CRASH DATA RESEARCH CENTER

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CALSPAN ON-SITE CHILD SAFETY SEAT CRASH INVESTIGATION
CALSPAN CASE NO.: CA07-007

LOCATION: NEW JERSEY

VEHICLE: 1998 NISSAN QUEST

CRASH DATE: JANUARY 2007

Contract No. DTNH22-07-C-00043

Prepared for:

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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.

TECHNICAL REPORT STANDARD TITLE PAGE

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BACKGROUND

This on-site investigative effort focused on a Rear Facing Child Safety Seat (RFCSS), the injury sources for an 11-month-old female passenger, and the ejection of the RFCSS and the infant passenger. The infant passenger was restrained in the RFCSS in the second row left position of a 1998 Nissan Quest **(Figure 1)**. Additionally, the Nissan was occupied by a 21-year-old male driver, a 17-year-old female front right passenger, and a 23-year-old female second row right passenger. The Quest was involved in a moderate severity run-off-road rollover crash. During the rollover, the RFCSS and the infant passenger were ejected from the vehicle. As a result of the ejection, the 11-month-old female sustained critical injuries and was transported to a trauma center where she was pronounced deceased upon arrival. The driver sustained minor injuries and was transported to a trauma center where he was treated and released. The two adult female passengers sustained minor injuries and were transported to a local hospital where they were treated and released.

Figure 1. Subject vehicle 1998 Nissan Quest.

This crash was identified by the Calspan Special Crash Investigation (SCI) team through and Internet news search for potential cases of interest to the SCI program. Due to the presence of the RFCSS and resulting injuries to the infant passenger, the article was forwarded to the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA). CID assigned the crash to the Calspan SCI team on February 7, 2007. The vehicle and the RFCSS were located and cooperation was established with the investigating police agency to inspect the vehicle and RFCSS. The vehicle, RFCSS, and the scene inspection were conducted on February 21, 2007.

SUMMARY

Crash Site

This run-off-road crash occurred on the south roadside of a four-lane east/west interstate roadway. Three travel lanes and an exit ramp comprised the eastbound travel direction. The eastbound travel lanes were separated by broken white lane lines and curved slightly left at the crash location. The off-ramp began at the crash site and curved right as it extended beyond the crash site. The east and westbound lanes were physically separated by a W-beam guardrail median barrier system. The south roadside consisted of a

mountable concrete curb, grass, a W-beam guardrail system, overhead luminaries, and a tree line. The posted speed limit for the interstate was 105 km/h (65 mph). The Scene Schematic is included as **Figure 17** of this report.

Vehicle Data

1998 Nissan Quest

The vehicle in this crash was a 1998 Nissan Quest. The vehicle placard was located on the left B-pillar and was not accessible due to the jammed left front door; therefore the manufacture date was unknown. The Vehicle Identification Number (VIN) that identified the vehicle was 4N2ZN1118WD (production number deleted). The odometer reading at the time of the SCI inspection was 174,215 kilometers (108,252 miles). The vehicle was a three-door minivan with a rear lift gate that was equipped with a 3.0-liter, V6 engine linked to a four-speed automatic transmission with a column mounted transmission shifter. The service brakes were front disc and rear drum. The vehicle was equipped with OEM five-spoke alloy wheels with P225/70R15 tires. The tires on the Nissan were Republic Enterprise. The manufacturer recommended front and rear tire pressure was unknown due to the inaccessible placard. The specific tire data at the time of the SCI inspection was a follows:

Position	Measured Tire Pressure	Measured Tread Depth	Damage
Left Front	Tire Flat	6 mm (8/32”)	De-beaded
Left Rear	Tire Flat	8 mm (10/32”)	De-beaded
Right Front	Tire Flat	6 mm (8/32”)	De-beaded
Right Rear	Tire Flat	8 mm (10/32”)	De-beaded

The interior of the Quest was configured with cloth surfaced front bucket seats with height adjustable head restraints. The front left head restraint was adjusted to 6 cm (2.5”) above the seatback and the front right was in the full-down position. The second row was equipped with captain seats with height adjustable head restraints. The adjustment of the left rear head restraint was 6 cm (2.5”) above the seatback and the rear right was in the full-down position at the time of the SCI inspection. The third row was a three-passenger bench seat with height adjustable head restraints for the outboard seats. These head restraints were in the full-down position.

