash, they were able to quickly call for emergency assistance, which arrived within minutes. Both victims were attended and the severely injured passenger was flown via medivac helicopter to a major hospital trauma center 50 miles away. She died of severe trauma to her chest and abdomen while in the emergency room about 1-½ hours after the crash occurred. The driver was driven by ambulance to the nearest hospital about 12 miles away. She was examined and treated for minor bruising, injuries and shock. She was released about three hours later with no physical difficulties. After interviewing the driver at the hospital and completing his investigation, The Trooper charged the driver with reckless driving.

**DISCUSSION:**

According to the findings revealed in the investigation, it was determined that both the driver and vehicle were in good condition. No roadway defects existed that would have contributed to the crash. The 18-year-old driver advised the Trooper, that as they were proceeding through Virginia, she remarked to her passenger that she had a bad headache. Instead of pulling off the road, she continued to drive as her passenger released her safety belt and reached into the back seat area for some ibuprofen. Upon securing the medication and turning around in her seat, the passenger handed the tablets to the driver. The driver turned toward the passenger, picked up the tablets placed them in her mouth. As these actions were occurring, the driver took one hand off the steering wheel and her eyes off the road only momentarily. The Montero began running off the pavement while the road curved underneath it. Before the passenger could re-belt herself, the SUV was off the road and over-steered several times just prior to over-turning. The driver, while emotionally upset at the hospital when she gave her statement to the Trooper, said she had taken her eyes and attention away from her driving actions for "only a few short seconds" when she found herself in the median and the vehicle out-of-control.

This case illustrates the violent nature of a rollover crash, especially one involving a vehicle traveling at a high speed and when an occupant is unrestrained. Although the Montero's exterior and undercarriage were damaged excessively, the interior displayed little damage. This crash provides strong evidence for a fact that is well known to vehicle dynamics experts and highway safety devotees: the safest place to be in a collision is inside the vehicle, properly restrained to ride down the hostile energy forces generated during the crash or rollover. The driver, because she was wearing her lap and shoulder belt, benefited in two regards. First, she stayed in place inside the vehicle and did not contact the vehicle's interior components during the collision with the embankment. Second, she was not ejected during the vehicle's nearly three rollovers. As a result, she only sustained bruising from the belt's webbing. Had she not been belted, she may have suffered the same fate as her passenger. If her passenger had been wearing her safety belt, she would have ridden down the collision forces in much the same way as the driver. She

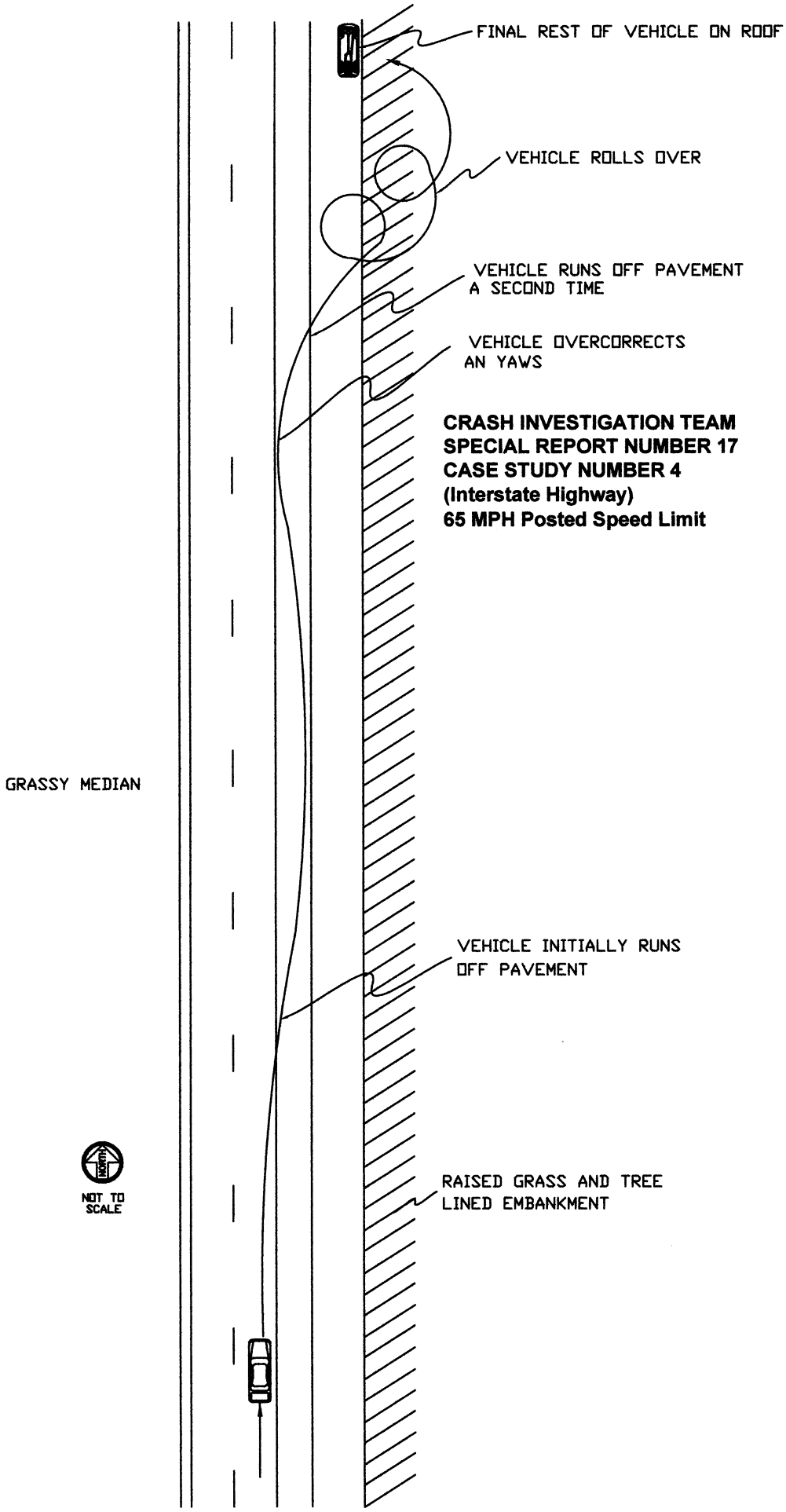
certainly would not have been ejected and she would probably have survived the crash with only minor injuries.

