

**TRANSPORTATION SCIENCES  
CRASH DATA RESEARCH CENTER**

Veridian Engineering  
Buffalo, NY 14225

**OFFICE OF DEFECTS INVESTIGATION**

**2000 FORD CROWN VICTORIA POLICE INTERCEPTOR REAR IMPACT CRASH**

**VERIDIAN CASE NO: CA03-002**

**LOCATION: NEW YORK**

**CRASH DATE: DECEMBER, 2002**

Contract No. DTNH22-01-C-17002

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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<p>16. <i>Abstract</i> This investigation focused on the cause of a crash-induced fire in a 2000 Ford Crown Victoria Police Interceptor that resulted in the death of a 31 year old male New York State Police Trooper. The Ford Crown Victoria was involved in a high speed rear-end crash with a 2002 Jeep Grand Cherokee that was traveling in excess of the posted speed limit. The force of the crash then displaced the Ford forward into a secondary chain-reaction collision with three other vehicles. At the time of the crash, the New York State Trooper was sitting in the stopped Ford completing a traffic crash report that involved those secondary vehicles. The ensuing fire hampered rescue of the officer resulting in his death. The 20 year old male driver of the Jeep and a pedestrian were also fatally injured in the crash.</p> <p>The Special Crash Investigations team at Veridian Engineering notified the Crash Investigations Division (CID) of the National Highway Traffic Safety Administration (NHTSA) of the crash on the evening of December 20, 2002. NHTSA's Office of Defect Investigations (ODI) requested that the CID assign an on-site investigation of the crash to the Special Crash Investigations Team at Veridian Engineering. The investigation was conducted to provide supplemental information to the defect investigation closed by ODI in October 2002. The Ford Crown Victoria and Jeep Grand Cherokee had been impounded on the date of the crash and were available for inspection. A joint inspection was conducted January 17, 2003 and was attended by technical representatives from Ford Motor Company, the NYSP and other state agencies.</p>			
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**OFFICE OF DEFECTS INVESTIGATION  
2000 FORD CROWN VICTORIA POLICE INTERCEPTOR REAR IMPACT CRASH**

**VERIDIAN CASE NO: CA03-002  
LOCATION: NEW YORK  
CRASH DATE: DECEMBER, 2002**

***BACKGROUND***

This investigation focused on the cause of a crash-induced fire in a 2000 Ford Crown Victoria Police Interceptor that resulted in the death of a 31 year old male New York State Police Trooper. The Ford Crown Victoria was involved in a high speed rear-end crash with a 2002 Jeep Grand Cherokee that was traveling in excess of the posted speed limit. The force of the crash then displaced the Ford forward into a secondary chain-reaction collision with three other vehicles. At the time of the crash, the New York State Trooper was sitting in the stopped Ford completing a traffic crash report that involved those secondary vehicles. The ensuing fire hampered rescue of the officer resulting in his death. The 20 year old male driver of the Jeep and a pedestrian were also fatally injured in the crash.

The Special Crash Investigations team at Veridian Engineering notified the Crash Investigations Division (CID) of the National Highway Traffic Safety Administration (NHTSA) of the crash on the evening of December 20, 2002. NHTSA's Office of Defect Investigations (ODI) requested that the CID assign an on-site investigation of the crash to the Special Crash Investigations Team at Veridian Engineering. The investigation was conducted to provide supplemental information to the defect investigation closed by ODI in October 2002. The Ford Crown Victoria and Jeep Grand Cherokee had been impounded on the date of the crash and were available for inspection. A joint inspection was conducted January 17, 2003 and was attended by technical representatives from Ford Motor Company, the NYSP and other state agencies.

***SUMMARY***

***Crash Site***

This multi-vehicle crash occurred during the evening hours of December, 2002. At the time, the weather was cloudy and was not a factor in the crash. The road surface was dry. The crash occurred on the northbound lanes of a north/south divided state highway in a commercial setting. The northbound highway consisted of four 3.7 m (12.0 ft) lanes. A 3 m (10 ft) wide breakdown lane and a box-beam guardrail bordered the east road edge. There was a large radius left curve and a negative grade (estimated greater than two percent) for the northbound traffic. Approximately 60 m (200 ft) north of the crash scene, the outboard travel lane transitioned into an exit ramp from the highway. The speed limit in the area of the crash was 89 km/h (55 mph). **Figure 1** is a northbound trajectory view approaching the crash scene.