Figure 2. On-scene image of the on-road yaw marks.

Crash Sequence

Pre-Crash

The 21-year-old male driver was operating the vehicle eastbound on the interstate during the evening hours in the center lane at an estimated speed of 105 km/h (65 mph). The weather was police reported as cloudy and the asphalt road surface was dry. The driver had fallen asleep and the vehicle began to drift to the right. The front right passenger stated to the investigating police

officer that she shouted to the driver in an attempt to awake him. At this time, the driver woke-up and applied a left steering input to return the vehicle to the travel lane. The driver then applied a rapid right steering input which initiated a clockwise yaw with loss of directional control of the Nissan. The Nissan began to yaw left side leading and began traveling towards the south roadside. Two yaw marks from the left side tires were present on the roadway at the time of the crash; however, they faded prior to the SCI scene inspection. These yaw marks extended from the roadway to the roadside in a west to east direction. **Figure 2** is an on-scene police image of the on-road evidence. The left side tires of the Nissan overrode the concrete mountable curb and the vehicle entered the roadside. No damage was noted to the left side wheels of the Nissan or the curb. The Nissan entered the grassy roadside continuing its clockwise rotation where the left side tires furrowed into the soft surface **(Figure 3)**. The off-road travel was evidenced by a left front tire mark that measured 13 meters (42.6 feet) in length and a left rear tire mark which measured 9 meters (29.5 feet) in length. The Nissan rotated to an angle of 90 degrees from its original heading. The distance between the yaw marks was 285 cm (112") at the end points.

Figure 3. Left side tire marks on roadside.

Crash

The continued furrowing resulted in a tripping mechanism at the end of the tire marks. The vehicle began a left side leading rollover event. During the first and second quarter-turns, the left side front and second row glazing disintegrated and the RFCSS with the infant passenger were ejected. The ejection portal was the second left glazing. The point of ejection was determined based on the final rest position of the RFCSS with respect to the final rest position of the Nissan. The vehicle rolled a total of four-quarter turns coming to rest on its wheels 25 meters (82 feet) east of the trip point **(Figure 4)**. The driver and the adult passengers remained in the vehicle during the rollover event.

Figure 4. On-scene impact of the final rest positions of the safety seat and the Nissan.

Post-Crash

The passenger's of the Nissan stated that it took a short time for them to regain their senses. They further stated that when the event was complete, the whereabouts of the infant was unknown. A non-contact vehicle that was traveling behind the Nissan stopped

at the crash site. This driver exited his vehicle and discovered the RFCSS inverted on the ground approximately 13 meters (43 feet) west of the Nissan. He up-righted the RFCSS and observed the infant restrained within the safety seat. The driver of the non-contact vehicle was a medical doctor and ascertained the condition of the infant and began Cardiopulmonary Resuscitation (CPR) until paramedics arrived on-scene. The infant sustained critical level injuries and was transported by ambulance to a trauma center where she was pronounced deceased upon arrival. The driver sustained minor severity injuries and was transported by helicopter to a trauma center where he was treated and released. The two female passengers sustained minor injuries and were transported by ground ambulance to a local hospital where they were treated and released.

Vehicle Damage

Exterior

The 1998 Nissan Quest sustained moderate severity damage to the roof area as a result of the rollover crash **(Figures 5 and 6)**. Isolated deformation was noted to the side, front, and rear planes of the Nissan. The left front window frame was deflected outboard of the vehicle from the ground contact during the first and second quarter turns. The roof side rails of the vehicle were deformed vertically downward. The direct contact damage on the left roof side rail began 15 cm (6") rear of the A-pillar and extended 241 cm (95") to the D-pillar. The maximum crush was centered over the second row glazing within the B-pillar area of the vehicle and measured 9 cm (3.5").

Figure 5. Left side damage and roof side rail crush profile.

Figure 6. Right roof side rail crush documentation.

The direct contact damage on the right roof side rail extended the full length measuring a total length of 241 cm (95"). The maximum crush measured 11 cm (4.5") and was located 51 cm (20") forward of the D-pillar. The maximum vertical and lateral crush were located at the D-pillar area. These crush values were 11 cm (4.5") and 28 cm (10.5"), respectively. The Collision Deformation Classification for the rollover event was 00-TDDO-2.

