

**TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION**

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**REDESIGNED AIR BAG SPECIAL STUDY (RABSS)
SCI TECHNICAL SUMMARY REPORT**

NASS CDS CASE NO. 1998-43-212A

**RABSS VEHICLES - 1998 PLYMOUTH GRAND VOYAGER SE
1998 FORD F-150 SUPER CAB PICKUP TRUCK**

LOCATION - STATE OF NORTH CAROLINA

CRASH DATE - AUGUST, 1998

Contract No. DTNH22-94-D-07058

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.

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<p>16. <i>Abstract</i> This investigation focused on a multiple vehicle crash involving a 1998 Plymouth Grand Voyager SE minivan (subject vehicle #1), a 1998 Ford F-150 Super Cab pickup truck (subject vehicle #2) and a 1995 Ford Escort LX 4-door hatchback. The Plymouth Grand Voyager and Ford F-150 pickup were equipped with redesigned frontal air bags that deployed as a result of an acute angle collision. The driver of the Ford Escort was operating the vehicle westbound on approach to a 3-leg intersection when he failed to detect the stop sign or northbound Plymouth as he attempted to turn left (south). As the Ford Escort entered the intersection, the front right area impacted the right passenger area of the Plymouth. Impact resulted in moderate damage to both vehicles. At this point, the Plymouth Grand Voyager rotated clockwise and entered the south bound lane into the path of the Ford pickup. As the Plymouth entered the southbound lane the frontal area of the Ford pickup struck the left passenger area of the Plymouth. Impact resulted in moderate damage to the Ford pickup and severe damage to the Plymouth. The 42 year old female driver of the Plymouth Grand Voyager was restrained by the available 3-point manual lap and shoulder belt system and initiated a forward/lateral trajectory in response to the (second impact) 10 o'clock impact force, loading the manual restraint and various left side components which resulted in multiple soft tissue injuries. She struck the left B-pillar and roof side rail resulting in a cerebral contusion and subdural hematoma; and which also indirectly contributed to a cervical fracture. The driver was transported by ambulance to a local trauma center where she was pronounced dead 2.5 hours later. The 34 year old male driver of the Ford pickup was also restrained by the 3-point manual lap and shoulder belt system and initiated a forward trajectory in response to the 12 o'clock impact force. He loaded the manual restraint as the expanding air bag contacted the anterior aspect of both forearms resulting in bilateral abrasions. He also sustained abrasions to the chest from loading to the manual restraint. The driver was transported to a local hospital for treatment and released.</p>			
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CRASH DATE - AUGUST, 1998**

BACKGROUND

This investigation focused on a multiple vehicle crash involving a 1998 Plymouth Grand Voyager SE minivan (subject vehicle #1), a 1998 Ford F-150 Super Cab pickup truck (subject vehicle #2) and a 1995 Ford Escort LX 4-door hatchback. The Plymouth Grand Voyager and Ford F-150 pickup were equipped with redesigned frontal air bags that deployed as a result of an acute angle collision. The driver of the Ford Escort was operating the vehicle westbound on approach to a 3-leg intersection when he failed to detect the stop sign or northbound Plymouth as he attempted to turn left (south). As the Ford Escort entered the intersection, the front right area impacted the right passenger area of the Plymouth. Impact resulted in moderate damage to both vehicles. At this point, the Plymouth Grand Voyager rotated clockwise and entered the south bound lane into the path of the Ford pickup. As the Plymouth entered the southbound lane the frontal area of the Ford pickup struck the left passenger area of the Plymouth. Impact resulted in moderate damage to the Ford pickup and severe damage to the Plymouth. The 42 year old female driver of the Plymouth Grand Voyager was restrained by the available 3-point manual lap and shoulder belt system and initiated a forward/lateral trajectory in response to the (second impact) 10 o'clock impact force, loading the manual restraint and various left side components which resulted in multiple soft tissue injuries. She struck the left B-pillar and roof side rail resulting in a cerebral contusion and subdural hematoma; and which also indirectly contributed to a cervical fracture. The driver was transported by ambulance to a local trauma center where she was pronounced dead 2.5 hours later. The 34 year old male driver of the Ford pickup was also restrained by the 3-point manual lap and shoulder belt system and initiated a forward trajectory in response to the 12 o'clock impact force. He loaded the manual restraint as the expanding air bag contacted the anterior aspect of both forearms resulting in bilateral abrasions. He also sustained abrasions to the chest from loading to the manual restraint. The driver was transported to a local hospital for treatment and released.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as CDS case number 98-43-212A and included in the Redesigned Air Bag Special Study. The Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) assigned the Special Crash Investigation (SCI) team at Veridian/Calspan the task of case review and final report preparation. Please note that a multitude of errors in the NASS case file were identified by the author of this summary (corrected data was used in this summary), but were too numerous to mention in this report.

