

CRASH DATA RESEARCH CENTER

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CALSPAN ON-SITE ROLLOVER CRASH INVESTIGATION

CALSPAN CASE NO.: CA04-049

LOCATION: VIRGINIA

VEHICLE: 2002 CADILLAC ESCALADE

CRASH DATE: OCTOBER 2004

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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TABLE OF CONTENTS

BACKGROUND	1
SUMMARY	1
VEHICLE DATA	2
2002 CADILLAC ESCALADE.....	2
CRASH SEQUENCE.....	2
PRE-CRASH.....	2
CRASH.....	3
POST-CRASH	3
VEHICLE DAMAGE	3
EXTERIOR.....	3
INTERIOR	4
ELECTRONIC STABILITY CONTROL SYSTEM	5
REDESIGNED FRONTAL AIR BAGS	5
SIDE IMPACT AIR BAGS	5
MANUAL SAFETY BELT SYSTEMS	5
OCCUPANT DEMOGRAPHICS/DATA	6
DRIVER	6
DRIVER KINEMATICS	6
FRONT RIGHT PASSENGER.....	6
FRONT RIGHT PASSENGER INJURIES.....	7
FRONT RIGHT PASSENGER.....	7
SECOND ROW LEFT PASSENGER.....	7
SECOND ROW LEFT PASSENGER.....	7
SECOND ROW CENTER PASSENGER.....	8
SECOND ROW CENTER PASSENGER.....	8
SECOND ROW RIGHT PASSENGER.....	8
SECOND ROW RIGHT PASSENGER.....	9
THIRD ROW LEFT PASSENGER.....	9
THIRD ROW LEFT PASSENGER.....	9
THIRD ROW RIGHT PASSENGER	9
THIRD ROW RIGHT PASSENGER	10
FIGURE 6: SCENE SCHEMATIC	11

CALSPAN ON-SITE ROLLOVER CRASH INVESTIGATION
CASE NO.: CA04-049
VEHICLE: 2002 CADILLAC ESCALADE
LOCATION: VIRGINIA
CRASH DATE: OCTOBER 2004

BACKGROUND

This on-site investigate effort focused on the crash severity, rollover dynamics, and the injury sources that contributed to the death of the 17-year old female front right passenger of a 2002 Cadillac Escalade (**Figure 1**). The Cadillac was equipped with Stabilitrack, an electronic stability control system, redesigned frontal air bags, and seat back mounted side impact air bags for the driver and front right passenger positions. The Cadillac was involved in a single vehicle rollover crash on an interstate roadway during daylight hours. The air bags did not deploy in this crash. The front right passenger of the Cadillac expired at the scene of the crash. The 16-year old female driver and five additional teenage female passengers sustained minor severity injuries and were treated and released at a local hospital.



Figure 1. 2002 Cadillac Escalade subject vehicle.

An Internet news article of the crash was forwarded by NHTSA to the Calspan Special Crash Investigations team for follow-up and potential on-site investigation. Due to the on-road rollover and the presence of the Stabilitrak system on the Cadillac, the case was assigned for an SCI investigation on November 23, 2004. The vehicle and crash site were inspected on December 3, 2004.

SUMMARY

The crash occurred on the southbound lanes of a north/south interstate during daylight hours. The three southbound travel lanes were constructed of asphalt and were delineated by broken white lane lines. The travel lanes were bordered by asphalt shoulders on the east and west roadsides. A concrete median barrier wall divided the roadway. The posted speed limit was 89 km/h (55 mph). Due to the passage of time between the crash date and the investigation date, there was no remaining physical evidence at the crash site to support the vehicle's trajectory. The scene schematic is included as **Figure 6** of this report.

Vehicle Data

2002 Cadillac Escalade

The subject vehicle, a 2002 Cadillac Escalade, was identified by the Vehicle Identification Number (VIN) 1GYEK63N22R (production number deleted). The odometer reading at the time of the SCI inspection was 52,272 kilometers (32,481 miles). The Cadillac was a four-door sport utility vehicle equipped with a 6.0 liter V-8 engine linked to a four-speed automatic transmission. Additionally, the Cadillac was equipped with Stabilitrak and traction control. The service brakes were four-wheel disc with anti-lock. The vehicle was equipped with Goodyear Wrangler HP P265/70R17 tires on OEM alloy rims. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Damage
Left Front	0 kPa	4 mm (5/32")	De-beaded with rim fractures
Left Rear	172 kPa (25 PSI)	3 mm (4/32")	Rim abrasions
Right Front	214 kPa (31 PSI)	4 mm (5/32")	Rim abrasions
Right Rear	0 kPa	4 mm (5/32")	De-beaded with rim fractures

The interior of the Cadillac was configured with leather front bucket seats and three-passenger second and third row bench seats. The front and second row outboard seats were equipped with height adjustable head restraints that were adjusted to the full-down positions at the time of the SCI inspection. The third row was equipped height adjustable head restraints for the outboard positions. The left head restraint was adjusted to the full-up position and the right was adjusted to the full-down position at the time of the SCI inspection.