The left front door and the rear lift gate were jammed in the closed positions. The right side doors were closed and were operational post-crash. The windshield was in place and was not damaged during the crash. The second row right hinged glazing was separated

from the vehicle; however, it remained intact and was placed in the interior of the vehicle. The front left and right, second row left, third row right, and rear glazing were disintegrated during the rollover. The third row left glazing remained in place and intact. The second row, third row, and rear glazing were AS3 tempered glass with original tint.

Interior

The interior of the Nissan sustained minor interior damage that was attributed to occupant contact points and passenger compartment intrusion. A probable contact point for the driver was noted to the roof area over the front left area. This contact was evidenced by a strand of hair. The front passenger contact's consisted of a single strand of hair on the roof over the front right area. The front right door panel was fractured from contact with the front right passenger's right leg. Additionally, the center console was dislodged from possible contact from either the driver or the front right passenger. The rear right passenger contacted and deformed the rear aspect of the front seatback. This contact was not visible and was discovered by feeling the seatback. Two smear marks were noted on top aspect the second row left window frame. These marks appeared to be grease and may have occurred post-crash. No occupant contacts were attributed to the rear left infant passenger. The passenger compartment intrusions were minor and were as follows:

Seat Position	Intruded Component	Magnitude	Direction
Second row left	Roof	8 cm (3")	Vertical
Second row left	Rood side rail	9 cm (3.5")	Vertical
Third row right	Roof	10 cm (4")	Vertical
Third row right	Rood side rail	11 cm (4.5")	Vertical

Frontal Air Bag System

The Nissan was originally equipped with a redesigned frontal air bag system for the driver and front right passenger positions. During the inspection of the air bag system, it was determined that this vehicle was involved in a previous collision where the air bag system deployed. The determination was based on the rear right passenger's statement to the investigating officer that she was involved in a prior collision with a curb that resulted in the deployment of the frontal air bag system. Additionally, the replacement air bag modules in the vehicle were obtained from a Mercury Villager which was the peer vehicle to the Nissan Quest. **Figure 7** is a view of the replaced driver's air bag module. The frontal air bag system did not deploy in this rollover crash.

Figure 5. Replaced driver's air bag module.

Child Safety Seat

The 11-month-old female was restrained in the second row left position of the Nissan. She was positioned in a Graco Snug Ride infant seat and was restrained by the integrated five-point harness system. The safety seat Model Number was 8465LRD2 and was manufactured on 01/17/06. The child seat was placarded with a label that advised against usage after December 2011. The following was also placarded on the safety seat: The safety seat was labeled for use under the following guidelines:

Rear Facing:

Height up to 74 cm (29")
Weight 3-10 kgs (5-22 lbs)

The RFCSS was purchased new by the child's mother. Although the vehicle was involved in a previous crash, it was unknown if the RFCSS was in the vehicle at that time The RFCSS was equipped with a detachable base and was designed to be used with or without the detachable base.

Child Safety Seat Installation

At the time of the crash, the RFCSS was installed without the base. The driver stated to the investigating police officer that he installed the RFCSS in the vehicle. This was further confirmed by statements from the passengers of the Nissan. The driver described the installation procedure, which consisted of placing the RFCSS in the second row left seat. He extended the manual lap and shoulder belt across the RFCSS and placed the safety belt through the belt path and buckled the latch plate into the buckle. Upon completion of this installation, the second row right passenger proceeded to inspect the safety seat for a snug installation by further tensioning the belt webbing. The investigating police officer questioned the driver and rear right passenger regarding the retractor setting of the belt system. Both were unaware of the Automatic Locking Retractor (ALR) feature of the safety belt. However, the ALR feature was possibly engaged by the second row right passenger as she extended the webbing. The safety belt was found by the SCI investigator buckled with the retractor set in the ALR mode.

Figure 8. On-scene image of the rear left belt system.

Figure 9. Rear left safety belt position at the time of the SCI inspection.

