TRANSPORTATION SCIENCES
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VERIDIAN REMOTE ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION SCI TECHNICAL SUMMARY REPORT

NASS/SCI COMBO CASE NO. 02-08-235E

VEHICLE – 2003 HONDA ODYSSEY

LOCATION - STATE OF PENNSYLVANIA

CRASH DATE – DECEMBER 2002

Contract No. DTNH22-01-C-17002

Prepared for:

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National Highway Traffic Safety Administration
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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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16. Abstract

This remote investigation focused on the performance of the Advanced 208-Compliant safety system in a 2003 Honda Odyssey minivan. The safety system included a front right passenger seat weight sensor, driver and front right seat track position sensors, dual-stage frontal air bags, safety belt pretensioners and an Event Data Recorder (EDR). The Odyssey was also equipped with side impact air bags. The Odyssey was occupied by a restrained 40-year-old female driver, a 5-year-old male restrained in a high-back belt-positioning booster child safety seat (CSS), and an 11-month-old female restrained in a rear-facing convertible CSS with Lower Anchors and Tethers for Children (LATCH). The Odyssey was the striking vehicle in a moderate severity front-to-rear crash with a 2001 Ford Excursion, which was displaced forward into a 2002 Dodge Intrepid. The impact was sufficient to deploy the driver's air bag and driver's safety belt pretensioner in the Odyssey. The driver sustained a cervical spine strain, multiple teeth dislocations, multiple lip and gum lacerations, a left corneal abrasion, a left eyelid contusion, a second-degree burn to the right forearm, a laceration and abrasion to a finger on the right hand, and bilateral knee contusions. She was transported by ambulance to a local hospital where she was treated for her injuries and released. The children in the vehicle were not injured and did not receive medical treatment.

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BACKGROUND

This remote investigation focused on the performance of the Advanced 208-Compliant safety system in a 2003 Honda Odyssey minivan. The safety system included a front right passenger seat weight sensor, driver and front right seat track position sensors, dual-stage frontal air bags, safety belt pretensioners and an Event Data Recorder (EDR). The Odyssey was also equipped with side impact air bags. The Odyssey was occupied by a restrained 40-year-old female driver, a 5-year-old male restrained in a high-back belt-positioning booster child safety seat (CSS), and an 11-month-old female restrained in a rear-facing convertible CSS with Lower Anchors and Tethers for Children (LATCH). The Odyssey **(Figure 1)** was the striking vehicle in a moderate severity front-to-rear crash with a 2001 Ford Excursion, which was displaced forward into a 2002 Dodge Intrepid. The impact was sufficient to deploy the driver's air bag and driver's safety belt pretensioner in the Odyssey. The driver sustained a cervical spine strain, multiple teeth dislocations, multiple lip and gum lacerations, a left corneal abrasion, a left eyelid contusion, a second-degree burn to the right forearm, a laceration and abrasion to a finger on the right hand, and bilateral knee contusions. She was transported by ambulance to a local hospital where she was treated for her injuries and released. The children in the vehicle were not injured and did not receive medical treatment.

Figure 1. Damaged 2003 Honda Odyssey

This crash was identified by the National Automotive Sampling System (NASS) PSU 08 during the weekly sampling of Police Accident Reports (PARs). This crash was selected as CDS Case No. 02-08-235E. The NASS PSU performed the vehicle inspection and scene inspection. The Ford Excursion was not inspected by the NASS researcher, and the Dodge Intrepid was fully repaired. Due to the presence of the Advanced 208-Compliant safety system, deployment of the driver's air bag, and activation of the driver's safety belt pretensioner, NHTSA assigned the tasks of case review and report preparation to the Veridian SCI team.

SUMMARY

Crash Site

This three-vehicle crash occurred during the daylight hours of December 2002 in the state of Pennsylvania. At the time of the crash, there were no adverse weather conditions and the asphalt roadway surface was dry. The crash occurred on the outboard eastbound lane of a four-lane undivided roadway on approach to a four-leg intersection. The east/west roadway was configured with two travel lanes in each direction that were separated by a double-yellow

centerline. The roadway was bordered by white fog lines adjacent to concrete curbs. The roadway was straight at the crash site and exhibited an eastbound left curve on the east leg of the intersection. The roadway also exhibited a positive 4 percent eastbound grade. Traffic flow through the intersection was controlled by overhead three-phase traffic signals. A yellow traffic signal warning sign was present on the roadside of the west leg of the intersection. The roadside environment consisted of private residences and commercial buildings. The posted speed limit for the east/west roadway was 56 km/h (35 mph). The NASS scene schematic is included as **Figure 12** of this report.