**Figure 1: Northbound trajectory view approximately 46 m (150 ft) south of the point of impact.**

## ***CRASH SEQUENCE***

### ***Pre-Crash***

At an unknown time prior to the subject crash, a minor front-to-rear, property damage only, crash involving a 1990 Ford Crown Victoria and a 1997 Toyota Camry occurred in the outboard northbound travel lane of the highway. This crash occurred due to a back-up in traffic on the exit ramp located north of these vehicles. A New York State Trooper was dispatched to this traffic crash to investigate. The Trooper was in the fifth hour of his work shift and reportedly, was patrolling the area by being called out of the station. The subject Police Interceptor was not his normal shift vehicle. The records regarding the vehicle's refuel history were not available. The best estimate regarding the vehicle's last fuel stop was within 2 to 4 days prior to the crash and the best estimate regarding the Ford's fuel level provided by the investigating NYSP was approximately one half of a full tank.

The NYS trooper pulled to a stop approximately 3.7 m (12 ft) behind the 1990 Ford Crown Victoria. The vehicles were located in the breakdown lane (right shoulder) and were approximately in-line with one another. A tow truck responding to the crash was positioned in front of the Toyota Camry. The tow truck operator was in the process of hooking his truck to the Camry. The 50 year old male driver of the Toyota was standing between the back plane of the Toyota and front plane of the 1990 Ford. The location of the 61 year old male driver of the 1990 Ford was not known. The 31 year old male Trooper was seated in his 2000 Ford Crown Victoria Police Interceptor in the process of writing the traffic crash report.

The 2002 Jeep Grand Cherokee was northbound on the inboard travel lane approaching the stopped vehicles. Witnesses reported the Jeep was being driven recklessly and at a high rate of speed [an estimated 113-129 km/h (70-80 mph)]. The Jeep was driven by a 20 year old unrestrained male. The police investigation determined this driver was alcohol impaired and was driving on a suspended license. The Jeep was also occupied by an 18 year old unrestrained male front right passenger, a 17 year old unrestrained male rear left passenger and a 20 year old

unrestrained rear right passenger. Coincident to the Jeep's travel, a 2000 Nissan Maxima, driven by a 50 year old male, was northbound in the left center lane.

Approximately 122 m (400 ft) south of the stopped Police Interceptor, the Jeep began to overtake the Nissan. For unknown reasons, the right frontal area of the Jeep sideswiped the left rear quarterpanel of a 2000 Nissan Maxima and drove up the left side of the vehicle, **Figure 2**. The force of the impact caused the Nissan to rotate counter-clockwise and its driver lost control. The Jeep then passed in front of the Nissan without redirection. However, the impact aired out the right front tire of the Jeep and the driver lost directional control. The drag of the deflated right front tire caused the Jeep to drift to the right during its northbound travel. The lack of directional control combined with the left road curvature displaced the Jeep laterally from the inboard lane to the outboard lane over its trajectory. The Jeep's pre-crash trajectory, **Figure 3**, was evidenced by a continuous scratch mark attributed to the right front wheel rim. The length of the scratch mark measured 58 m (190 ft) and led to the point of impact with the Police Interceptor.



**Figure 2: Nissan left rear view.**



**Figure 3: Trajectory of the Jeep evidenced by the RF scratch mark**

### ***Crash***

The front plane of the Jeep impacted the back plane of the 2000 Ford Police Interceptor in a 12/6 o'clock impact configuration. The Principle Direction of Force was an estimated 190 to 195 degrees with respect to the Ford. The momentum of the Jeep caused it to then override the rear aspect of the Ford as it was accelerated forward. The force of the impact severely crushed the Ford's left rear quarterpanel and trunk, and buckled the rear frame members. The override forced the rear aspect of the Ford down to the pavement. A tire scuff identified during the police investigation was attributed the left rear tire of the Ford and identified the point of impact. A pattern of pavement gouges was also identified leading away from the point of impact. **Figure 4** is a view of the point of impact.