The investigating police officer stated to the SCI investigator that the safety belt position and retractor setting were not altered from the time of the crash to the time of the SCI

inspection. This was further supported by the on-scene images of the safety belt system. **Figures 8 and 9** are of the rear left safety belt system exhibiting the same position post-crash and at the time of the SCI investigation. The recline angle of the safety seat and the tightness of the installation were unknown. The vehicle seatback was adjusted to 35 degrees rearward of vertical.

Post-Crash Location of RFCSS

The RFCSS and the infant passenger were ejected from the vehicle during the rollover event. It was determined that the ejection occurred during the first and second quarter-turns of the four-quarter turn rollover. This was supported by the final rest position of the safety seat which was located approximately 13 meters (43 feet) west to the vehicle's final rest position **Figure 10**. Additionally, the first responder that found the safety seat confirmed the location and position to the investigating police officers.

Figure 10. Approximate position of the safety seat at final rest.

Determination of Safety Belt Usage

The exposed portion of the webbing in the buckled position at the time of the crash was approximately 140 cm (50"). The RFCSS was repositioned on the left rear seat **(Figure 11)** to determine the position of the safety belt. The amount of exposed webbing was not sufficient to install the RFCSS using the belt path. To install the RFCSS, the SCI investigator unbuckled the safety belt and rerouted the lap belt through the belt path **(Figure 12)**. In **Figure 11**, the yellow markings on the webbing indicate the location of the webbing in the post-crash position. Inspection of the safety belt webbing and the components revealed no crash related evidence (i.e., frictional abrasions on the hard points or loading of the webbing).

Figure 11. Reinstalled RFCSS using the belt path.

Figure 12. Front-to-rear rotation of the safety seat. The webbing remained engaged with the belt path during this simulation.

The safety seat was moved from side-to-side to duplicate the pre-crash steering inputs. This movement did not result in disengagement of the safety belt from the belt path. The safety seat was then rotated from front-to-rear to simulate movement during the rollover event and to achieve the ejection that occurred during the first and second quarter-turns of the rollover. During the rotation, the safety belt remained engaged with the belt path and should not have resulted in the ejection **(Figure 12)**.

The safety seat was repositioned on the left rear seat with the lap belt routed through the belt path. The RFCSS was rotated from rear-to-front **(Figure 13)**. During this movement, the safety belt webbing became restricted between the belt path and carry handle mounting point. This restriction would have prevented the ejection of the RFCSS that occurred early in the crash event.

Figure 13. Rear to front rotation of the RFCSS.

The safety seat was reinstalled using the lap belt positioned across the safety seat, rearward of the belt path **(Figure 14)**. The safety seat was moved from side-to-side to duplicate the pre-crash steering inputs. This movement caused the webbing to slide slightly rearward. The safety seat was then rotated from front-to-rear resulting in disengagement from the safety belt system **(Figure 15)**. At this point, the safety seat was not restrained and would have resulted in the ejection that occurred during the first and second quarter-turns of the crash phase.

Based on the lack of evidence on the safety belt system and at the belt path of the RFCSS, it was determined that the safety belt webbing was not routed through the belt path and was positioned over the rear aspect of the safety seat. This positioning resulted in the ejection of the safety seat during the first and second quarter turns of the rollover event. The SCI test concluded that with the vehicle safety belt system routed through the belt path, the RFCSS would not have disengaged, thus preventing an ejection of the RFCSS and the child.

Figure 14. RFCSS with the lap positioned across the rear of the safety seat.

Figure 15. Separation from the safety belt system.

Child Safety Seat Damage

The RFCSS exhibited damage that was attributed to the ground contact during the ejection. The damage consisted of white stress marks throughout the plastic shell of the RFCSS. These stress marks were also present across the entire 42 cm (16.5") width of the carrying handle. In addition to these stress marks, two fractures were noted. The largest of these fractures measured 50 cm (19.5") and began at the rear aspect of the right belt path and wrapped around to the right left of the safety seat **(Figure 16)**. A second fracture was found at the rear edge of the safety seat and measured 5 cm (2"). The harness straps where free of damage and contained body fluid and dirt. The total length of the exposed harness straps was 30 cm (12"). The cushion of the safety seat also contained body fluid and dirt from the ground contact.

Figure 16. Stress marks and fracture at the right belt path.

Manual Safety Belt Systems

The 1998 Nissan Quest was equipped with three-point lap and shoulder belt systems for the six outboard positions. A manual lap belt was located in the third row center seat. The outboard safety belts consisted of continuous loop webbing with sliding latch plates.