Pre-Crash

The 40-year-old female driver of the 2003 Honda Odyssey was operating the vehicle eastbound on approach to the four-leg intersection **(Figure 2)**. A 2002 Dodge Intrepid was stopped in traffic prior to the intersection, and a 2001 Ford Excursion was stopped behind the Intrepid. It was not known which phase the traffic signal was in for east/west traffic. The driver of the Odyssey stated in the NASS interview that for unknown reasons she looked away from the roadway as the vehicle was approaching the intersection. When she subsequently looked at the roadway, she detected the stopped vehicles in the lane ahead of the Odyssey. The driver did not attempt any avoidance maneuvers prior to the impact with the Ford Excursion.

Figure 2. Eastbound approach for the Honda Odyssey

Crash

The front of the Odyssey impacted the rear aspect of the Ford Excursion. Impact resulted in moderate damage to the Odyssey and was sufficient to deploy the driver's air bag and activate the driver's safety belt pretensioner. The Odyssey was under repair at the time of the vehicle inspection, and a crush profile could not be documented. Based on pre-repair photographs of the frontal damage, the delta-V appeared to be within the 16 – 24 km/h (10 – 15 mph) range. The impact also displaced the Ford Excursion forward into the stopped Dodge Intrepid which resulted in minor damage to the Intrepid. The vehicles came to rest in the travel lane.

Post-Crash

The driver of the Odyssey exited the vehicle under her own power. She was transported by ambulance to a local hospital. She was treated for her injuries and released. The uninjured children were removed from the vehicle with assistance, although it was not known if the assistance was provided by the driver. The status of the occupants of the Ford Excursion and Dodge Stratus was not known.

VEHICLE DATA – 2003 Honda Odyssey

The 2003 Honda Odyssey was identified by the Vehicle Identification Number (VIN): 5FNRL18993B (production sequence omitted). The odometer reading was unknown due to lack of power to the vehicle at the time of the inspection. The vehicle was a four-door minivan that was equipped with a 3.5 liter, 6 cylinder engine, and a 5-speed automatic transmission. The

Odyssey was equipped with the EX trim package which included a Traction Control System, power-assisted front and rear disc brakes with anti-lock, an Electronic Brake Distribution System, variable-assist power rack-and-pinion steering, and a tile steering column. The Honda Odyssey was equipped with Michelin Symetry P225/60R16 tires for each wheel.

The 2003 Honda Odyssey was configured with front bucket seats, two second row bucket seats, and a third row bench seat with a folding back. The third row bench seat folded forward and could be stowed in the floor area of the Odyssey. The driver's seat was equipped with an 8-way power adjustment and manual lumbar support.

VEHICLE DAMAGE

Exterior Damage – 2003 Honda Odyssey

The 2003 Honda Odyssey sustained moderate frontal damage as a result of the impact with the 2001 Ford Excursion. The Odyssey was partially disassembled at the time of the vehicle inspection, and the NASS researcher's damage assessment was supported by damaged parts and pre-repair photographs of the vehicle. Due to repair status of the vehicle, crush measurements could not be documented. Photographs obtained from the vehicle's owner **(Figures 3 and 4)** illustrated the pre-repair damage of the Odyssey. The direct damage began 29 cm (11") left of the centerline and extended 98 cm (39") laterally to the right across the frontal plane. The combined direct and induced damage involved the entire frontal width of the vehicle. The hood was buckled rearward and slightly abraded on the leading aspect. The bumper beam was crushed in the center aspect. The bumper fascia was separated from the vehicle and exhibited multiple fractures. The left head lamp was fractured and the grille was displaced. The right front fender was displaced outward slightly. There was no reduction of the wheelbases. The Collision Deformation Classification for the frontal impact to the Odyssey was 12-FDEW. The extent zone was estimated to be a zone 1.

