

**TRANSPORTATION SCIENCES  
CRASH DATA RESEARCH CENTER**

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**ON-SITE ON-SITE POTENTIAL OVER-SENSITIVE AIR BAG DEPLOYMENT  
INVESTIGATION  
SCI TECHNICAL SUMMARY REPORT**

**VERIDIAN CASE NO. CA01-035**

**VEHICLE - 2001 FORD FOCUS ZX3**

**LOCATION - STATE OF NEW YORK**

**CRASH DATE - JUNE 2001**

Contract No. DTNH22-94-D-07058

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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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16. <i>Abstract</i> This crash involved a 2001 Ford Focus ZX3 that was occupied by a 70-year-old male driver and a 2000 Honda Odyssey occupied by a 47-year-old female driver. Both drivers were restrained by the 3-point lap and shoulder belt systems. The driver of the Ford Focus was operating the vehicle on a three-lane divided roadway in the outboard lane when he failed to detect the slowed Honda Odyssey ahead of his vehicle in the travel lane. The Ford Focus impacted the Odyssey in a front-to-rear configuration. The damage to both vehicles was minor, however, the impact-induced deceleration was sufficient to deploy the redesigned frontal air bag system and seat belt pretensioner system in the Focus. The driver of the Focus initiated a forward trajectory in response to the crash force and loaded the manual restraint. The driver stated that he received minor forearm abrasions and refused medical treatment at the scene. The Ford Focus was towed from the scene and the Honda Odyssey was driven from the scene by the driver. This investigation focused on the deployment of the redesigned frontal air bag system and seat belt pretensioner system relative to the change in velocity for the Ford Focus. The on-site inspection of the Ford Focus was performed on June 12, 2001, and the inspection of the Honda Odyssey was completed on June 15, 2001.			
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LOCATION: STATE OF NEW YORK  
VEHICLE: 2001 FORD FOCUS ZX3  
CRASH DATE: JUNE 2001**

***BACKGROUND***

This crash involved a 2001 Ford Focus ZX3 (**Figure 1**) that was occupied by a 70-year-old male driver and a 2000 Honda Odyssey occupied by a 47-year-old female driver. Both drivers were restrained by the 3-point lap and shoulder belt systems. The driver of the Ford Focus was operating the vehicle on a three-lane divided roadway in the outboard lane when he failed to detect the slowed Honda Odyssey ahead of his vehicle in the travel lane. The Ford Focus impacted the Odyssey in a front-to-rear configuration. The damage to both vehicles was minor, however, the impact-induced deceleration was sufficient to



**Figure 1. 2001 Ford Focus ZX3**

deploy the redesigned frontal air bag system and seat belt pretensioner system in the Focus. The driver of the Focus initiated a forward trajectory in response to the crash force and loaded the manual restraint. The driver stated that he received minor forearm abrasions and refused medical treatment at the scene. The Ford Focus was towed from the scene and the Honda Odyssey was driven from the scene by the driver. This investigation focused on the deployment of the redesigned frontal air bag system and seat belt pretensioner system relative to the change in velocity for the Ford Focus. The on-site inspection of the Ford Focus was performed on June 12, 2001, and the inspection of the Honda Odyssey was completed on June 15, 2001.

This crash was identified by an SCI investigator who passed the scene shortly after the crash. This crash occurred in June 2001 and the case was pursued at the request of the Office of Defect Investigations as a potential over-sensitive air bag deployment. It was assigned to the Veridian Special Crash Investigation Team on June 11, 2001 as an on-site investigation effort.

***SUMMARY***

**Crash Site**

This two vehicle crash occurred in the outboard westbound lane of a three-lane divided state roadway during daylight hours. At the time of the crash, there were no adverse weather conditions, as the asphalt road surface was dry. The east/west state roadway consisted of three travel lanes in each direction that were separated by a curbed median. The roadway was straight with a level grade and was bordered by concrete curbs, grassy areas, and sidewalks. The roadside environment consisted of commercial properties. There was no traffic control device at the crash site. The posted speed limit was 64 km/h (40 mph).