The driver's safety belt retracted onto an Emergency Locking Retractor (ELR) and was configured with a height adjustable D-ring which was in the full-up position. The driver utilized the safety belt in the crash, which was evidenced by minor frictional abrasions on the latch plate.

The remaining outboard belt systems utilized switchable ELR/Automatic Locking Retractors (ALR) and a height adjustable D-ring which was in the full-down position for the front right seat. The front right and second row right passengers utilized the safety belts in the subject crash, which was supported by minor frictional abrasions on the latch plates. The belt status of the driver and adult passenger's was further supported by the lack of distinct contact evidence and their non-ejected status.

The second row left safety belt was improperly used to install the RFCSS in this position. The lap belt portion of the safety belt was positioned over the top of the safety seat and was not routed through the belt path. This safety belt system exhibited no crash related evidence.

The third row was not occupied during the crash; therefore, the safety belts were not used.

Occupant Demographics/Data

Driver

Age/Sex:	21-year-old/Male
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Full-rear track position
Eyewear:	Unknown
Manual Safety Belt Usage:	Manual lap and shoulder belt
Usage Source:	Vehicle inspection
Egress from Vehicle:	Exited without assistance
Mode of Transport from Scene:	Transported by helicopter to a trauma center
Type of Medical Treatment:	Treated and released

Driver Injuries

Injury	**Injury Severity AIS90/Update 98**	**Injury Source**
Unknown minor injuries	Unknown	Unknown

Source – Police report

Driver Kinematics

The 21-year-old male driver of the 1998 Nissan Quest was seated in an upright driving posture. The driver's seat was adjusted to the full-rear track position and he was restrained by the manual safety belt system.

The pre-crash steering inputs minimally displaced the driver left and right within the front left area of the vehicle. The Nissan departed the right roadside where it tripped into a four quarter-turn rollover event. Due to the driver's belted status, he remained in the front left area and was displaced vertically where he contacted the roof. The driver sustained minor severity injuries and was transported by helicopter to a local trauma center where he was treated and released.

Front Right Passenger

Age/Sex:	17-year-old/Female
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Rear track position
Restraint Use:	Manual lap and shoulder belt
Usage Source:	Vehicle inspection
Egress from Vehicle:	Exited without assistance
Mode of Transport from Scene:	Transported by ambulance
Type of Medical Treatment:	Treated and released

Front Right Passenger Injuries

Injury	Injury Severity (AIS 90, Update 98)	Injury Source
Unknown minor injuries	Unknown	Unknown

Source – Police report

Front Right Passenger Kinematics

The 17-year-old female front right passenger was seated in a rear track position and was restrained by the manual safety belt system. The front right passenger was reportedly wearing headphones. She reported looking at the driver and noticed that he had fallen asleep and called out to him. The steering inputs that were applied by the driver resulted in slight lateral displacement of the front right passenger. The vehicle departed the right roadside and subsequently rolled over. The front right passenger contacted the right front door panel as a result of the lateral motion. This contact was evidenced by the fractured panel. Additionally, she was displaced vertically during the rollover and contacted the roof. A strand of hair was noted above the front right passenger position. The front right passenger sustained minor injuries and was transported by ground ambulance to a local hospital where she was treated and released.

Rear Left Child Passenger

Age/Sex:	11-month-old/Female
Height:	76 cm (30”)
Weight:	8 kg (18 lbs)
Seat Track Position:	Not adjustable
Eyewear:	None
Child Restraint Use:	Rear facing child safety seat with 5-point harness
Usage Source:	Vehicle inspection
Egress from Vehicle:	Fully ejected
Mode of Transport from Scene:	Ambulance to hospital
Type of Medical Treatment:	None, pronounced deceased upon arrival

Rear Left Child Injuries

Injury	Injury Severity AIS90/Update 98	Injury Source
Gliding contusion of the left posterior third cerebral hemisphere with palpification of the cortical ribbon	Critical (140628.5,2)	Ground
Left subdural hemorrhages	Severe (140650.4,2)	Ground
Left epidural hemorrhages	Severe (140630.4,2)	Ground
Bilateral posterolateral lung contusions of the lower lobes measures 0.7 cm (0.3”)	Severe (441410.4,3)	Shell of CSS from ground contact