The Ford's drive shaft buckled and separated from the differential, forward of the companion flange. During the vehicle's deformation, the rear axle of the Ford rotated counterclockwise (with respect to the left side of the vehicle). This rotation allowed the differential's input shaft to contact the pavement and presented the rear cover of the differential to the front wall of the fuel

tank. Contact between the front wall of the tank and the differential cover punctured the center aspect of the tank. The deformed left rear sway bar bracket and left rear shock absorber mount punctured the left side of the tank as it was crushed forward. A crash induced fire ignited and was fed by the punctured fuel tank. The Jeep and Ford Police Interceptor remained in sustained contact and became engaged. Reportedly, the vehicles had to be separated by tow trucks. **Figure 5** is a view of the final rest location of the Jeep and Police Interceptor.



**Figure 4: Point of impact.**



**Figure 5: Final rest position of the Jeep and Ford CVPI.**

The impact momentum of the Jeep displaced the 2000 Ford Police Interceptor forward into a secondary collision with the 1990 Ford Crown Victoria. The front plane of the 2000 Police Interceptor impacted and overrode the back plane of the 1990 Ford causing the crush and displacement of its trunk lid to the backlight, **Figure 6**. The 1990 Ford in-turn was displaced forward and impacted the back plane of the Toyota Camry, **Figure 7**. These vehicles remained in sustained contact and the front aspect of the Toyota then impacted work boom of the tow truck. The driver of the Toyota was standing in front of the 1990 Ford during this secondary collision sequence and was struck by the front of the vehicle, wrapping onto the hood, and then displaced into the Ford's windshield. This driver was fatally injured as a result of this impact. The operator of the tow truck was in the process of hooking up to the Toyota and was also injured in this secondary collision sequence. A schematic of the crash developed by the NYSP is attached as **Figure 22** at the end of this report.





**Figure 6: Left rear view of the 1990 Ford.**



**Figure 7: Front view of the Toyota Camry.**

### ***Post-Crash***

All the individuals involved in this multi-vehicle/multiple impact crash were incapacitated in some manner and no one was immediately available to render aid to the Trooper trapped in the Police Interceptor. Upon arrival of the responding police, fire, and ambulance personnel the crash induced fire had engulfed the 2000 Ford and the vehicle was not approachable. Reportedly, the responders removed the four occupants of the Jeep and then that vehicle also became engulfed in the fire. The Ford Police Interceptor burned forward; the fire damage terminating at the A-pillars. The Jeep was completely burned.

The Trooper's cause of death was certified as asphyxia due to inhalation of smoke containing carbon monoxide. In addition, he suffered burns of the body, rib and vertebra fractures (not further specified) and a liver laceration.

The driver of the Jeep was pronounced dead at the hospital. Reportedly, he sustained multiple blunt chest and internal trauma as a result of unrestrained contact to the steering wheel/column. The other occupants of the Jeep sustained unknown minor injuries.

### **2000 FORD CROWN VICTORIA**

The 2000 Ford Crown Victoria, **Figure 8**, was identified by the Vehicle Identification Number (VIN): 2FAFP71W7YX (production sequence deleted). The 4-door, body on frame, sedan was equipped with the Police Interceptor Package. The power train consisted a 4.6 liter/V8 engine linked to a four-speed automatic transmission. The service brakes were four-wheel disc with ABS. The Ford's odometer reading and refuel history were not available.



**Figure 8: Left side view of the Ford.**

The complete collapse of the trunk space and total burn of the vehicle precluded identifying the contents of the trunk. An inventory of the contents was not taken.

### ***Exterior Damage***

**Figures 9 through 12** are an overhead, left lateral, right lateral and rear view of the damaged Ford, respectively. The back plane of the vehicle sustained severe impact damage that extended across its entire 142.2 cm (56.0 in) end-width. The damage was biased to the left side and extended longitudinally forward to the left B-pillar. The left rear door was crushed and buckled outward. The left C-pillar was crushed forward within 25 cm (10 in) of the left B-pillar. The left front door was jammed shut and removed by extrication. The left A-pillar and B-pillar were cut during its removal. The right doors were fully intact and were jammed shut due to the deformation of the vehicle's frame. The trunk space collapsed and its contents completely crushed. The deformation extended forward through the rear occupant space to approximately the front seat backs. The intrusion of the mid-aspect of the left rear seat frame measured 73.2 cm (28.8 in). The fire consumed everything rearward of the instrument panel.