Crash Sequence

Pre-Crash

The 16-year-old female driver of the Cadillac was operating the vehicle southbound in the center lane (**Figure 2**) at a police reported speed of 105 km/h (65 mph). The vehicle was also occupied by six teenage females that were seated in the front right, second row, and third row (2/3/2). The driver attempted to change lanes from the center to the left lane. As the vehicle entered the left travel lane, the driver applied a sudden right steering input that resulted in a loss of directional control. The left side tires rolled under the alloy wheels exposing the rims to the asphalt road surface.



Figure 2. Southbound travel direction of the Cadillac.

Crash

The left side alloy rims contacted the asphalt road surface resulting in a tripped left side leading rollover. The vehicle rolled four-quarter turns and came to rest on the center travel lane facing in a westerly direction (**Figure 3**). The total distance from the rollover initiation to final rest was approximately 13 meters (40 feet). Due to the passage of time and the heavily traveled interstate roadway, there was no physical evidence remaining at the crash site



Figure 3. Area of rollover and final rest.

Post-Crash

Emergency Medical Service (EMS) and police personnel responded to the crash site. The 16-year old female driver and five additional teenage female rear seat passengers sustained minor severity injuries and were treated and released at a local hospital. The 17-year-old female front right passenger sustained fatal injuries and was pronounced deceased at the crash site. The Cadillac was towed from the crash site and was consequently deemed a total loss by the insurance company.

Vehicle Damage

Exterior

The Cadillac sustained moderate severity damage to all four planes as a result of the four quarter-turn rollover event. The area of greatest crush was located along the right roof side rail. The direct contact damage measured 244 cm (96") and extended from the right A-pillar to the right D-pillar. The maximum crush measured 13 cm (5.1") and was located at center of the right front door on the roof side rail. A crush profile was documented along the full length of the roof side rail (**Figure 4**). The six crush measurements were as follows: C1 = 5 cm (2"), C2 = 4 cm (1.6"), C3 = 7 cm (2.8"), C4 = 9 cm (3.5"), C5 = 10 cm (3.9"), C6 = 12 cm (4.7"). The Collision Deformation Classification for this event was 00-TDDO-3.



Figure 4. Overall view of the crush to the roof side rail.

The side doors and tailgate remained closed during the crash. The right front door was pried opened by rescue personnel post-crash. The remaining side doors were operational post-crash. The tailgate was jammed in the closed position post-crash. The windshield fractured during the crash. Due to the weight of the glazing, it separated creating a large opening across the top aspect. The sunroof, right side, and rear glazing were

disintegrated. Additionally, the left front and third row glazing disintegrated and the left rear door glazing remained intact.

Interior

The interior of the Cadillac sustained severe damage as result of intrusion and occupant contact points. The driver’s area consisted of a contact point at the left A-pillar which was evidenced by body fluid and tissue. The right front passenger contact points consisted of hair, body fluid, and tissue that was located on the right A-pillar. Body fluid was noted on the top aspect of the right B-pillar and throughout the right front passenger space. Additionally, hair, tissue, and body fluid



Figure 5. Overall view of the front right area.

was found on the out side of the right front door. **Figure 5** is an overall view of the front right area.

An occupant contact point was observed on the left C-pillar above the D-ring. This contact consisted of a fracture of the plastic trim. Hair also evidenced the fracture location. A probable occupant contact point on the headliner over the third row seat was documented. This contact point was evidenced by a black colored scuff mark

The passenger compartment intrusions are listed in the following table:

Seat Position	Intruded Component	Magnitude	Direction
Front right	Roof	10 cm (3.9")	Vertical
Front right	A-pillar	10 cm (3.9")	Vertical
Front right	Roof rail	10 cm (3.9")	Vertical
Front right	Windshield header	8 – 15 cm (3.2 – 6")	Vertical
Second right	Roof side rail	8 – 15 cm (3.2 – 6")	Vertical
Front right	B-pillar	5 cm (2.0")	Vertical
Second right	Window frame	3 – 8 cm (1.2 – 3.2 “)	Vertical
Second right	Roof	2 cm (0.8")	Vertical
Third right	Roof side rail	4 cm (1.6")	Vertical
Third right	Roof	4 cm (1.6")	Vertical

Electronic Stability Control System

The Cadillac Escalade was equipped with Stabilitrak an Electronic Stability Control system (ESC). This Stabilitrak utilizes ABS, traction control, throttle, and braking systems to prevent yaw and maintain directional control. If wheel slipping is detected, it can apply braking to the slipping wheel(s) or increase/decrease throttle to keep the vehicle on its intended travel path. The control button was located on the center instrument panel for the Stabilitrak ESC system; however, the activation status of the system at the time of the crash was unknown.