The reason both occupants initially wore their safety belts, as indicated by the driver, was because they "believed" in their effectiveness. They had both learned of the life saving benefits of safety belt use while learning to drive in Texas, and the need to continue to wear them after high school was reinforced by their parents. The driver was well aware that her home state has a mandatory belt use law but was unsure about the states that they were passing through. Since it was a habit for the two of them to wear their belts, the driver said they "hardly thought about it" when they got into a car.

In conclusion, this crash had a devastating emotional impact on the victim's family and the driver herself. She said that hardly a day goes by without thinking of her best friend killed in the crash. She said she wishes that she had never requested her passenger to retrieve the medicine for her headache, the scenario that started the entire crash sequence. According to NHTSA, the economic impact of this fatal motor vehicle crash was at least $977,000. This, of course, does not take into consideration the huge emotional and personal loss suffered by the family and friends of the 20-year old passenger.

***Photo #5- Damage to the front and right side of the 1995 Mitsubishi Montero. This was the trailing side of the SUV during the 2-¾ rollovers. The unbelted, fatally injured passenger was seated on this side of the SUV.***

***Photo #6- Closer view of the Montero's left side showing its' damage. The fatally injured, unbelted passenger was ejected through the right front window opening. The SUV's interior was remarkably undamaged.***




**CRASH INVESTIGATION TEAM**
**SPECIAL REPORT NUMBER 17**
**CASE STUDY NUMBER 4**
**(Interstate Highway)**
**65 MPH Posted Speed Limit**

## CASE STUDY NUMBER 4

**Type of Crash:** Single vehicle embankment collision/rollover

**Vehicle Involved:** 1988 Honda Accord, four door sedan

**Roadway:** Rural primary/ limited access highway

**Severity:** One fatality **(unbelted passenger),** one minor injury **(belted driver)** and property damage

**SUMMARY:**

On a Saturday night in October at about 9:30 p.m., a 1988 Honda Accord driven by a 16-year-old male was northbound on a four lane, divided primary highway. The concrete paved road is a limited access highway bordered by asphalt-paved shoulders. The facility is in excellent condition, is designed with interstate-type specifications and is posted for 65 mph. Adjacent to the pavement on both the median and outside shoulders are high, raised embankments with grass and trees. The driver was accompanied by his 15-year-old male cousin, seated in the right front. The driver was properly wearing the car's combination lap/shoulder belt and the passenger was unbelted. The weather was cool, dry and no roadway or mechanical defects on the car were suspected. The roadway was dark with no ambient lighting. The driver and the passenger were students at nearby high schools. The driver owned the car and was familiar with the Honda. He was also familiar with the highway, since he lived in the area near the crash site. His DMV record indicated that he had received his driver's license only about six weeks prior to this night. He had completed an approved driver's education course and had received a learner's permit just over nine months earlier. He had received no driving convictions and he had a zero safe driving point balance at the time of this crash.

At a point where the highway is constructed on a slight downgrade and long straight section of road preceding a curve, the Honda suddenly veered from the right lane onto the emergency shoulder. It continued diagonally across the shoulder and entered a

grassy berm paralleling the road. Apparently startled, the driver steered hard to his left in an attempt to regain the road, thus causing the Honda to abruptly change its direction of travel and head back toward the roadway. The driver, sensing that the car was headed back onto the road more sharply than intended, steered hard again, this time to the right. This action caused the Honda's left side tires to yaw on the asphalt-paved shoulder before it ran off the road a second time. This steering action rendered the car out-of-control, sliding broadside across the grassy berm and paved ditch line. Its left front corner and undercarriage struck the embankment and then began to climb onto the steep, raised berm. The vehicle had sufficient speed and momentum to travel up the embankment for about 30 feet while simultaneously beginning to rollover onto its' left side. It then traveled down the embankment while continuing to rollover until it reached the concrete drainage ditch at the embankment's foot, where it stopped on its roof. The Honda had rolled over at least 1-½ times and rotated nearly 45 degrees from its original heading when it contacted the concrete ditch. Physical evidence at the scene revealed that the car had traveled out-of-control nearly 425 feet from the point where it first left the road to final rest. Speed calculations from the car's left side tire yaw marks indicate that it was traveling about 70 mph during the first steering over-correction. The total rollover distance was measured at 119 feet.

During the rollover, the unbelted passenger was lifted off his seat and initially struck the front dashboard with his knees and chest. As the rollover continued, he was ejected through the passenger side window that had broken from contact with him and the collision with the ground. He was thrown out onto the ground and was pinned partially underneath the car when the Honda came to rest on its roof, facing north. He received numerous severe multiple injuries to his head, chest and extremities which would later prove fatal.

Witnesses following the car called 911 and reported the crash to authorities. The investigating Trooper and two rescue squad vehicles arrived at the scene within minutes. The severely injured passenger was lying on the grass, unconscious. The driver had stayed inside the car during the crash sequence and was sitting on the embankment with

bystanders when police and rescue arrived. Both he and the passenger were driven via separate rescue squad vehicles to a local hospital with an emergency trauma center. The investigating Trooper completed his on-scene investigation. He then drove to the hospital to check on the conditions of the occupants and obtain a driver's statement. His findings revealed that no other vehicle was involved in the cause of this crash. The authorities notified relatives of the occupants and they arrived at the hospital to be with their children.