Figure 4. Frontal view of damage to the Odyssey

Figure 3. Right front view of the damaged Odyssey

Interior Damage – 2003 Honda Odyssey

The 2003 Honda Odyssey sustained minor interior damage **(Figure 5)** as a result of the crash. Based on pre-repair images, it did not appear that the vehicle sustained damage to the windshield or vehicle glazing. There was no integrity loss and no passenger compartment intrusion. The driver's lap belt was scuffed as a result of occupant contact.

Figure 5. Interior view of front row

Exterior Damage – 2001 Ford Excursion

The 2001 Ford Excursion was not located for inspection.

Exterior Damage – 2002 Dodge Intrepid

The 2002 Dodge Intrepid sustained minor damage as a result of the rear impact with the Ford Excursion. At the time of the vehicle inspection, the Intrepid had been fully repaired.

MANUAL RESTRAINT SYSTEMS – 2003 Honda Odyssey

The 2003 Honda Odyssey was equipped with manual 3-point lap and shoulder belts for each seating position. The driver's safety belt was configured with a sliding latch plate and a belt-sensitive Emergency Locking Retractor (ELR). Stretch marks on the driver's lap and shoulder belt were visible in the NASS photographs from occupant loading **(Figure 6)**. The remaining safety belts were configured with sliding latch plates and belt-sensitive switchable ELR/Automatic Locking Retractors (ALR). Both front seat safety belts were equipped with retractor-mounted pretensioners and adjustable D-rings. The second row restraints were also equipped with adjustable D-rings. The second row bucket seats were equipped with both tether and lower LATCH anchors. The third row bench seat was equipped with tether anchors only.

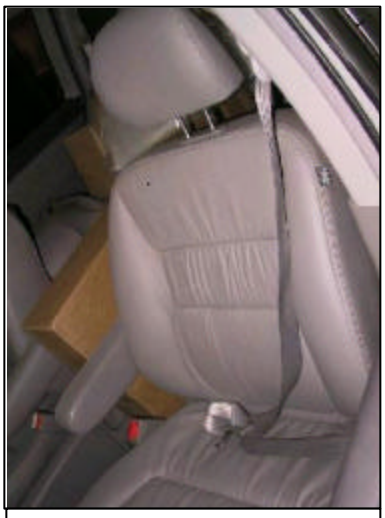

Figure 6. View of driver's safety belt

CHILD SAFETY SEATS – 2003 Honda Odyssey

Fisher-Price Belt Positioning Booster CSS

A Fisher-Price high-back belt-positioning booster CSS **(Figure 7)** was positioned in the second row left bucket seat of the Odyssey. The model number was 79750 and the Date of Manufacture was April 26, 1998. The CSS was not configured with a harness system. The CSS was not configured with Lower Anchorages and Tethers for Children (LATCH) attachments or a tether. The CSS was designed for use with the vehicle's manual 3-point lap and shoulder belt system in a forward-facing orientation. The booster seat was also configured with adjustable shoulder belt positioners on each side of the seat. The label **(Figure 8)** affixed to the rear aspect of the CSS indicated the minimum and maximum height recommendations by an illustration which identified two lateral indicators that were on the CSS seat back.

There was no identifiable damage to the Fisher-Price CSS .

Figure 8. Fisher-Price booster CSS

Figure 7. View of height recommendations on the rear aspect of the booster CSS

Graco ComfortSport Convertible CSS

A Graco ComfortSport convertible CSS **(Figure 9)** was installed in a rear-facing orientation on the second row right bucket seat of the Odyssey. The model number was 8432BLK and the date of manufacture was July 15, 2002. The CSS was configured with lower LATCH attachments. They consisted of clips fixed to a section of webbing which was positioned through the CSS belt path. The CSS was also configured with a tether. The lower LATCH attachments were used for the installation, however, the tether was not. The CSS was configured with a 5-point harness system and the harness straps were positioned through the middle harness slots. The CSS was also configured with a padded head rest on the top aspect of the seat.