Redesigned Frontal Air Bags

The 2002 Cadillac Escalade was equipped with a redesigned frontal air bag system. The driver's air bag was conventionally located in the center of the steering wheel. The front right air bag was a mid-mount in the front right instrument panel. The frontal air bags did not deploy during the rollover crash.

Side Impact Air bags

The Cadillac was equipped seat back mounted side impact air bag for the front seating positions. These air bags did not deploy during the rollover crash.

Manual Safety Belt Systems

The Cadillac was equipped with three-point lap and shoulder belt systems for the six outboard seated positions.

The front safety belts were integrated into the seatbacks and were equipped with continuous loop webbing and sliding latch plates. The driver's safety belt retracted onto an Emergency Locking Retractor (ELR) and the front right retracted onto a switchable ELR/Automatic Locking Retractors (ALR).

The front left safety belt was found in the stowed position and the retractor was operational. Although, the driver used the safety belt in the crash, no loading evidenced was noted on the belt system.

The front right safety belt was used during the crash and was found in the stowed position and had been cut by rescue personnel. The cut was full width and was located 20 cm (8.0") above the seat cushion. Body fluid was noted on the lap belt position of the safety belt and loading abrasions were present on the latch plate.

The two second row outboard safety belts were lap and shoulder restraints with fixed D-rings. Both safety belts were equipped with sliding latch plates and retracted onto a switchable ELR/ALR. The webbings were soiled from exposure to weather and dirt. No loading evidence was found on the outboard safety belts. The second row center safety belt was a manual two-point lap belt that utilized a locking latch plate and no retractor. Loading evidence that included stretching and green clothing transfers were noted on the webbing from use during the crash. A Lower Anchors and Tethers for Children (LATCH) system was available for rear seated passengers.

The third row was equipped with lap and shoulder belts for the outboard positions and a center two-point lap belt. The three belts exhibited no loading evidence from the crash. However, based on the lack of occupant contact points for the third row passengers and the lack of ejection, these passengers used the safety belt during the crash.

Occupant Demographics/Data

Driver

Age/Sex:	16-year-old/Female
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Mid to rear
Eyewear:	Unknown
Manual Safety Belt Usage:	Lap and shoulder belt
Usage Source:	Vehicle inspection
Egress from Vehicle:	Unknown
Mode of Transport from Scene:	Transported by ambulance to a hospital
Type of Medical Treatment:	Unknown

Driver Kinematics

The 16-year old female driver of the 2002 Cadillac was seated in an upright driving posture and was restrained by the integrated safety belt system. The driver steered left to change lanes and abruptly applied a right steering maneuver. As a result of the lateral motion, the driver was displaced to the left and loaded the left front door. The vehicle subsequently rolled over four quarter turns coming to final rest on its wheels. The driver of the Cadillac sustained police reported minor injuries and was transported to a local hospital. The driver could not be located for an interview. Furthermore, the medical facility refused to release the medical records that documented the driver's injuries.

Front Right Passenger

Age/Sex:	17-year-old/Female
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Mid to rear
Eyewear:	Unknown
Manual Safety Belt Usage:	Lap and shoulder belt
Usage Source:	Vehicle inspection
Egress from Vehicle:	Unknown
Mode of Transport from Scene:	Expired at the scene
Type of Medical Treatment:	None

Front Right Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Multiple skull fractures, NFS	Moderate (150400.2,9)	Intruding A-pillar
Left face abrasions, including left forehead, eye, nose, and mouth area	Minor (290202.1,2)	Intruding A-pillar
Laceration to right side of mouth extended to chin	Minor (290600.1,1)	Intruding A-pillar
Open wound to the posterior head, NFS	Minor (190600.1,6)	Intruding A-pillar
Abrasions to the posterior aspect of the left hand	Minor (790202.1,2)	Unknown
Laceration to the left big toe	Minor (890600.1,2)	Unknown

Source = Medical Examiner

Front Right Passenger

The 17-year old female front right passenger of the 2002 Cadillac was seated in an upright posture and was restrained by the safety belt system. The driver steered left to change lanes and abruptly applied a right steering maneuver. As a result of the lateral motion, the front right passenger was displaced to the left and loaded the center console. The vehicle subsequently rolled over four-quarter turns coming to final rest on its wheels. Due to the ground contact by the roof, the right front roof area intruded into the passenger compartment. The passenger moved forward and struck the intruding A-pillar with her head resulting in the multiple head and facial injuries. Additionally, the front right passenger sustained abrasions to the palm of the left hand and a laceration to the left first metacarpal.