**DISCUSSION:**

The unbelted passenger died at the hospital about 5 ½ hours after the crash from a blunt head trauma. The driver, because he was belted, was held in his seat during the crash/rollover sequences and came to rest inside the car behind the steering wheel, but upside down. He remained conscious throughout the collision and was able to unbuckle his safety belt, fall down onto the interior of the roof and climb unaided through the driver's side window. Although he was shaken up and received minor cuts and bruises, he was otherwise physically uninjured. He was released within two hours after being examined at the hospital.

The driver told the trooper that he and his passenger had just left his cousin's house located about ten miles away when the crash occurred. They were en route to his home where the two were going to spend the night together with family. They were about seven miles away from their destination when he lost control of the car. When asked what happened to cause the crash, the driver stated that he reached over and started adjusting the car's radio/CD player, in conjunction with the passenger. In the short time it took him to reach for and find the CD that he wanted, his car had already run off the road. He then quickly and abruptly turned the steering wheel in an attempt to regain the road and subsequently lost control of the vehicle. The driver was later charged with reckless driving.

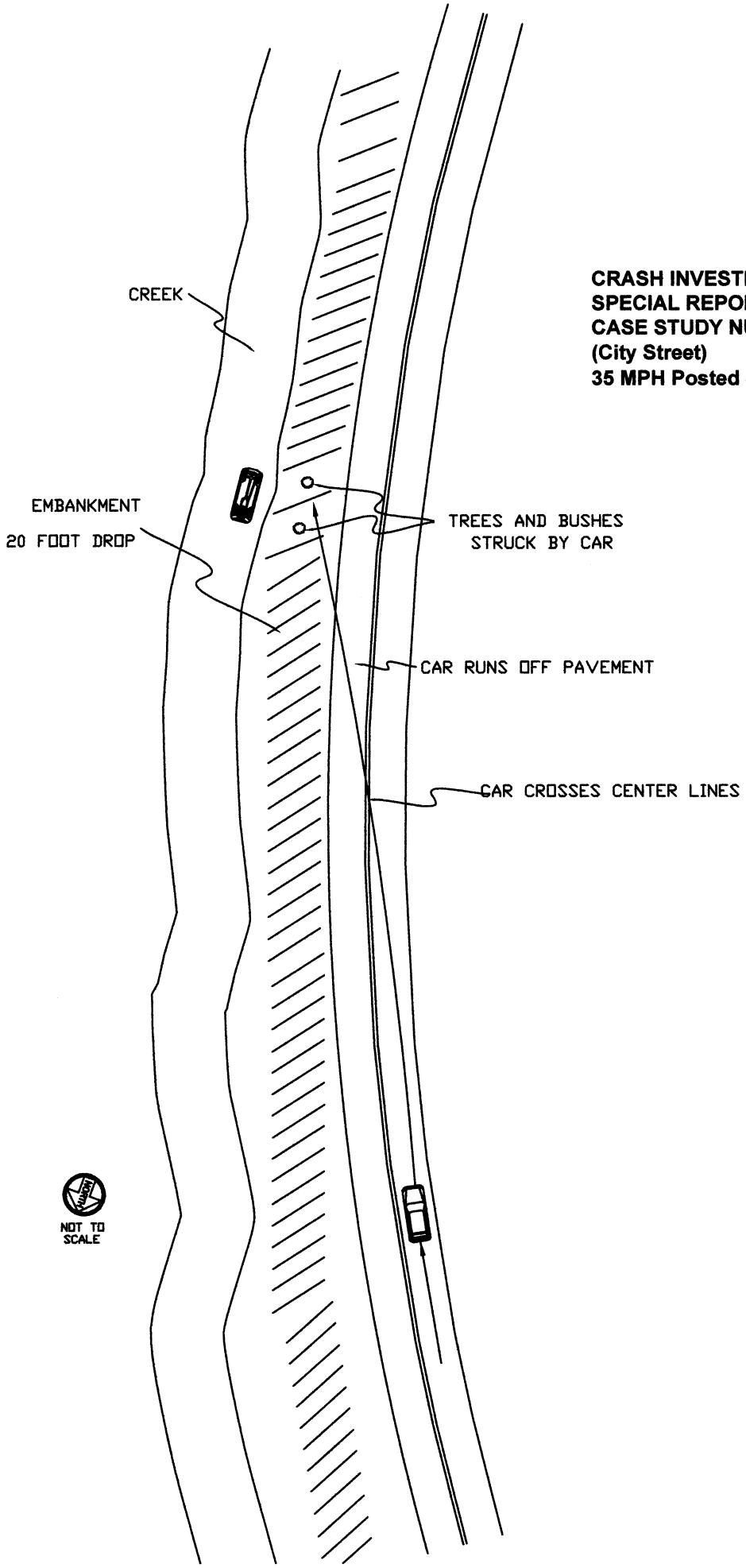
In conclusion, this tragic crash resulted in the ejection and death of a 15-year-old passenger who was not wearing his available safety belt. Had the passenger been belted, he would have likely survived this crash with no or only minor injuries. The crash was also a success story, however, in that the driver was properly belted and sustained only minor physical injuries. Considering the car's high speed and the vehicle impact and rollover dynamics, had the 16-year-old driver not been belted, he would have been tossed around inside the vehicle and probably ejected. The costs associated with this crash, excluding the emotional trauma and loss by the victim's family and friends, is estimated at just under one million dollars. This figure is based on the economic impact of motor vehicle crashes, which considers such costs as medical, emergency services, market productivity, insurance administration, work place costs and legal costs.