SUMMARY

Crash Site

This multiple vehicle crash occurred during the morning hours of August, 1998. At the time of the crash, it was daylight with no adverse conditions as the asphalt roads were dry. The crash occurred at a rural 3-leg (Y) intersection of two state roadways (see **Figure 14 - page 11**). The north/south roadway consisted of two travel lanes that were straight with a negative grade to the north. The east/west

roadway consisted of two travel lanes that were straight with a negative grade to the east. The roadside environment included soft shoulders and a shallow drainage ditch to the west. Traffic control at the scene included a stop sign for westbound traffic which had a posted speed limit of 72 km/h (45 mph).

Pre-Crash

The 20 year old male driver of the 1995 Ford Escort LX was operating the vehicle westbound on approach to the rural 3-leg intersection (**Figure 1**) when he failed to detect the stop sign or northbound Plymouth as he attempted to turn left (south). The 42 year old female driver of the 1998 Plymouth Grand Voyager was operating the vehicle northbound (**Figure 2**) on approach to the same intersection. There were no brake marks within either vehicle's trajectory indicative of driver avoidance maneuvers. Each of these vehicles were reported by police as traveling at the speed limit of 72 km/h (45 mph). The 34 year old male driver of the 1998 Ford F-150 was operating the vehicle southbound (**Figure 3**) also on approach to the 3-leg intersection at a driver reported speed of 80 km/h (50 mph). Upon recognition of the impending harmful event, he steered right and braked, remaining in the southbound lane prior to impact. The investigating officer noted 9.7 meters (32.0 feet) of pre-impact skid marks, however, the NASS researcher failed to identify the marks at the scene.



Figure 1. Westbound approach for the 1995 Ford Escort LX.

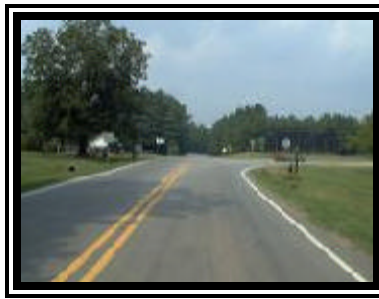


Figure 2. Northbound approach for the 1998 Plymouth Grand Voyager SE.



Figure 3. Southbound approach for the 1998 Ford F-150 Super Cab pickup truck.

Crash

As the Ford Escort entered the intersection, the front right area impacted the right passenger area of the Plymouth Grand Voyager. Impact resulted in moderate damage to both vehicles. The impact induced deceleration was sufficient to deploy the frontal air bag system only in the 1995 Ford Escort. The damage algorithm of the WinSMASH program computed (*revised*) velocity changes of 12.7 km/h (7.9 mph) for the Plymouth (subject vehicle #1) and 19.7 km/h (12.2 mph) for the striking Ford. The specific longitudinal components were -8.2 km/h (-5.1 mph) and -19.4 km/h (-12.1 mph). The (*revised*) Collision Deformation Classification (CDC) for this initial impact to the Plymouth Grand Voyager was 02-RPEW-2 with a principal direction of force of (+)50 degrees. The (*revised*) CDC for this impact to the Ford Escort was 12-FREE-2 with a principal direction of force of (-)10 degrees. The 1995 Ford Escort rotated clockwise approximately 75 degrees and came to rest partially off the east shoulder of the north/south roadway facing northwest.