### Pre-Crash

The 46-year-old female driver of the 2000 Honda Odyssey was operating the vehicle on the outboard westbound lane of the state roadway (**Figure 2**). An uninvolved vehicle was traveling in the same lane in front of the Odyssey that slowed quickly to make a right turn onto a local roadway. The driver of the Odyssey applied the brakes and continued to travel in a forward direction while she remained in the travel lane. The 70-year-old male driver of the 2001 Ford Focus was operating the vehicle in the outboard westbound lane (**Figure 3**) behind the Odyssey. The driver of the Focus did not detect the uninvolved vehicle making the right turn and did not realize the Odyssey had slowed in the travel lane ahead. He stated that the sun was very bright at the time of the crash which may have obscured his vision. When the driver of the Focus realized the impending crash, he attempted to apply the brakes. He stated that he may have inadvertently engaged the accelerator and the brake at the same time due to the close proximity of the foot controls. The driver of the Odyssey stated that she was not aware of the approaching Ford Focus behind her vehicle prior to the crash, and did not attempt any avoidance maneuvers. A cellular telephone was present in the Odyssey but was not in use at the time of the crash.



**Figure 2. Westbound path of travel for the Honda Odyssey**



**Figure 3. Westbound path of travel for the Ford Focus**

### Crash

The Ford Focus struck the Honda Odyssey in a front-to-rear configuration (**Figure 4**). Both vehicles were still traveling forward at impact. The directions of force were in the 12 o'clock and 6 o'clock sectors for the Focus and Odyssey, respectively. The driver of the Focus stated that his estimated impact speed was approximately 16 km/h (10 mph). Although the Delta V's appeared to be low for both vehicles, the impact induced deceleration was sufficient to deploy the frontal air bag system in the Ford Focus. The damage algorithm of the WinSMASH program computed velocity changes of 15.0 km/h (9.3 mph) for the Focus and 9.0 km/h (5.6 mph) for the Odyssey based on the respective crush profiles. The Honda Odyssey was displaced forward and came to rest in the travel lane. Although damage was identified on the right rear wheel of the Odyssey that appeared to be from a curb impact, the crash configuration and lack of scene evidence did not support a secondary impact to the Odyssey. The Ford Focus departed the



**Figure 4. Point of impact**

lane on the right side and traveled over the curb and came to rest facing west on the grassy area adjacent to the sidewalk (**Figure 5**). The driver stated that he did not deliberately maneuver the vehicle after the impact.

### **Post-Crash**

The driver of the Odyssey did not sustain injury. She drove the vehicle around the corner and parked it in the parking lot adjacent to the crash site. She exited the vehicle under her own power. The driver of the Focus remained in the vehicle until rescue personnel arrived. He exited the vehicle under his own power and refused medical treatment at the scene. The Odyssey was driven from the scene and the Focus was towed from the scene.



**Figure 5. Final rest position for the Ford Focus**

## **VEHICLE DATA**

### ***2001 Ford Focus ZX3***

The 2001 Ford Focus was identified by the Vehicle Identification Number (VIN): 3FAFP31351R (production sequence omitted). The driver was the owner of the vehicle. The Focus ZX3 was a two-door hatchback equipped with a 2.0 liter, 4-cylinder engine, front-wheel drive, and automatic transmission. A manual crank sun/moon roof was present. The Focus was configured with front bucket seats with folding backs with adjustable head restraints and a rear bench with a folding back. The Focus was also equipped with a tilt steering wheel that was between the center and full-down positions at the time of the vehicle inspection. The owner reported no previous crashes to the Focus.