The driver advised authorities that he had been routinely wearing safety belts for "as long as he could remember". His parents and friends used them and he was instructed by them to wear safety belts. The need and purpose of belt use, he said, was emphasized in his driver education classes through both the classroom training and behind-the-wheel instruction. One of the reasons he gave for wearing a safety belt was that he was aware that Virginia has a safety belt law requiring use. He said that he did not want to get a ticket, so he naturally buckled up. His cousin also "usually" wore a belt when he was with him. This may be in part due to the fact that safety belt use for ages 16 and under is already a primary law in Virginia.

***Photo #7- View looking north at roadway shoulder and raised embankment where the Honda ran off the road and rolled over. Note the tire marks on the shoulder and impact points along the embankment.***

***Photo #8- Damage to the right side and front of the 1988 Honda Accord. This was the trailing side of the Honda during the 1-½ rollovers. The unbelted, fatally injured passenger was ejected through this side glass and was found lying underneath the car at final rest. The car's interior was not damaged.***

**CRASH INVESTIGATION TEAM**
**SPECIAL REPORT NUMBER 17**
**CASE STUDY NUMBER 5**
**(City Street)**
**35 MPH Posted Speed Limit**



## CASE STUDY NUMBER 5

| | |
|---|---|
| **Type of Crash:** | Single vehicle, tree impact and rollover and partial submersion |
| **Vehicle Involved:** | 2000 Pontiac Grand AM, four door sedan |
| **Roadway:** | Rural city street |
| **Severity:** | One minor injury **(belted driver)** and vehicle totaled |

**SUMMARY:**

On a clear, dry Sunday afternoon in July at about 2:00 p.m., a 2000 four door Pontiac Grand AM was traveling north on a two lane, undivided city street. The asphalt-paved roadway is located in a rural, tree-lined area that is intermittently spaced with private homes and businesses. The pavement is 36 feet wide, marked with typical yellow and white pavement lines denoting the directions of travel and separate turn lanes. Bordering the road on the east in a raised embankment and, on the west, a gravel tree-lined shoulder and a steep embankment sloping down to a 30 foot wide, 5 feet deep creek. The crash site is located about 250 feet north of a signalized intersection between a four-lane divided street and the two-lane city road. The Pontiac was driven by a lone 21-year-old female who was properly restrained by the car's lap and shoulder belt. She was familiar with both the roadway and her car. The driver was running errands and was en route to her home located about 15 miles away when the crash occurred.

As the Pontiac crossed the signalized intersection on a green traffic light phase, going straight ahead, the two-lane road curves slightly to the right. It is also constructed on a slight downgrade at this point. After negotiating about 100 feet of the nearly 300 foot curve, the car gradually left its' correct northbound lane, crossed the center lines and entered the southbound lane. The car diagonally crossed the pavement and entered the gravel shoulder bordering the road. Apparently aware of her situation, the driver slammed on the brakes as the car left the shoulder and struck several tree limbs, plummeting off a 20-foot deep embankment. The car then began to roll over onto its right side and

continued traveling airborne down the embankment until it struck the creek below. When the car's front and roof hit the creek, the Pontiac became partially submerged in the five-foot deep water. The fast flow of the water pushed the floating, half-submerged car southeastward several feet, where it stopped against the creek bank, resting on its top.

A motorist following the Pontiac witnessed the crash, stopped his vehicle and went to the aid of the woman. He ran down the embankment, entered the water and was able to reach through the driver's door to the Pontiac's driver, who was hanging upside down inside the car. She was conscious and suspended by her safety belt, with her head only inches above the water flowing inside the car beneath her. The witness unbuckled the safety belt, causing the driver to fall into the creek, where he was able to cradle her in his arms as he pulled her from the car. As they were exiting the vehicle, other motorists stopped to assist and helped them crawl up the embankment to the roadway shoulder above. These motorists had called 911 for assistance. Shortly after the driver and witness had climbed up the creek embankment and were sitting down on the shoulder, the investigating officer arrived, followed a few minutes later by a local rescue squad.

The driver was unhurt except for being in shock and receiving minor bruises. She was examined by medical personnel and taken via ambulance to a local hospital emergency room. The investigating police officer requested a tow truck to remove the car. The car was later evaluated as being totaled and was sold to a salvage company. The officer completed his at-scene investigation within one hour of arrival and drove to the hospital to check on the driver and to complete his investigation. After obtaining a driver's statement and comparing it to the witness' account of the crash and the available physical evidence at the scene, he charged the Pontiac driver with failure to maintain control of her vehicle. The driver was released that day from the hospital and taken home by her mother.

**DISCUSSION:**

The Pontiac driver told the investigating officer that she was traveling about 35 mph when she crossed the intersection and entered the two-lane road and curve where the crash occurred. No other vehicles were close to her and no one contributed to the driver running off the road. She could not recall what actually caused her to lose control of the car but remembers looking up as the car crossed into the opposite lane. She hit her brakes as the car entered the gravel shoulder bordering the pavement. She does remember wearing her safety belt, as she always wears one when she is in the vehicle. Due to the gentle angle that the car crossed the pavement, the investigating officer's investigation revealed that the driver was inattentive and probably fatigued or asleep at the time of the crash.

This Pontiac was equipped with an Event Data Recorder (EDR) that was downloaded by the Crash Investigation Team several weeks after the crash. The recorded information indicated that the driver's Belt Switch Circuit Status (seat belt) was "Buckled" at the time of the crash, confirming the use of her wearing her belt. The data also indicated that the driver was in fact braking and the car had decelerated to about 19 mph when it plunged off the embankment.