The force of the impact deformed and buckled the rear frame members. The deformation of the trailing end of the left and right frame measured 177.8 cm (70.0 in) and 80.0 cm (31.5 in), respectively. The left wheelbase was foreshortened 95.0 cm (37.4 in). The right wheelbase was foreshortened 9.7 cm (3.8 in). The longitudinal deformation at the upper aspect of the C-pillars was 30.7 cm (12.1 in) and 6.7 cm (2.6 in), measured at the left and right aft corners of the roof respectively.

The crush profile of the Ford was measured along the rear bumper reinforcement beam. The residual crush profile was as follows: C1 = 184.7 cm (72.7 in), C2 = 182.3 cm (71.8 in), C3 = 178.6 cm (70.3 in), C4 = 88.1 cm (34.7 in). The Collision Deformation Classification (CDC) was 06-BDEW-6. The total Delta V of the Ford calculated by the Damage Algorithm of the WINSMASH model was 73.0 km/h (45.4 mph). The longitudinal and lateral components were +71.9 km/h (+44.7 mph) and +12.7 km/h (+7.9 mph), respectively. A conservative estimate of the Jeep's impact speed was approximately 113 – 121 km/h (70 – 75 mph) based on the Conservation of Momentum.



**Figure 9: Overhead view of the Ford.**



**Figure 10: Left lateral view of the extent of damage.**



**Figure 11: Right lateral view of the deformation.**



**Figure 12: Rear view of the Ford.**

The 2000 Ford also sustained front-end damage as a result of its impact and override of the 1990 Ford Crown Victoria. The direct contact damage extended across the entire 152 cm (60 in) frontal end width of the vehicle. The crush along the front bumper was uniform and measured 8 cm (3 in) on the vehicle's centerline. Due to the override, the extent of the damage was greater along the lower radiator support and measured 23 cm (9 in) on the vehicle's centerline. The CDC of this impact was 12-FDEW-1. This secondary multi-vehicle/multiple crash sequence altered the resultant crash dynamics and momentum transfer from the Jeep to the Police Interceptor as compared to a simple two-vehicle rear impact.

### ***2002 JEEP GRAND CHEROKEE***

The 2002 Jeep Grand Cherokee was a four door, 4-wheel drive sport utility vehicle with a 269 cm (105.9 in) wheelbase. The vehicle sustained severe impact damage that extended across its entire 158 cm (62 in) front-end width as a result of the impacts with the Nissan and the Ford. The forward aspect of the right frame was buckled and the right wheelbase was reduced 21.3 cm (8.4 in). The left wheelbase lengthened 4.6 cm (1.8 in) due to a rotation of the front axle. The left front door and both right side doors were jammed shut by the impact force. The left rear door was opened by extrication. The right A-pillar was displaced rearward and caused the roof to buckle. The residual crush profile measured along the bumper reinforcement bar was as follows: C1 = 58.2 cm (22.9 in), C2 = 38.9 cm (15.3 in), C3 = 39.1 cm (15.4 in), C4 = 30.5 cm (12.0 in), C5 = 17.3 cm (6.8 in), C6 = 26.9 cm (10.6 in). The Collision Deformation Classification of the overlapping damage patterns was 12-FDEW-3. The total delta V calculated by the Damage Algorithm of the WINSMASH was 69.0 km/h (42.9 mph). **Figures 13 and 14** are the front left and right lateral views of the Jeep.