Comminuted fractures of the anterior and middle fossa with a horizontal fracture over the posterior fossa passing behind the foramen manum. Extensive fracture of the left orbital roof and an eggshell type fracture of the right orbital roof. Hinged type fracture along the cribiform plate passing through the sella turcica and posterior petrous ridge	Severe (150206.4,8)	Ground
Comminuted fracture of the left parietal and temporal 10 x 8 cm (4 x 3”) with brain matter admixed	Severe (150406.4,2)	Ground
Comminuted fracture of the left occipital bone (diastatic fracture of the coronal and lambdoid sutures)	Severe (150406.4,6)	Ground
Fracture of the frontal bone	Serious (150404.3,5)	Ground
Cerebral edema/swelling with widening of the gyri and sulci	Serious (140660.3,9)	Ground
Fracture of the right zygomatic arch	Moderate (251800.2,1)	Ground
Unknown fracture of the maxilla	Moderate (250800.2,9)	Ground
Extensive hemorrhages of the left subcutaneuous and galeal	Minor (190402.1,2)	Ground
0.9 cm (0.4”) laceration of the right upper eye lid	Minor (297602.1,1)	Ground
Superficial abrasion of the right upper and lower eye lid	Minor (297202.1,1)	Ground
Contusion of the right lower eye lid	Minor (297402.1,1)	Ground
Abrasions to the left upper eye lid	Minor (297202.1,2)	Ground
2 cm (0.75”) laceration of the left upper eye lid	Minor (297602.1,2)	Ground
Lacerations (superficial scratches) of the right cheek	Minor (290602.1,0)	Ground

3 x 3 cm (1 x1”), forehead 11 x 6 cm (4.5 x 2.5”), upper lip, bridge of nose		
Abrasions of the forehead, nose, left cheek, and the upper lip	Minor (290202.1,0)	Ground

Source = Autopsy

Rear Left Child Kinematics

The 11-month-old female child passenger was seated in a Graco Snug Ride rear facing child safety seat and was restrained by the integrated five-point harness system. The lap belt portion of the safety belt system was positioned across the safety seat rearward of the belt path. The pre-crash steering maneuver resulted in lateral movement of the safety seat which allowed the safety belt to slide toward the rear of the RFCSS. The Nissan departed the right roadside where it began to rollover. The left side of the vehicle contacted the ground which disintegrated the left side glazing and resulted in the disengagement of the RFCSS from the safety belt system. As the vehicle initiated a second quarter-turn onto its roof, the RFCSS with the infant passenger were ejected through the second row left window opening. The infant’s face and head contacted the ground which resulted in the minor-to-critical severity head injuries. Additionally, during the child’s movement and contact with the ground she contacted the shell which resulted in the bilateral posterolateral lung contusions.

The driver of a non-contact vehicle discovered the RFCSS inverted on the ground approximately 13 meters (43 feet) from the vehicle. He uprighted the RFCSS and observed the infant in the safety seat. The driver of the non-contact vehicle was a medical doctor and evaluated the condition of the infant. He began Cardiopulmonary Resuscitation (CPR) until paramedics arrived and transported the infant by ground ambulance to a trauma center where she was pronounced deceased upon arrival.

Second Row Right Passenger

Age/Sex:	23-year-old/Female
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Not adjustable
Eyewear:	None
Child Restraint Use:	Manual lap and shoulder belt
Usage Source:	Vehicle inspection
Egress from Vehicle:	Exited without assistance
Mode of Transport from Scene:	Ambulance to hospital
Type of Medical Treatment:	Treated and released

Second Row Right Passenger Injuries

Injury	Injury Severity AIS90/Update 98	Injury Source
Unknown minor injuries	Unknown	Unknown

Source = Police report

Second Row Right Passenger Kinematics

The 23-year-old female rear right passenger was seated in a semi-reclined position. The seatback angle was measured at 45 degrees from vertical. Additionally, this passenger stated to the investigating police officer that she was reading a book prior to the crash. The pre-crash maneuver resulted in minimal lateral displacement due to her belt usage.