This crash is an excellent example of the life saving capabilities of safety belt use. It not only kept the driver safely in her seat and prevented her from striking the interior of the vehicle as she plunged down the embankment into the water below; it also prevented a possible ejection when the car rolled over. Additionally, by keeping her suspended above the water line, she was able to breath safely without possibly drowning before the witness was able to reach her. Since the driver was not a good swimmer, the possibility exists that, had she not been belted, she may have become submerged inside the car, increasing the risk of drowning. This driver advised that she routinely wore her safety belt because she was taught the importance of being belted years earlier; both through driver's education classes she had completed and by friends, family and public information materials she had encountered. She also confided that she is aware of

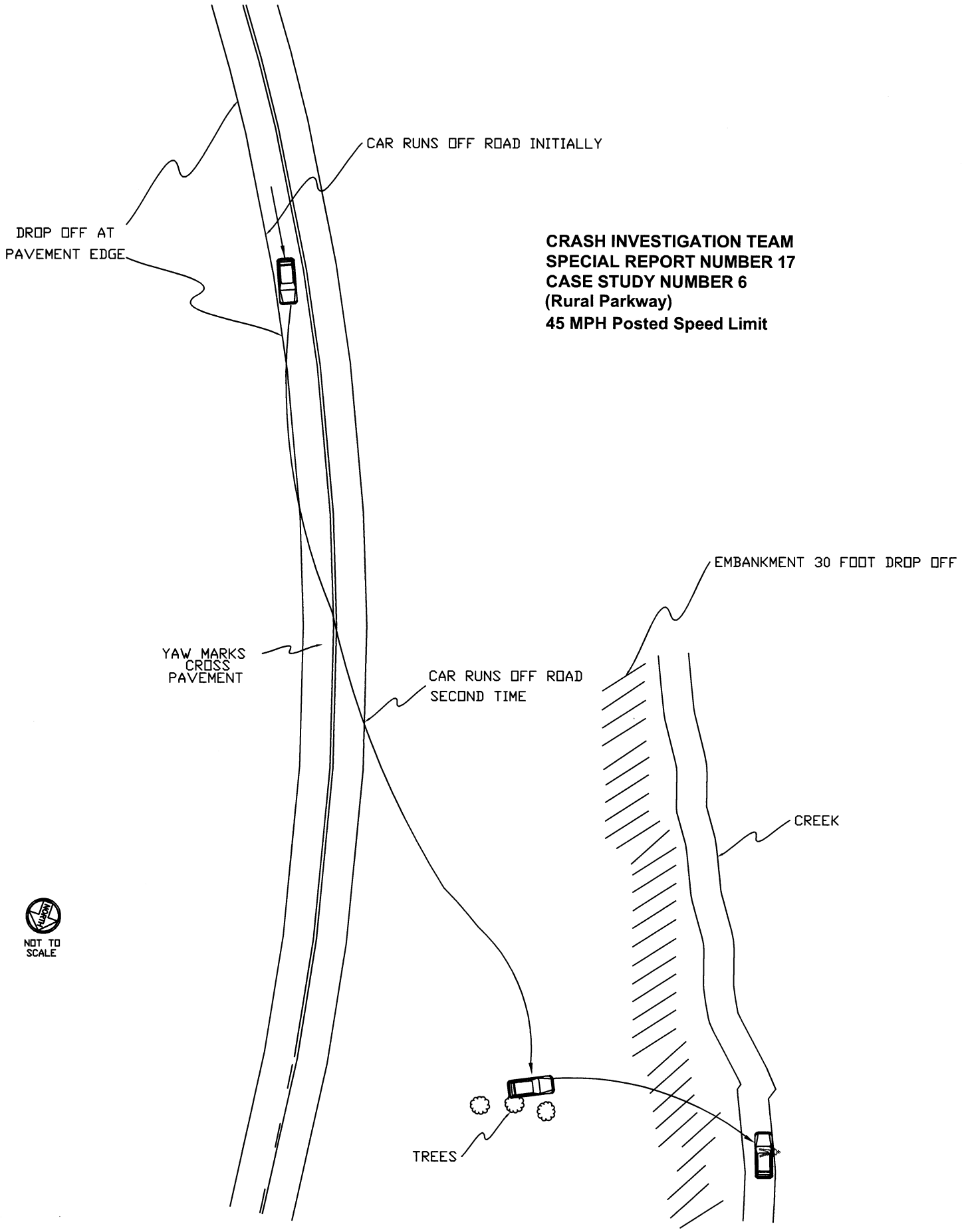
Virginia's law requiring her to be belted. She said that she complied with this law so that she would not receive a ticket.

While this crash had the potential to result in a fatality or a serious injury, the use of her safety belt prevented this from occurring. Instead of incurring an economic cost estimated at between $178,000 to nearly one million dollars, the approximate cost associated with this property damage crash is estimated at about $10,000.

***Photo #9- Damage to the right side and front of the 2000 Pontiac Grand Am. This was the leading side in the ½ rollover as the car traveled down an embankment and landed in a creek on its' top. The belted driver was uninjured in the crash.***

***Photo #10- Damage to the right side and rear of the Pontiac. Although it traveled down an embankment, rolled ½ time and came to rest up side down in a creek, the car's interior was not damaged. The Pontiac was totaled in the crash.***

**CRASH INVESTIGATION TEAM**
**SPECIAL REPORT NUMBER 17**
**CASE STUDY NUMBER 6**
**(Rural Parkway)**
**45 MPH Posted Speed Limit**



## CASE STUDY NUMBER 6

**Type of Crash:** Single vehicle, fixed object collision

**Vehicle Involved:** 2004 Volkswagen Passat, four door sedan

**Roadway:** Rural National Parkway

**Severity:** One fatality **(unbelted driver)** and vehicle totaled

**SUMMARY:**

On a cloudy, damp Thursday morning in November sometime between 12:45 a.m. and 3:45 a.m., a 2004 Volkswagen Passat was traveling north on a two lane, undivided parkway. The road is a rural, asphalt-paved facility, marked by double solid yellow centerlines traversing a heavily wooded, mountainous terrain. The roadway has a 45 mph posted speed limit and generally travels in a north-south direction. The road at the crash site is constructed on a relatively sharp 10-degree curve about 900 feet long, with a 4-½ percent grade and a 9 percent super elevation. Bordering the northbound lane is a four-foot wide grassy shoulder adjacent to a raised embankment with grass and trees. Paralleling the southbound lane is a 15-foot wide grassy shoulder bordered by a steep embankment, 30 feet deep. Intermittently spaced along the embankment are numerous trees and brush. At the foot of the embankment is a small, shallow creek with rock outcroppings.