**Figure 13: Left front view of the Jeep.**



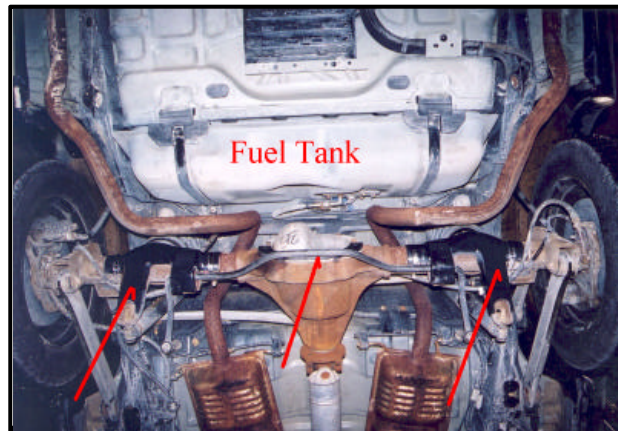
**Figure 14: Right lateral view.**

## 2000 FORD CROWN VICTORIA

### Fuel System

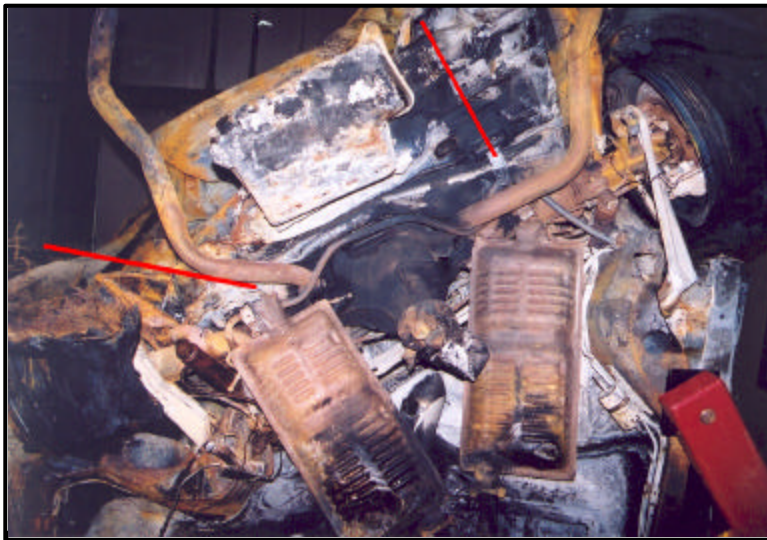
**Figure 15** is an undercarriage view of an exemplar 2000 Ford Crown Victoria Police Interceptor depicting the layout of the rear suspension and fuel tank. The front of the vehicle is toward the bottom of the photograph. The fuel tank is located immediately forward of the trunk well, approximately 25 cm (10 in) behind the rear axle. The tank is secured to the front wall of the trunk by two band straps attached to the upper and lower aspects of the wall. The tank is metal construction and had a capacity of approximately 72 liters (19 gallons). The fuel level in the subject vehicle was not known at the time of this report.

It should be noted that a retrofit kit provided by Ford Motor Company had been installed on the exemplar vehicle. The kit was comprised of two molded plastic shields that cover the shock mount and sway bar brackets on the respective sides of the vehicle, and a rubber guard that covered the lower rear aspect of the differential cover. The purpose of the kit was to provide a layer of protection between the fuel tank and the offending rear axle/suspension components during a rear impact. The arrows in the figure denote the components of the retrofit kit. This retrofit kit was not installed on the subject Ford Crown Victoria.



**Figure 15: Undercarriage view of an exemplar 2000 Ford Crown Victoria.**

**Figure 16** is an overall undercarriage view of the subject Ford. The front of the vehicle is located at bottom of the photograph and can be compared to the exemplar vehicle in Figure 15. The arrows in the figure denote the locations of the tank straps. **Figure 17** is a close up view of the residual location of the deformed tank. The extensive crush reduced the trunk's volume to near zero and displaced the tank forward. The force of the collision buckled the drive shaft and it separated from the differential. The rear axle rotated down and the differential cover contacted and punctured the center aspect of the deforming fuel tank. The left sway bar bracket and left shock absorber mount contacted and punctured the left side of the tank. The procedure to grind the tabs on the sway bar bracket referenced in the Technical Safety Bulletin (TSB) issued by Ford on October 21, 2001 had been completed on the subject vehicle.