Second Row Left Passenger

Age/Sex: 16-year-old/Female
Height: Unknown
Weight: Unknown
Seat Track Position: Not adjustable
Eyewear: Unknown
Manual Safety Belt Usage: Lap and shoulder belt
Usage Source: Vehicle inspection
Egress from Vehicle: Unknown
Mode of Transport from Scene: Transported by ambulance to a hospital
Type of Medical Treatment: Unknown

Second Row Left Passenger

The 16-year old female second row left passenger of the 2002 Cadillac was seated in an upright posture and was restrained by the safety belt system. The abrupt right steering

maneuver resulted in this passenger to moving laterally left. The subsequent rollover event resulted in minimal displacement of this passenger due to her belted status. She maintained her position within the passenger compartment. She sustained police reported minor injuries and was transported to a local hospital for treatment. The medical facility refused to release the medical records that documented the injuries for this passenger. This passenger could not be located for an interview.

Second Row Center Passenger

Age/Sex: 16-year-old/Female
Height: Unknown
Weight: Unknown
Seat Track Position: Not adjustable
Eyewear: Unknown
Manual Safety Belt Usage: Lap and shoulder belt
Usage Source: Vehicle inspection
Egress from Vehicle: Unknown
Mode of Transport from
Scene: Transported by ambulance to a hospital
Type of Medical Treatment: Unknown

Second Row Center Passenger

The 16-year old female second row center passenger of the 2002 Cadillac was seated in an upright posture and was restrained by the center lap safety belt system. This passenger was minimally displaced during the steering maneuvers. The subsequent rollover event resulted in minimal displacement of this passenger due to her belted status. She remained with the passenger compartment of the vehicle and sustained police reported minor injuries and was transported to a local hospital for treatment. The medical facility refused to release the medical records that documented the injuries for this passenger. Furthermore, this passenger could not be located for an interview.

Second Row Right Passenger

Age/Sex: 17-year-old/Female
Height: Unknown
Weight: Unknown
Seat Track Position: Not adjustable
Eyewear: Unknown
Manual Safety Belt Usage: Lap and shoulder belt
Usage Source: Vehicle inspection
Egress from Vehicle: Unknown
Mode of Transport from
Scene: Transported by ambulance to a hospital
Type of Medical Treatment: Unknown

Second Row Right Passenger

The 17-year old female second row right passenger of the 2002 Cadillac was seated in an upright posture and was restrained by the lap and shoulder safety belt system. Minimal displacement of this passenger occurred during the steering maneuvers. The subsequent rollover event did not result in significant displacement of this passenger due to her belted status. She was not ejected from the vehicle. This passenger sustained police reported minor injuries and was transported to a local hospital for treatment. The medical facility refused to release the medical records that documented the injuries for this passenger. Furthermore, this passenger could not be located for an interview.

Third Row Left Passenger

Age/Sex: 16-year-old/Female
Height: Unknown
Weight: Unknown
Seat Track Position: Not adjustable
Eyewear: Unknown
Manual Safety Belt Usage: Lap and shoulder belt
Usage Source: Vehicle inspection
Egress from Vehicle: Unknown
Mode of Transport from
Scene: Transported by ambulance to a hospital
Type of Medical Treatment: Unknown

Third Row Left Passenger

The 16-year old female third row left passenger of the 2002 Cadillac was seated in an upright posture and was restrained by the lap and shoulder safety belt system. During the crash sequence, she remained within the passenger compartment of the vehicle. She sustained police reported minor injuries and was transported to a local hospital for treatment. The medical facility refused to release the medical records that documented the injuries for this passenger. This passenger could not be located for an interview.