### ***2000 Honda Odyssey***

The 2000 Honda Odyssey was identified by the VIN: 2HKRL1859YH (production sequence omitted). The Odyssey was a 5-door minivan equipped with a 3.5 liter, V-6 engine, front disc and rear drum anti-lock brakes with electronic brake force distribution, and a 4-speed automatic transmission. The driver's husband was listed as the owner of the vehicle. The seating was configured with front bucket seats, two convertible second row bucket seats, third row bench seat that retracted into the rear floor well. All seating positions were equipped with 3-point manual lap and shoulder belts and the front manual restraints were equipped with retractor pretensioners. The driver stated that the Odyssey was involved in a previous frontal crash with a deer, however, there was no reportable damage to the vehicle.

## VEHICLE DAMAGE

### Exterior Damage - 2001 Ford Focus ZX3

The 2001 Ford Focus sustained minor damage as a result of the impact with the Honda Odyssey. Direct contact began on the bumper fascia 19.8 cm (7.8") to the left of the centerline and extended 48.3 cm (19.0") laterally to the right (**Figure 6**). The front license plate was deformed from direct contact and was displaced downward 2.5 cm (1.0"). An angled abrasion was also noted on the face of the front bumper fascia to the right of the license plate. The combined direct and induced damage involved the entire frontal width of the vehicle. The bumper beam was crushed rearward behind the bumper fascia and Styrofoam filler. The maximum crush at the bumper beam was located 3.8 cm (1.5") to the left of the centerline and measured 5.7 cm (2.3"). The composite bumper beam was also fractured at the location of maximum crush (**Figure 7**). The bumper fascia and Styrofoam filler appeared to have rebounded to the original position after the crash, as there was no significant damage to either component. The Collision Deformation Classification (CDC) for the impact with the Odyssey was 12-FZLW-1. Six crush measurements were taken at the bumper beam and were as follows: C1 = 1.0 cm (0.4"), C2 = 2.0 cm (0.8"), C3 = 4.0 cm (1.6"), C4 = 4.0 cm (1.6"), C5 = 3.0 cm (1.2"), C6 = 1.0 cm (0.4").

### Interior Damage - 2001 Ford Focus ZX3

Interior damage to the 2001 Ford Focus was minor (**Figure 8**) and attributed to the activation of the supplemental restraint systems. The windshield was fractured on the right side from the front right redesigned air bag module cover flap. There was no passenger compartment intrusion. A faint scuff mark was identified on the lower left aspect of the rigid plastic knee bolster from possible left knee contact, however, there was no injury to support it.



**Figure 6. Frontal damage to the Ford Focus**



**Figure 7. Fractured bumper beam**



**Figure 8. Interior view of the Ford Focus**

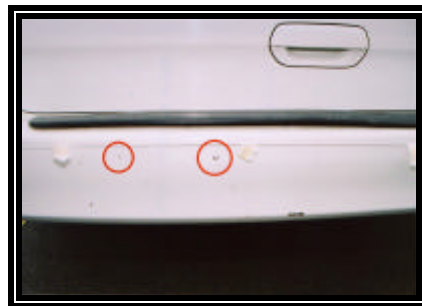


### **Exterior Damage - 2000 Honda Odyssey**

The 2000 Honda Odyssey sustained minor damage as a result of the impact with the Ford Focus. The direct contact damage was located on the rear bumper fascia, and began 2.5 cm (1.0") left of the centerline and extended laterally 55.9 cm (22.0") to the left (**Figure 9**). The direct contact consisted of an abrasion 2.5 cm (1.0") to the left of the centerline and two 1.3 cm (0.5") diameter hexagon shaped impressions 17.8 cm (7.0") to the left of the centerline (**Figure 10**). The hexagon-shaped impressions were from the Focus' top license plate screw heads that were used to anchor the license plate to the bumper fascia. The rubber trim molding on the top aspect of the rear bumper was displaced upward. The maximum vertical displacement was 1.3 cm (0.5") and was located 2.5 cm (1.0") to the left of the centerline. Damage to the outer edge of the right rear wheel cover was identified on the Odyssey that appeared to be from a curb impact. However, the crash configuration and lack of scene evidence did not support a secondary impact to the Odyssey. Therefore, the wheel damage appears to be unrelated to this crash. The CDC for the impact with the Ford Focus was 06-BYLW-1. There was no measurable crush to the Odyssey.