**Figure 16: Undercarriage view of the deformation.**



**Figure 17: Close-up of the deformed tank.**

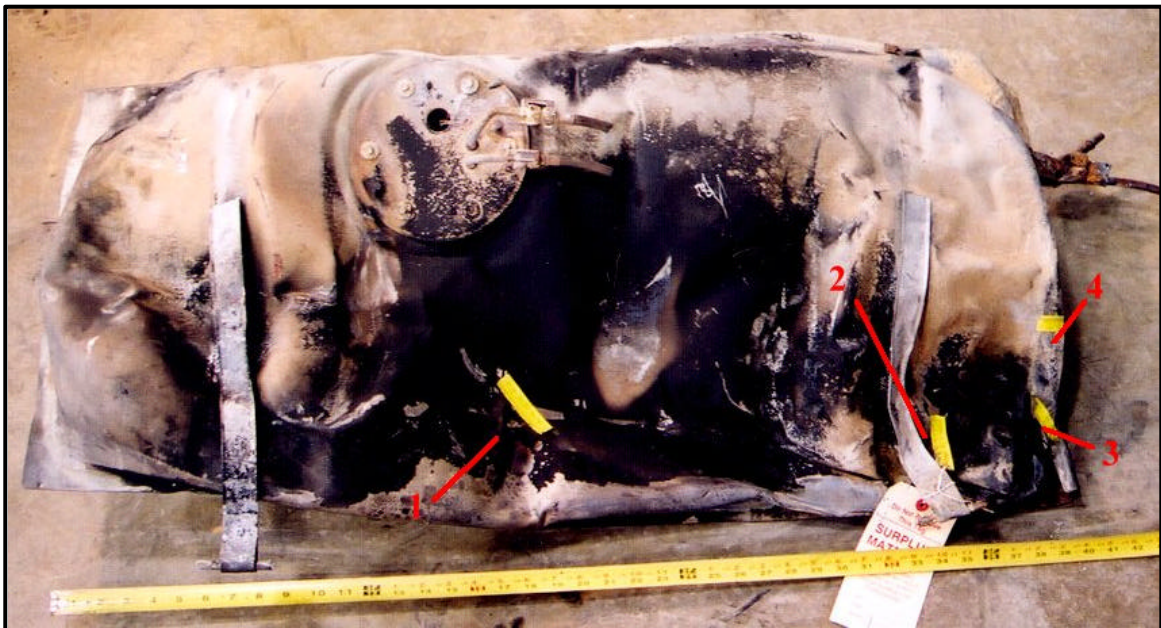
During the inspection of the Ford, a vehicle autopsy was conducted in order to access and remove the fuel tank. This procedure involved removing the deformed exhaust system and rear axle. The rear axle was removed as a complete assembly. Removal of these components allowed access to the tank carry straps. The straps were then cut as high above the level of deformation as possible. Due to buckling, the rear frame members had to be spread laterally by a hydraulic ram in order for the tank to be removed. The filler neck routed within the deformed left rear quarter panel hampered direct removal of the tank and it had to be cut. There was no separation of the filler neck from the tank during the impact sequence. The end of the filler neck

was displaced forward 139.4 cm (54.9 in) by the crash forces. Post-crash, it was located approximately 15 cm (6 in) behind the driver's seat and 15 cm (6 in) inboard of the left B-pillar, **Figure 18**.



**Figure 18: Residual location of the filler neck.**

**Figure 19** is a view of the front side of the fuel tank. The left side of the tank is on the right. A distinct burn pattern was noted. The tank was punctured in four locations denoted by the arrows. The table below summarizes the size of the puncture and the component that punctured the tank.



**Figure 19: View of the front side of the fuel tank.**

Puncture	Size	Contacting component
1	22.2 x 19.1 mm (7/8 x 3/4 in)	Rear differential
2	41.3 x 6.4 mm (1-5/8 x 1/4 in)	Left tank strap and sway bar bracket
3	19.1 x 19.1 mm (3/4 x 3/4 in)	Left rear shock mount
4	3.2 x 3.2 mm (1/8 x 1/8 in)	Left rear shock mount

Figures 20 and 21 are views of the rear axle and fuel tank after removal and depict their probable interaction. Ford's retrofit kit places shields over all the components that damaged the tank in this crash, however the kit was not installed on the subject vehicle.



Figure 20: Right view along the rear axle.