Third Row Right Passenger

Age/Sex: 16-year-old/Female
Height: Unknown
Weight: Unknown
Seat Track Position: Not adjustable
Eyewear: Unknown
Manual Safety Belt Usage: Lap and shoulder belt
Usage Source: Vehicle inspection
Egress from Vehicle: Unknown
Mode of Transport from
Scene: Transported by ambulance to a hospital
Type of Medical Treatment: Unknown

Third Row Right Passenger

The 16-year old female third row right passenger of the Cadillac was seated in an upright posture and was restrained by the lap and shoulder safety belt system. During the crash sequence she remained within the passenger compartment of the vehicle. She sustained police reported minor injuries and was transported to a local hospital for treatment. The medical records for this passenger were not obtained due to the medical facility refusal to release injury information. This passenger could not be located; therefore, an interview was not obtained.

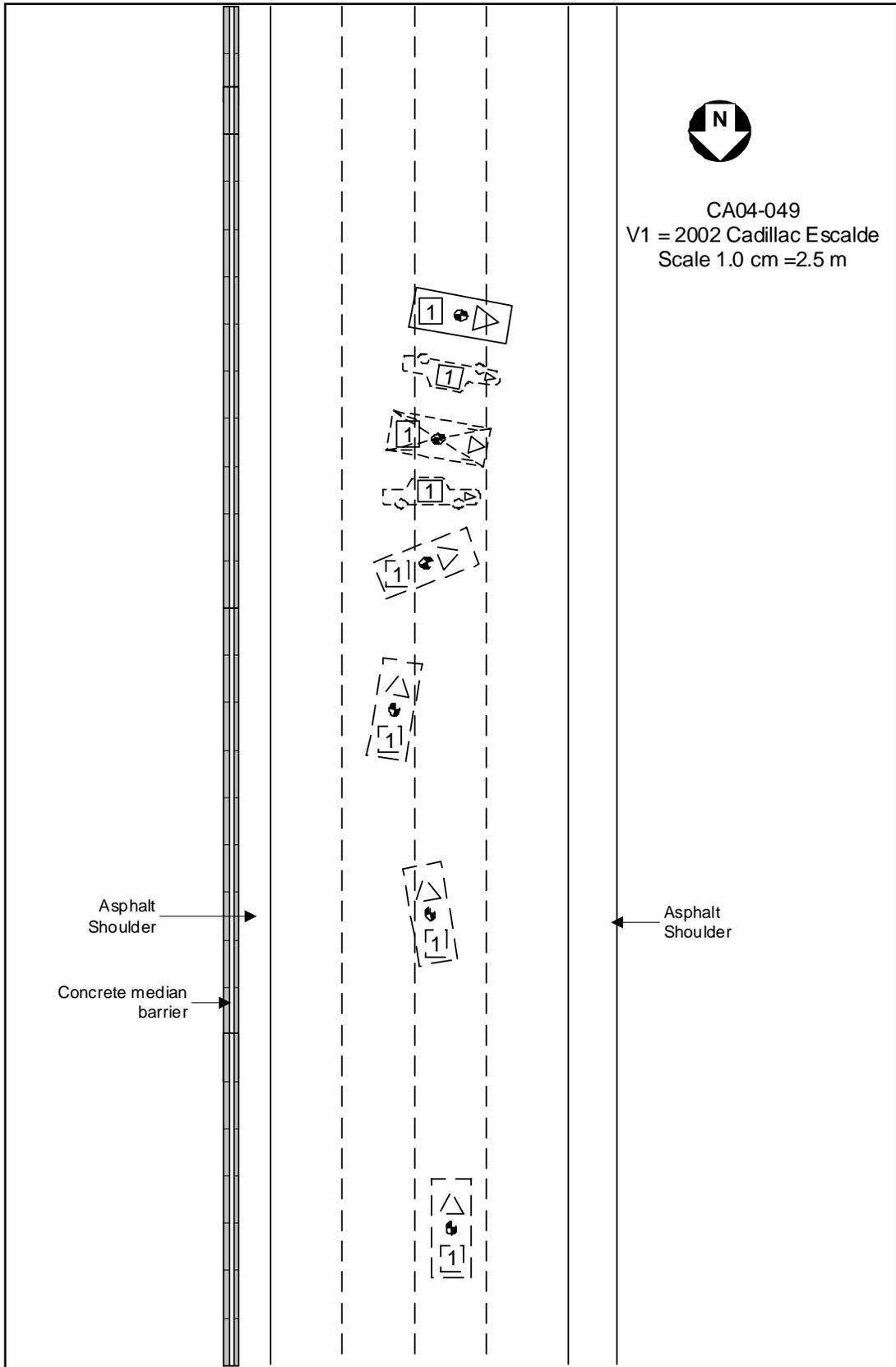


Figure 6: Scene Schematic