**Figure 9. Damage to the rear bumper of the Odyssey**



**Figure 10. Marks from the Focus' license plate screws (highlighted in circles)**

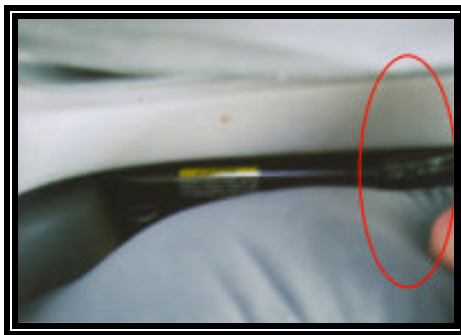
### **Interior Damage - 2000 Honda Odyssey**

There was no interior damage to the 2000 Honda Odyssey.

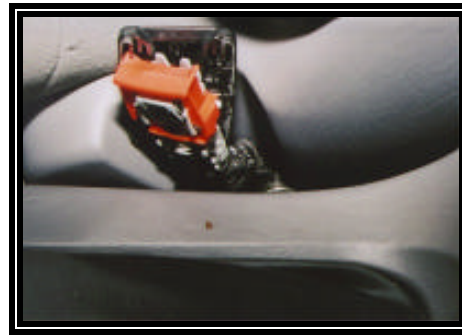
### **MANUAL RESTRAINT SYSTEM - 2001 Ford Focus ZX3**

The driver's manual restraint consisted of a 3-point lap and shoulder belt with a sliding latchplate and inertial lock/belt sensitive retractors. The driver's manual restraint was equipped with a retractor pretensioner. According to the repair facility at the time of the vehicle inspection, the driver's pretensioner was activated as a result of the crash. However, the retractor appeared to operate normally when the webbing was extended and released during the vehicle inspection. Abrasions were noted on the underside of the sliding latch plate that were indicative of the driver loading the manual belt system. The adjustable D-ring for the driver's manual restraint was in the full-up position.

The front right manual restraint consisted of a 3-point lap and shoulder belt with a sliding latch plate and an inertial and switchable retractor. The adjustable D-ring for the front right manual restraint was in the full-down position. The front right manual restraint was equipped with a buckle pretensioner that was longitudinally located along the lower inboard edge of the seat cushion. The 2001 Ford Focus was not equipped with an Advanced Occupant Protection System (AOPS). The seat belt pretensioners were designed to fire together, regardless of seat occupancy. The front right pretensioner fired as a result of the frontal impact. Since the seat belt was not engaged with the buckle and there was no occupant to provide resistance to the belt system, the piston was propelled forward 14.8 cm (5.8") which caused the leading edge of the cable to protrude 3.8 cm (1.5") out of the forward edge of the canister (**Figure 11**). Due to the excessive forward travel of the piston and cable, the vertical force applied to the buckle caused the plastic cover around the buckle to separate from the interior assembly (**Figure 12**). This did not impair the performance of the buckle assembly, as the buckle was tested with the latch plate, post-crash.



**Figure 11. Front right buckle pretensioner canister showing the cable protruding from the forward edge**



**Figure 12. Front right buckle assembly damage**

The three rear seating positions were each equipped with manual 3-point lap and shoulder belts with sliding latch plates.

### REDESIGNED FRONTAL AIR BAG SYSTEM - 2001 Ford Focus ZX3

The 2001 Ford Focus was equipped with redesigned air bags for the driver and front right passenger positions that deployed as a result of the impact with the Honda Odyssey. The redesigned driver's air bag was housed in the center of the steering wheel with asymmetrical module cover flaps that were trapezoidal in shape. The top cover flap measured 5.1 cm (2.0") in height and 17.8 cm (7.0") in width at the tear seam. The bottom flap measured 7.6 cm (3.0") in height and 17.8 cm (7.0") in width at the tear seam. The redesigned air bag measured 54.6 cm (21.5") in diameter in its deflated state (**Figure 13**). The driver's redesigned air bag was vented by a series of nine 1.3 cm (0.5") diameter semi-circular ports located at the 12 o'clock aspect. The two rows of vent ports were arranged linearly in a rectangular area that measured 3.8 cm (1.5") in height and 14.0 cm (5.5") in width. Multiple lateral lines of intentional break-away stitching were noted around the circumference of the air bag which extended approximately 12.7 cm (5.0") on each side of the air bag seam (**Figure 14**). A vinyl transfer was identified on the top aspect of the bag forward of the vent ports along the seam from expansion against the cover flap. The air bag was not tethered.