Figure 9. Graco ComfortSport Convertible CSS

The CSS label on the side aspect of the CSS at the belt path stated the following with regard to the CSS design for use:

> Rear-facing:
> Infants who weigh less than 20 lbs. (9 kg) MUST be rear-facing.
>
> Forward facing:
> 20 – 40 lbs. (9-16 kg): Toddlers who weigh between 20 and 30 lbs. (9-13.6 kg) and are at least one year old may be forward-facing.
>
> Toddlers who weigh between 30 and 40 lbs. (13.6 kg – 18 kg) and up to 40 in. (102 cm) tall MUST be forward-facing.

The child restrained in the rear-facing CSS was 11 months old, and weighed 10 kg (22 lb). Based on the label outlining the weight and height guidelines, although the child's weight exceeded the rear-facing listed weight of 9 kg (20 lb) on the CSS label, the child was not yet one year old. Given the age of the child, the rear-facing installation was consistent with the manufacturer's instructions.

Based on the NASS interview, the CSS was purchased new by the driver, and was used on a regular basis to restrain the child. The driver described the installation as 'tight', and used a towel under the CSS, although the purpose and position of the towel was not specified. The kickstand was retracted. The driver stated in the interview that a locking clip was used to lock the vehicle safety belt, although, it appears the driver was referring to the slack adjusters on the LATCH belt of the CSS. The NASS researcher's assessment of the installation confirmed that there was no locking clip in use. The driver stated that the CSS harness straps were positioned at the child's shoulder level and there was approximately two finger-widths of space between the harness and the child's chest. The harness retainer clip was positioned at the level of the child's navel, and the child was wearing a bulky/heavy coat at the time of the crash, under the harness system. Damage to the CSS was minor. There appeared to be minor abrasions at the belt path from the loading applied by the CSS to the LATCH belt webbing. There was no obvious loading or stretching noted on the harness system.

ADVANCED 208-COMLIANT SAFETY SYSTEM – 2003 Honda Odyssey

Frontal Air Bag System

The 2003 Honda Odyssey was equipped with dual-stage frontal air bags for the driver and front right passenger positions. The frontal air bag system was also equipped with a front right passenger seat weight sensor and driver and front right seat track position sensors. Per the Odyssey's owner's manual, the front passenger's weight sensors were located under both front right seat rails. If the total weight on the seat was approximately 30 kg (65 lb) or less, the system suppressed the air bag and the cutoff indicator light

Figure 10. Front right passenger's air bag cutoff indicator

(Figure 10) illuminated.

The driver's air bag deployed as a result of the frontal impact with the Ford Excursion. It was not known if the deployment was a single or dual stage deployment. The air bag deployed from the steering wheel hub through H-configuration module cover flaps. The top flap measured 9 cm (4") in height and the bottom flap measured 7 cm (3") in height. Both flaps measured 16 cm (6") in width at the tear seam. The driver's air bag **(Figure 11)** measured 58 cm (23") in diameter and was vented by two ports at the 10 and 2 o'clock positions on the rear aspect of the air bag. The air bag was tethered by two internal straps. Small amounts of body fluid were present on the upper left quadrant of the air bag from the driver.

Figure 11. Deployed driver's air bag

The front right passenger's air bag did not deploy in this crash. Given that the front right seat was unoccupied, it was probable that the passenger seat weight sensor suppressed the front right passenger's air bag. The front right seat was positioned in the mid-track position, although since the seat was not occupied, the seat track position sensor probably did not provide input into the system's non-deployment decision.

Side Impact Air Bag System

The 2003 Honda Odyssey was equipped with side impact air bags that were located in the front seat backs. The side impact air bag system did not deploy in this crash. The Odyssey's right front side impact air bag was equipped with an automatic suppression system. The system was designed to suppress the right front side impact air bag if the system detected an occupant leaning into the deployment path of the air bag.