The Passat was driven by its lone unbelted 22-year-old female owner who was familiar with both the roadway and with the vehicle. She had worked at a restaurant in the vicinity and, after its' closing, she had reportedly spent some time with friends. She was returning home, about two miles from the crash site.

As the Passat was traveling up a long straight section of the road, it entered a sharp, right hand curve. After negotiating nearly two-thirds of the curve, the driver suddenly steered the car hard to her left from the northbound lane. This swerving action caused the Passat to cross the pavement and enter the southbound lane at a sharp, 12-

degree angle. As it was crossing the pavement, the car began to leave scuffmarks from its four tires. With the right tire mark being the most discernable, they made an arcing pattern on the road surface about 76 feet long. The northbound Passat continued to rotate counter-clockwise as it ran off the southbound lane at a near 15-degree angle and onto the grassy shoulder. The car traveled nearly broadside a distance of 71 feet, crossed the shoulder, and slammed into three trees with its' right side. The car's forward movement was instantly stopped as the trees crushed into the car's side and rear. Maximum penetration of 21 inches occurred to the rear passenger door, just behind the B-post and to the car's roof and frame. This collision bowed the frame, causing the right front door to open. The Passat incurred nearly 16 inches of penetration from striking the second and third trees in the right corner trunk areas. All three trees were impacted at nearly the same time. Due to the tree's location near the top of the steeply sloped embankment, and because the car's heavier front was positioned lower than its' rear on the slope at impact, the Passat rebounded off the trees and slid down the embankment. The vertical and horizontal distances that the car traveled down the embankment were about 28 feet and 15 feet respectively. At the base of the embankment is the narrow, shallow stream, which flows in a southerly direction.

Upon impact with the trees, the car's unbelted driver was immediately thrown to the right, toward the front passenger door. The steep downward slope at impact, combined with the broadside movement of the Passat at impact, caused the car's right side to end up several feet lower than the left side. Due to the car's placement during the collision, the driver was ejected through the partially opened right front door as the car rebounded off the trees. She then struck the rocky and grass embankment and tumbled down the slope to the creek below, followed soon thereafter by the car. As a result, the car came to rest on top of her, while straddling the creek.

At 3:47 a.m., a county police officer on routine patrol was southbound on the parkway when a reflectorized item on the road's shoulder caught his attention. He stopped to investigate and found the Passat's rear bumper assembly wrapped around one of the trees. He noticed the presence of tire marks on the pavement and grass. He then

looked down the embankment and saw the silver Passat resting on the creek bank below. He contacted his dispatcher to request assistance and then ran to the wrecked car. The car was found facing southwest on its wheels. The ejected driver was lying partially underneath the left rear door area. The officer took her pulse and none was detected. The driver had died at the scene. Within the next 45 minutes, rescue, other police and a Park Ranger responded to the scene. The victim was taken via ambulance to the medical examiner's office. With assistance from a Park Ranger, the crash scene was documented, measured and photographed and the car was removed from the scene. After finding no evidence of another vehicle or an animal involved to cause the crash, and interviewing friends and family of the victim, the investigating officer completed his report. No witnesses to the crash were discovered and no defects with the car were suspected.

**DISCUSSION:**

The parents of the victim purchased the new Volkswagen Passat for her about six weeks prior to the crash. It was in excellent condition and she reportedly loved driving her new car. Friends of the driver said that she was visiting them during the hours preceding the crash. They stated that she had a beer or two during the visit. Apparently, nothing out of the ordinary occurred prior to the time she left to return to her parents' home. She was in good spirits and not upset nor in a rush to get home. Relatives advised that she, like many other motorists, sometimes wore her safety belt and sometimes not. At the time of this crash, she was unbelted which definitely led to her fatal injuries.

Since the collisions with the trees occurred on the car's right side, some four feet away from the driver's normal seated position, the driver's portion of the car's interior was undamaged. The majority of interior damage occurred to the Passat's right front passenger seat, roof, B-post and floor. Had the driver been belted, she would have likely stayed in her seat and would not have impacted the right interior of the car. She likewise would not have been ejected. The injuries she sustained, fatal blunt injuries to her head, neck and chest occurred as a result of her ejection. Had she stayed inside the car and all

other aspects of this crash remained the same, she probably would have survived this crash with only moderate injuries.

The initial speed that the Passat was traveling, based on the scuffmarks combined with the amount of crush damages on the car, was estimated at between 45 and 50 mph. The speed of the car at impact with the trees is estimated at about 30 mph. This collision speed is survivable considering where the car was impacted and if the driver had worn her safety belts.

The nature of the car's sudden and sharp movement off the road indicates that the driver was consciously steering her vehicle in some type of evasive action. The abrupt action caused her to lose control of her car. While no other contact damage from another vehicle and/or animal was noted on her car after the crash, it was reported that numerous deer were seen in the area during the early morning hours surrounding the crash times. It is possible that she may have been trying to avoid something such as a deer or other animal/object.

Also noted along the edge of the northbound lane near where the Passat's yaw marks begin, is a noticeable pavement edge drop off. This highway lip measured between 1-4 inches deep and contained black rubber residue obviously from a vehicle's tires that had inadvertently run off the pavement at this location. This condition was noted by Parkway authorities and was in the process of being rehabilitated at the time of the fatal crash. Due to the placement of a plastic sheeting along the eroded shoulder/pavement edge, no discernable tire prints from the Passat's right side tires could be detected along this shoulder. If such a vehicle strikes this lip with its' driver unaware of the highway defect, it can easily cause a driver to over-steer in an attempt to regain the road and lose control of the vehicle. This is especially true if the errant vehicle has small tires and is traveling at higher speeds.