At this point, the Plymouth rotated clockwise 40 degrees and entered the southbound lane where the frontal area of the southbound Ford pickup struck the left passenger area of the Plymouth. Impact resulted in severe damage to the Plymouth and moderate damage to the Ford pickup. The impact induced deceleration was sufficient to deploy the redesigned frontal air bag systems in both vehicles. The damage algorithm of the WinSMASH program computed (*revised*) velocity changes of 35.5 km/h (22.1 mph) for the Plymouth (subject vehicle #1) and 31.8 km/h (19.8 mph) for the struck Ford pickup (subject vehicle #2). The specific longitudinal components were -22.8 km/h (-14.2 mph) and -31.4 km/h (-19.5 mph). The (*revised*) CDC for this second impact to the Plymouth was 10-LZAW-5 with a principal direction of force of (-)50 degrees. The (*revised*) CDC for this impact to the Ford F-150 pickup was 12-FDEW-3 with a principal direction of force of (-)10 degrees. The 1998 Plymouth Grand Voyager rotated counterclockwise 155 degrees and came to rest perpendicular to the north/south travel lanes facing northwest. The 1998 Ford F-150 pickup rotated counterclockwise 40 degrees and came to rest off the west shoulder facing southeast.

Post-Crash

The driver of the Plymouth Grand Voyager was removed from the vehicle by rescue personnel while unconscious as the driver of the Ford pickup exited the vehicle under his own power. The exit status of the Ford Escort driver was unknown but was reported by police as sustaining only minor injuries. Treatment was rendered at the scene by emergency medical technicians (EMTs) and fire department personnel. The Plymouth driver was transported by ambulance to a local trauma center and arrived 17 minutes following the crash where she was pronounced dead 2.5 hours later. The Ford pickup driver was transported to a local hospital for treatment and released. All three vehicles were towed from the scene.

RABSS VEHICLES

1998 Plymouth Grand Voyager SE

The 1998 Grand Voyager SE was identified by the Vehicle Identification Number (VIN): 1P4GP44G0WB (production sequence deleted). The vehicle was a 5-door minivan equipped with all wheel drive and a 3.3 liter, 6 cylinder engine. The vehicle's odometer reading was 8,047 km (5,000 miles) at the time of the crash. The police report listed the driver as the owner of the vehicle. The seating was configured with box mounted (van type) bucket seats for the front and second rows along with a rear bench (with folding backs). The surrogate reported no previous crashes or maintenance on the air bag system (original equipment). No cell phone was present or in-use at the time of the collision.

1998 Ford F-150 pickup truck

The 1998 Ford F-150 Super Cab was identified by the Vehicle Identification Number (VIN): 1FTZX17W5WN (production sequence deleted). The vehicle was a 3-door pickup equipped with rear wheel drive and a 4.6 liter, V-8 engine. The vehicle's odometer reading was 13,290 km (8,258 miles) at the time of the crash. The police report listed an unspecified relative as the owner of the vehicle. The seating was configured with a front and rear split benches (with folding backs). The driver reported no previous crashes or maintenance on the air bag system (original equipment). A cellular "flip" phone was present but not in-use at the time of the collision.

VEHICLE DAMAGE - 1998 Plymouth Grand Voyager SE

Exterior Damage

The 1998 Plymouth Grand Voyager sustained moderate right side damage as a result of the impact with the Ford Escort (**Figure 4**). The (*revised*) direct contact damage began 63.0 cm (24.8 in) forward of the right rear axle and extended 227.0 cm (89.4 in) forward. The (*revised*) combined direct and induced damage length (Field L) also measured 227.0 cm (89.4 in). Six (*revised*) crush measurements were documented at the level of the lower door: C1= 5.0 cm (2.0 in), C2= 0 cm, C3= 0 cm, C4= 1.0 cm (0.4 in), C5= 9.0 cm (3.5 in), C6= 5.0 cm (2.0 in). The contact damage was concentrated mainly within the passenger area with the right front glazing disintegrated by the impact force. The right rear wheel/tire was restricted and deflated from rearward displacement against the frame (snagging effect prior to vehicle separation).