OCCUPANT DEMOGRAPHICS – 2003 Honda Odyssey

Driver

Age/Sex:	40-year-old female
Height:	173 cm (68")
Weight:	59 kg (130 lb)
Seat Track Position:	Full-rear at the time of the vehicle inspection, probably between mid-track and full-forward at the time of the crash
Manual Restraint Use:	Manual 3-point lap and shoulder belt
Usage Source:	Vehicle inspection
Eyewear:	Contact lenses
Type of Medical Treatment:	Transported by ambulance to a local hospital, treated for her injuries, and released

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Left cornea abrasion	Minor (240602.1,2)	Expanding driver's air bag
Lower gum (gingival) laceration	Minor (243204.1,8)	Expanding driver's air bag
Teeth dislocation/loosened	Minor (251402.1,8)	Expanding driver's air bag
Two minor lacerations on the right lower lip	Minor (290602.1,8)	Expanding driver's air bag
Left eyelid contusion	Minor (297402.1,2)	Expanding driver's air bag
Cervical spine strain	Minor (640278.1,6)	Expanding driver's air bag
Deep right fifth finger abrasion	Minor (790202.1,1)	Expanding driver's air bag
Right fifth finger laceration	Minor (790600.1,1)	Center instrument panel
Right upper arm 2nd degree burn	Minor (792006.1,1)	Air bag exhaust gases
Bilateral lower extremity skin contusion*	Minor (890402.1,3)	Knee bolster

Injury source: Emergency Room Records, *Interview

Driver Kinematics

The 40-year-old female driver of the 2003 Honda Odyssey was seated in an upright posture and restrained by the manual 3-point lap and shoulder belt. Although the seat track was in the full-rear track position at the time of the vehicle inspection, based on the injuries sustained, it was probable that the driver was seated in a more forward or mid-track position at the time of the crash. At impact, the driver's air bag deployed and the driver's safety belt pretensioner fired. The restrained driver initiated a forward trajectory into the path of the expanding air bag and loaded the plastic knee bolster which resulted in bilateral leg contusions. She loaded the manual restraint, and due to her probable forward position, her head probably jackknifed forward over the shoulder belt, and was contacted by the expanding driver's air bag. The expansion of the air bag against her face resulted in a left cornea abrasion, lower gum laceration, teeth dislocation/loosened, two minor lower lip lacerations, and a left eyelid contusion. The driver's head was displaced rearward with respect to her torso by the expansion of the air bag, which resulted in a cervical spine strain. The air bag also expanded against her right fifth finger which resulted in a deep right fifth finger abrasion. Her right hand was displaced into the center instrument panel which caused a laceration on the right fifth finger. The driver also sustained a second-degree burn to the right upper arm from the air bag exhaust gases. The driver exited the vehicle under her own power and was transported by ambulance to a local hospital where she was treated for her injuries and released.

Second Seat Left Child Passenger

Age/Sex:	5-year-old male
Height:	109 cm (43”)
Weight:	20 kg (44 lb)
Seat Track Position:	Full-forward
Manual Restraint Use:	High-back booster CSS with manual 3-point lap and shoulder belt
Usage Source:	Vehicle inspection, CSS inspection
Eyewear:	None
Type of Medical Treatment:	Did not sustain injury and did not receive medical treatment

Second Seat Left Child Passenger Kinematics

The 5-year-old male child was seated on a Fisher-Price high back belt-positioning booster CSS on the second row bucket seat of the Honda Odyssey. He was restrained by the vehicle’s manual 3-point lap and shoulder belt. The shoulder belt was routed through the outboard positioner on the CSS. At impact, the child initiated a forward trajectory and loaded the safety belt. He rebounded rearward against the high back booster CSS and did not sustain injury or receive medical treatment.

Second Seat Right Child Passenger

Age/Sex:	11-month-old female
Height:	76 cm (30”)
Weight:	10 kg (22 lb)
Seat Track Position:	Full-forward
Manual Restraint Use:	Rear-facing convertible CSS
Usage Source:	Vehicle inspection, CSS inspection
Eyewear:	None
Type of Medical Treatment:	Did not sustain injury and did not receive medical treatment

Second Seat Right Child Passenger Kinematics

The 11-month-old female was restrained in a Graco ComfortSport convertible CSS that was installed in a rear-facing orientation on the second row right bucket seat. The CSS was reported by the driver to have been installed tightly, and the driver reported being able to insert approximately two fingers between the harness and the child’s chest. The child was also wearing a bulky winter coat. At impact, the child and CSS initiated a rearward trajectory toward the front of the vehicle. The child loaded the plastic shell of the CSS and the upper aspect of the harness straps as the CSS loaded the lower LATCH attachment belt. Minor abrasions were noted on the outboard edges of the belt path from the CSS loading the LATCH belt. The child did not sustain injury and did not receive medical treatment.