The redesigned front right passenger's air bag deployed from the from a top-mounted module with a single cover flap design hinged at the forward aspect (**Figure 15**). The cover flap measured 12.7 cm (5.0") in height and 41.9 cm (16.5") in width. The air bag measured 58.4 cm (23.0") in height and 45.7 cm (18") in width and was vented by two ports that measured 2.5 cm (1.0") in diameter and were located at the 10 and 2 o'clock aspects. The redesigned front right passenger's air bag was not tethered.



**Figure 14. Driver's redesigned air bag**



**Figure 13. Driver's redesigned air bag showing vent ports and stitching**



**Figure 15. Redesigned front right passenger's air bag**

## OCCUPANT DEMOGRAPHICS - 2001 Ford Focus ZX3

### Driver

Age/Sex: 70-year-old male  
Height: 175 cm (69")  
Weight: 77 kg (170 lb)  
Seat Track Position: Full-rear  
Manual Restraint Use: 3-point manual lap and shoulder belt  
Usage Source: Vehicle inspection, interview, police report  
Eyewear: None  
Type of Medical Treatment: Refused medical treatment at the scene

### Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanisms
Right forearm abrasion	Minor (790202.1,1)	Expanding redesigned driver's air bag

\*Injury source: Driver interview

### Driver Kinematics

The 70-year-old male driver of the 2001 Ford Focus was seated in an upright posture with the seat track adjusted to the full rear position and the seat back slightly reclined. His left and right hands were positioned on the steering wheel rim at the 9 and 3 o'clock positions, respectively. The driver stated that his left foot was on the left aspect of the floor pan, but he was uncertain if his right foot was depressing the brake pedal, the accelerator, or both. He was properly restrained by the 3-point manual lap and shoulder belt. At impact with the Honda Odyssey, the redesigned frontal air bag system deployed and the seat belt pretensioners fired. The retractor pretensioner reduced the slack in the driver's seat belt which prevented additional forward motion. The driver's air bag expanded against the driver's right forearm which caused a right forearm abrasion. The driver initiated a forward trajectory and loaded the manual restraint and deployed redesigned driver's air bag. He stated that he did not maneuver the vehicle after the impact, and that he did not alter his posture until the vehicle came to rest. He remained in the vehicle until rescue personnel arrived on-scene. He exited the vehicle under his own power through the left door. He refused medical treatment at the scene.

## **OCCUPANT DEMOGRAPHICS - 2000 Honda Odyssey**

### **Driver**

Age/Sex:	46-year-old female
Height:	170 cm (67")
Weight:	77 kg (170 lb)
Seat Track Position:	Mid-track, 12.7 cm (5.0") rear of full-forward
Manual Restraint Use:	3-point manual lap and shoulder belt
Usage Source:	Interview, police report
Eyewear:	Contact lenses
Type of Medical Treatment:	Refused medical treatment at the scene

### **Driver Kinematics**

The 46-year-old female driver was seated in an upright posture with the seat track adjusted to the mid-track position and the seat back slightly reclined. She stated that her left foot was on the left aspect of the floor pan and her right foot was on the brake pedal. She was restrained by the 3-point manual lap and shoulder belt. At impact, the driver initiated a rearward trajectory and loaded the driver's seat back. She rebounded forward into the manual restraint. She did not sustain any injuries. After the Odyssey came to rest, she drove it around the corner and parked it in a parking lot adjacent to the crash site. She exited the vehicle under her own power through the left front door, and refused medical treatment at the scene.