Figure 4. Right side damage to the 1998 Plymouth Grand Voyager.

The 1995 Ford Escort LX sustained moderate frontal damage as a result of the impact with the Plymouth Grand Voyager (**Figure 5**). The (*revised*) direct contact damage began at the front right bumper corner and extended 40.0 cm (15.7 in) inboard. The hood was displaced rearward from engagement against the side surface of the Plymouth. Damage was also noted to the right fender which restricted/deflated the right front wheel/tire. Reduction in the right side wheelbase measured 7.0 cm (2.8 in). The windshield was undamaged.



Figure 5. Frontal damage to the 1995 Ford Escort LX.

The Plymouth also sustained severe left side damage as a result of the impact with the Ford pickup (**Figure 6**). The (*revised*) direct contact damage began 145.0 cm (57.1 in) aft of the left front axle and extended 175.0 cm (68.9 in) rearward. The (*revised*) combined direct and induced damage length (Field L) began 65.0 cm (25.6 in) aft of the left front axle and extended 287.0 cm (113.0 in) rearward. Six (*revised*) crush measurements were documented at the level of the mid-door: C1= 1.0 cm (0.4 in), C2= 91.0 cm (35.8 in), C3= 62.0 cm (24.4 in), C4= 77.0 cm (30.3 in), C5= 47.0 cm (18.5 in), C6= 4.0 cm (1.6 in). A (*revised*) secondary profile was taken at the level of the sill to capture the structural compromise due to the left rear door failure, resulting in an *averaged profile* of: C1= 1.0 cm (0.4 in), C2= 66.0 cm (26.0 in), C3= 51.0 cm (20.1 in), C4= 60.0 cm (23.6 in), C5= 47.0 cm (18.5 in), C6= 4.0 cm (1.6 in). The height of the direct contact damage surpassed the level of the beltline which produced induced buckling to the roof and upper window frame area. All left side tempered glazing was disintegrated with induced displacement noted to the rear hatch assembly. The windshield was fractured with bond separation noted along the header area. The left rear wheel/tire separated from the axle during the collision sequence.



Figure 6. Left side damage to the 1998 Plymouth Grand Voyager.

Interior Damage

Interior damage to the Plymouth Grand Voyager identified through the NASS vehicle inspection was severe and was attributed to occupant contact and component intrusion (**Figure 7**). A scuff mark was documented to the left front door panel with the door hardware out of place. Hair strands were identified on the roof and left side rail. The front left restraint was cut by rescue during the driver's extrication from the vehicle. The top portion of the steering wheel rim was deformed forward 13.0 cm (5.1 in). No deformation was identified on the knee bolster (rigid plastic type). A blood smear was noted to the right aspect of the driver seat back which was displaced slightly forward by lateral and longitudinal component intrusions. The armrest located on the right aspect of the driver seat was also deformed to the right. The rear view mirror was displaced. A multitude of intrusions were (*revised*) documented to include the following:

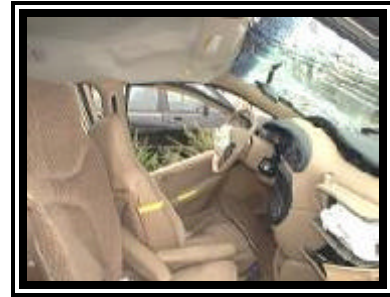


Figure 7. Interior view.