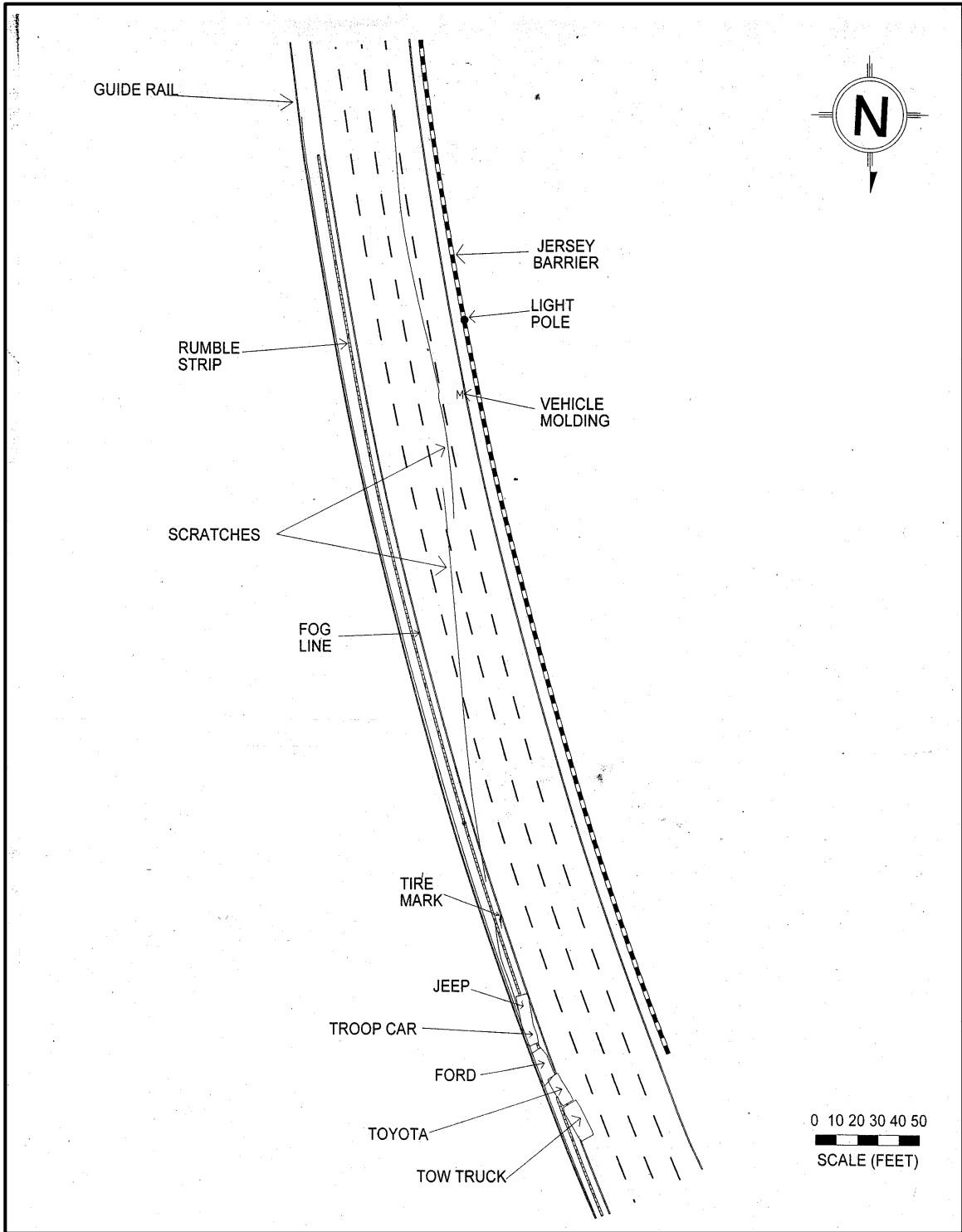
Figure 21: Left view along the rear axle.

### ***DRIVER INJURIES***

The County Medical Examiner conducted a post-mortem examination with autopsy the day following the crash. The Medical Examiner certified the Trooper's cause of death as: Asphyxia due to inhalation of smoke containing carbon monoxide, burns of the body, rib and vertebra fractures (not further specified) and a liver laceration. The driver's death was related to the crash induced fire. The skeletal fractures and liver laceration resulted from the driver's unrestrained contact to the interior during the impact sequence. The coded injuries are identified in the following table:



<i>Injury</i>	<i>Injury Severity (AIS update 98)</i>	<i>Injury Mechanism</i>
Asphyxia due to inhalation of smoke containing carbon monoxide	Moderate (919200.2,0)	Crash induced fire
Burns of the body, NFS	Minor (992000.1,9)	Crash induced fire
Rib fractures, NFS	Minor (450299.1,9)	Unknown interior contact
Liver laceration, NFS	Moderate (541820.2,1)	Unknown interior contact



**Figure 22: NYSP Crash Schematic.**