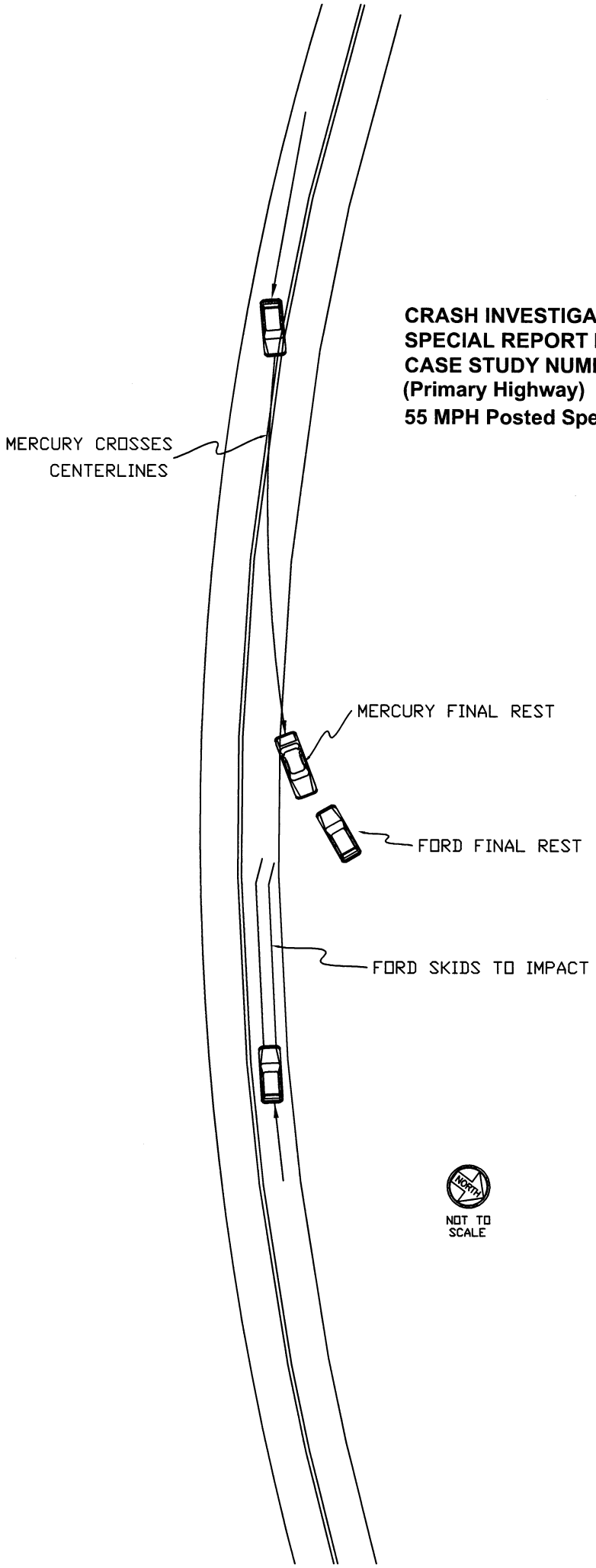
In conclusion, this traffic crash illustrates the dangers and hazards of not being belted and being involved in a fixed object collision. Had the driver been wearing her

safety belt, she would not have been ejected and she probably would have survived this collision with only moderate injuries. This fatal crash resulted in the estimated financial loss of nearly one million dollars. However, the tragic loss of this 22-year-old driver is incalculable to the emotional suffering and pain that will be experienced by her family and friends.

***Photo #11- Damage to the right side of the 2004 Volkswagon Passat. This is the area of contact with the three trees. The unbelted, fatally injured driver was ejected through the right front door. She was found underneath the car's left rear door area.***

***Photo #12- Closer view of the damage to the right rear side of the Volkswagon. The left side and driver's interior areas were not damaged in the collision with the trees and subsequent travel down the steep embankment.***

**CRASH INVESTIGATION TEAM**
**SPECIAL REPORT NUMBER 17**
**CASE STUDY NUMBER 7**
**(Primary Highway)**
**55 MPH Posted Speed Limit**



## CASE STUDY NUMBER 7

| | |
|---|---|
| **Type of Crash:** | Two vehicle, head-on collision |
| **Vehicles Involved:** | 1989 Mercury Cougar, two door sedan<br>2002 Ford Focus, four door sedan |
| **Roadway:** | Rural primary highway |
| **Severity:** | One fatality **(unbelted driver),** one serious injury **(unbelted passenger)** and one moderate injury **(belted driver)** |

**SUMMARY:**

On a cloudy, dry Thursday evening in April at 8:00 p.m., a 2002 Ford Focus was traveling west on a two lane, undivided, rural highway. The unlighted roadway is asphalt paved in excellent condition and posted with a 55 mph speed limit sign. The pavement is 22 feet-four inches wide and marked with double solid yellow centerlines and solid white edge lines. Bordering the road are narrow, unimproved gravel/sod shoulders and deep ditch lines ranging in width and depth of four to six feet. The roadway is constructed on a moderately sharp and level, four-degree curve about 800 feet long. Trees and brush are located adjacent to the ditch lines and berms. The Focus was driven by its' unbelted 20-year-old owner who was familiar with both the roadway and vehicle. Accompanying the driver was her 35-year-old female passenger seated in the right front who was also not belted. Both occupants were returning home, located about six miles away from friends they had visited, when the crash occurred.