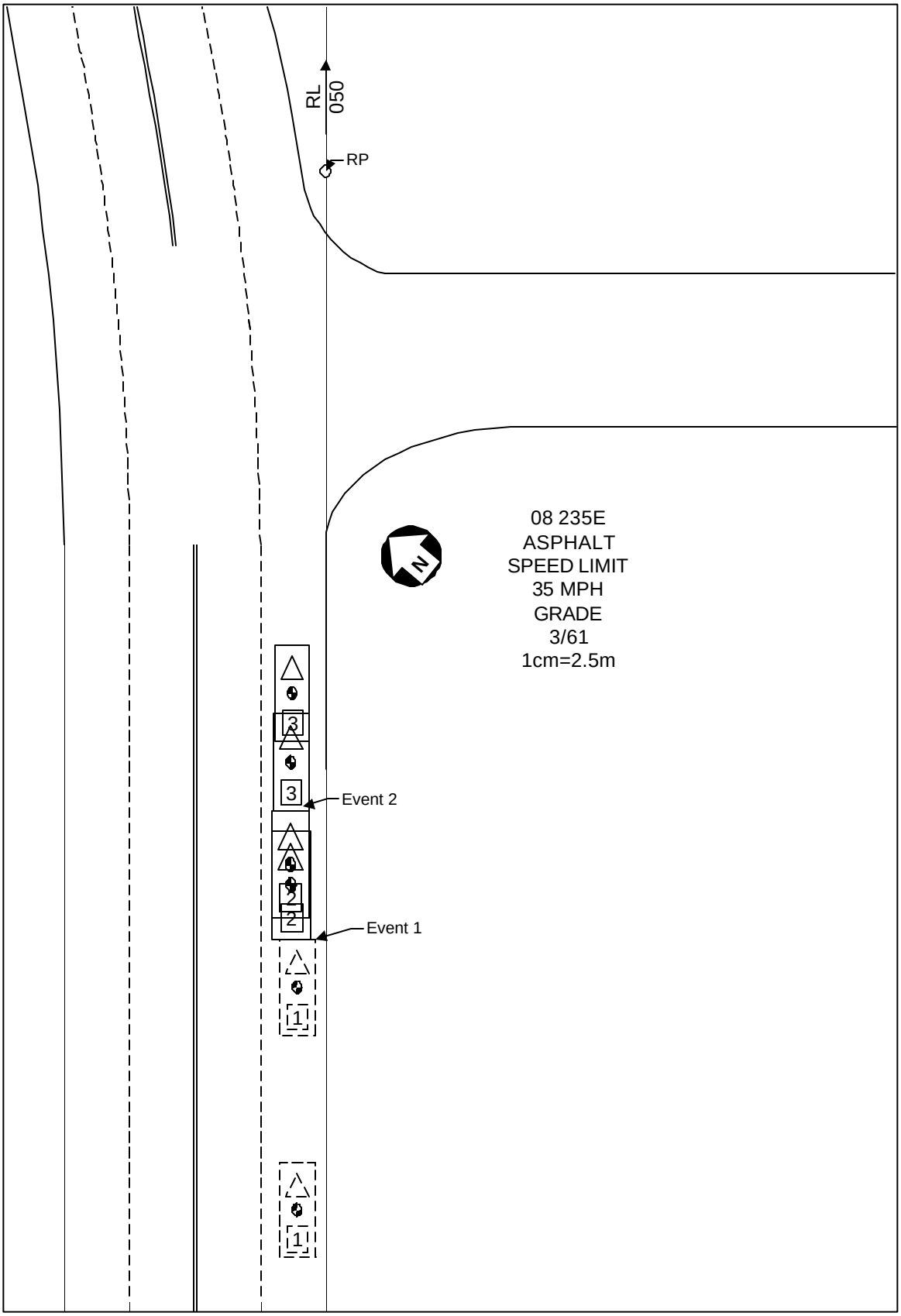

Figure 12. NASS scene schematic