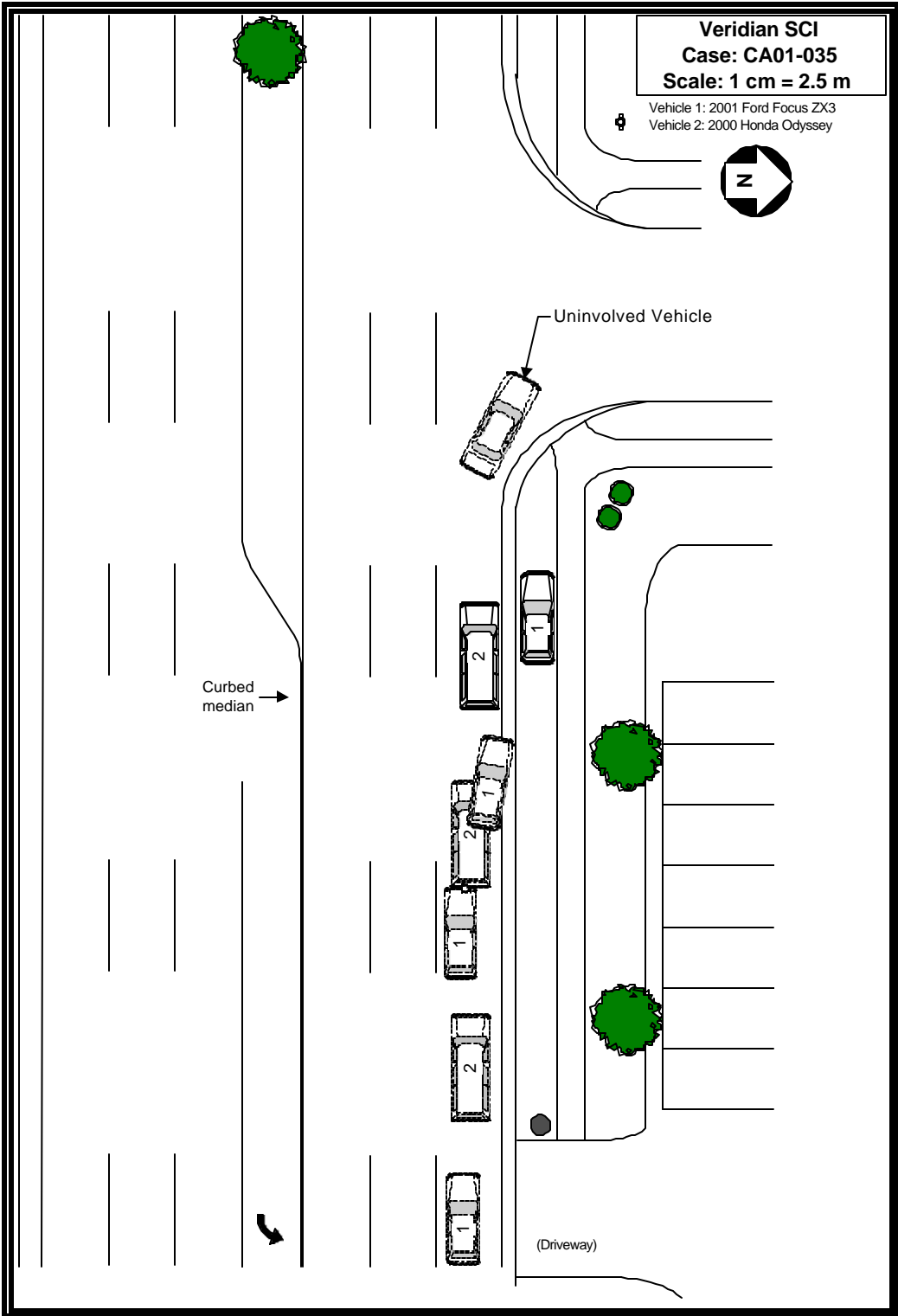


Figure 16. Scene schematic