The Nissan departed the right roadside where it subsequently rolled over. This passenger contacted the rear aspect of the front right seatback with her legs. This contact was supported by deformation of the seatback frame. As a result of the four quarter-turn rollover, she was displaced vertically; however, she remained within her seating position. The 23-year-old female sustained minor injuries and was transported by ground ambulance to a local hospital where she was treated and released.

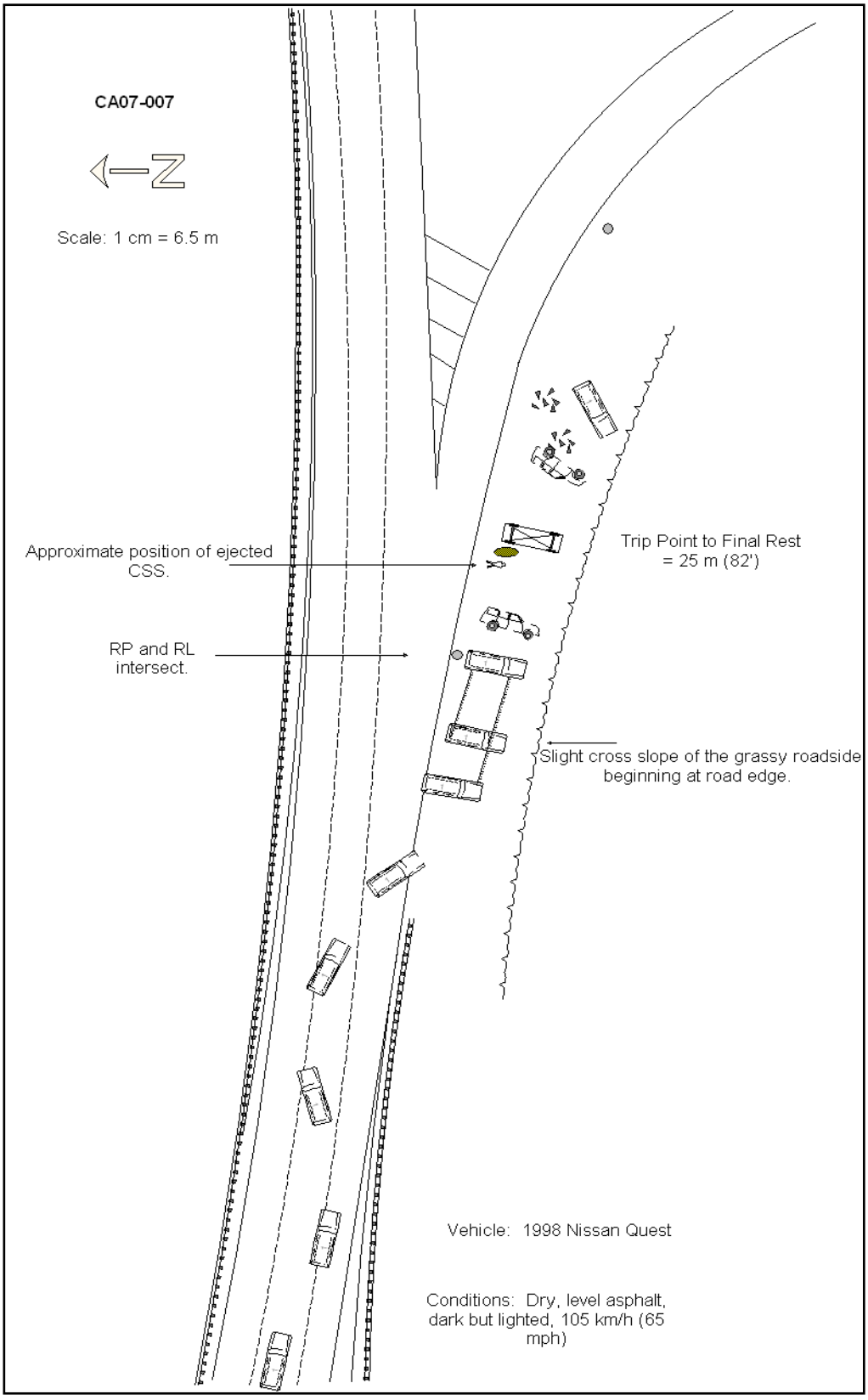

Figure 17: Scene Schematic