As the Ford began rounding the right hand curve, its driver noticed the presence of eastbound headlights coming toward her. The headlights belonged to a 1989 Mercury Cougar, which had entered the curve from the opposite end and was initially in its' correct lane of travel. The Cougar was driven by its' lone occupant, a 25-year-old male who owned the vehicle. The driver was properly wearing the car's separate lap belt and motor driven shoulder belt. He was returning home after visiting friends, where he had been drinking alcoholic beverages. As the cars approached, the Cougar crossed the

centerlines and entered the westbound lane. Without any evasive action by its driver, the wrong-way Cougar was now on a collision course with the Ford Focus.

The Ford's driver, aware of the impending collision, braked hard, causing the car's wheels to lock up and its' tires to slide on the pavement. At the last instant, she also steered to her right in an unsuccessful attempt to avoid a collision. After skidding about 25 feet, and with the Ford's right side tires nearing the right edge of the pavement in the westbound lane, the two cars collided head on. The collision was so great that the front ends of both cars collapsed immediately. The larger, heavier Cougar, weighing about 3600 pounds and having more momentum than the smaller Focus, stopped the forward movement of the Ford almost instantly and began to push it eastward. The Cougar traveled about 15 feet and came to a stop with its' front on the edge of the eastbound lane, positioned at a slight angle toward the shoulder. The Focus, weighing about 2600 pounds, was pushed backwards off the pavement, where it traveled down the six-foot-deep embankment and came to a rest about 20 feet from the Cougar. It was still facing the roadway at a slight angle. None of the car's occupants were ejected in the impact or the post-crash movement.

A passing motorist who came by the scene just as the collision occurred called authorities and stopped to offer assistance. Other motorists were stopping at the site by the time the investigating State Trooper and two rescue squad vehicles responded moments later.

Due to the severe frontal collapse and damage to the Focus, its' two unbelted occupants had to be extricated from the vehicle. The Ford sustained complete front end damage which shortened its' left side length by 20 inches and the right side by 17 inches. Inside the vehicle, both frontal airbags deployed on impact. However, the unbelted occupants were propelled over the inflating airbags. The steering wheel collapsed when the driver's chest struck it during the collision. The lower dashboard also collapsed from contact with her knees. A "spider web" contact damage pattern occurred when the driver's head struck the windshield. The car's right front interior displayed obvious

collision impact points from the Ford's unbelted passenger striking the dashboard. The rescuers cut the car's A&B posts and peeled back the top to remove the occupants. The Ford's occupants were stabilized at the scene and taken via ambulance about 40 minutes after the squads' arrival, to the area hospital located about 20 miles away. Both occupants were unconscious and sustained serious, multiple head, chest and extremity injuries. The injuries to the driver would prove fatal.

The Cougar also sustained major frontal, structural damage in the collision. Its' front end had been shortened on the left side by 30 inches and nearly 24 inches on the right side. The right front corner had been pulled around toward the left four inches off its' normal shape denoting that the Cougar experienced some rotation during impact. The Cougar driver's shoulder belt had to be cut by medical personnel in order to remove him from the vehicle. The Cougar's steering wheel was collapsed by the driver's hands and chest during the collision. This car was not equipped with airbags. The driver, although belted, still sustained compression injuries to his chest and was taken via ambulance to the local hospital where he was treated.

The investigating Trooper completed his on-scene examination and had the site cleared about 1-½ hours after the crash occurred. He then traveled to the hospital to check on the victims and to obtain a statement from the Cougar driver. While there, he realized that the Cougar driver was intoxicated and thus charged him with driving under the influence.

**DISCUSSION:**

The Focus driver died at the hospital emergency room nearly three hours after the crash occurred. The cause of death was blunt force injuries to her chest. She also sustained a fractured neck, probably from impact with the deploying airbag when she was thrown into it during the collision. She had also fractured each femur from impact with the dashboard and suffered numerous abrasions and lacerations. The passenger survived the collision with serious head and chest injuries, requiring her to be hospitalized for about two weeks after the crash.

The Cougar driver survived the collision with the least serious injuries of the three. He was hospitalized for 5 days and then released. He sustained multiple injuries to his chest from striking the steering wheel, even though he was belted. Due to the normal stretch of the belt's webbing and some spool-out from the belt's reel system, he still came forward upon impact and collided with the steering wheel. However, had he not been belted, he would have certainly struck the steering wheel with a much greater force and probably hit the windshield. Considering the impact speeds of the vehicles, estimated at about 45-50 mph for the Cougar and 30 mph for the Ford, the Cougar driver would have probably sustained fatal injuries if he had not been belted in this head-on collision. Had the Ford passenger been wearing her safety belt, she would have undoubtedly sustained far less serious injuries. The Ford driver's chances of surviving this collision would have increased had she been belted; especially considering the presence of an airbag in her vehicle. However, airbags are supplemental restraints, which are most effective when the driver is safety belted.

In conclusion, this serious crash is an excellent example of the differences between belt use and non-use in a head-on collision. By virtue of the Cougar driver being belted, he survived the crash. The unbelted occupants inside the Ford sustained fatal injuries to the driver and life threatening injuries to the passenger. This crash resulted in estimated economic losses of about $977,000 for the Ford driver and nearly $337,000 for the passenger. The Cougar driver's total estimated economic costs were estimated at nearly $67,000. These figures apply to the anticipated average medical, emergency services, market productivity, property damages, insurance, workplace and legal costs associated with crash statistics. The emotional and personal losses experienced by the Ford driver's family and friends cannot be estimated.

***Photo #13- Damage to the right side and front of the 1989 Mercury Cougar caused from the head-on collision. (The front tires/wheels had been removed). The belted driver survived the collision.***

***Photo #14- Damage to the front and left side of the 2002 Ford Focus from the head-on collision. Both unbelted front seat occupants received multiple, serious injuries in the collision. The unbelted driver died as a result of the crash.***