Component	Intrusion	Direction
Left front door panel	25.0 cm (9.8 in)	Lateral
Left front roof side rail	32.0 cm (12.6 in)	Lateral
Left front sill	20.0 cm (7.9 in)	Lateral
Left B-pillar	31.0 cm (12.2 in)	Lateral
Left front window frame	27.0 cm (10.6 in)	Lateral
Left front roof area	18.0 cm (7.1 in)	Vertical
Center left seat back	43.0 cm (16.9 in)	Longitudinal
Center left door panel	57.0 cm (22.4 in)	Lateral
Center left roof side rail	33.0 cm (13.0 in)	Lateral
Center left window frame	52.0 cm (20.5 in)	Lateral
Center left sill	21.0 cm (8.3 in)	Lateral
Center left roof area	19.0 cm (7.5 in)	Vertical
Rear left roof side rail	37.0 cm (14.6 in)	Lateral
Rear left side panel	79.0 cm (31.1 in)	Lateral
Rear left window frame	66.0 cm (26.0 in)	Lateral
Rear left roof area	14.0 cm (5.5 in)	Vertical
Rear left sill	7.0 cm (2.8 in)	Lateral
Rear left C-pillar	77.0 cm (30.3 in)	Lateral
Rear left D-pillar	8.0 cm (3.1 in)	Lateral

VEHICLE DAMAGE - 1998 Ford F-150 pickup truck

Exterior Damage

The 1998 Ford F-150 pickup sustained moderate frontal damage as a result of the impact with the Plymouth Grand Voyager (**Figure 8**). The direct contact damage encompassed the full frontal width resulting in a (*revised*) combined direct and induced damage length (Field L) of 145.0 cm (57.1 in). Six (*revised*) crush measurements were documented at the level of the bumper: C1= 53.0 cm (20.9 in), C2= 25.0 cm (9.8), C3= 20.0 cm (7.9 in), C4= 14.0 cm (5.5 in), C5= 9.0 cm (3.5 in), C6= 8.0 cm (3.1 in). The hood was displaced up and rearward from engagement against the side surface of the Plymouth. Direct contact damage was also noted to the left fender and door from sustained (wrap) contact between the vehicles during spinout. This damage pattern shattered the left front glazing and restricted/deflated the left front wheel/tire. The right front wheel was found to be deflated (not restricted). The windshield was fractured from exterior forces (only). Reduction in the left side wheelbase measured 43.0 cm (16.9 in). Reduction in the right side wheelbase measured 8.0 cm (3.1 in).



Figure 8. Frontal damage to the 1998 Ford F-150 pickup.

Interior Damage

No interior damage to the Ford pickup was identified through the NASS vehicle inspection (**Figure 9**). No deformation was identified on the knee bolster (rigid plastic type) or steering wheel hub/rim (tilt column set to the center position). No intrusions were found in the vehicle.



Figure 9. Interior view.

REDESIGNED AIR BAG SYSTEM

1998 Plymouth Grand Voyager SE

The 1998 Plymouth Grand Voyager was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags had deployed as a result of the impact with the Ford pickup. Air bag warning labels were affixed to each sun visor. The driver air bag was housed in the center of the steering wheel with a horizontally oriented flap tear seam (H-configuration). No contact evidence was identified on the air bag or exterior surface of the module cover flaps. The flaps were asymmetrical in shape as the upper flap measured 18.0 cm (7.1 in) in width and 2.0 cm (0.8 in) in height while the lower flap measured 18.0 cm (7.1 in) in width and 10.0 cm (3.9 in) in height. The NASS researcher measured the diameter of the driver air bag at 62.0 cm (24.4 in) in its deflated state (**Figure 10**). No vent ports were identified during the NASS inspection. The bag was tethered by two internal straps.

The front right passenger air bag deployed from the right mid-instrument panel area with a horizontally oriented flap tear seam (H-configuration). The cover flaps were rectangular and symmetrical in shape which measured 30.0 cm (11.8 in) in width and 7.0 cm (2.8 in) in height. Although no contact evidence was identified on the exterior surface of the module cover flaps, a blood smear was documented to the upper right quadrant of the air bag. The NASS researcher measured the passenger air bag at 44.0 cm

(17.3 in) in width and 65.0 cm (25.6 in) in height in its deflated state (**Figure 11**). No internal tether straps or vent ports were identified. No cutoff switch was reported for the front right redesigned passenger air bag.



Figure 10. 1998 Plymouth Grand Voyager redesigned driver air bag.



Figure 11. 1998 Plymouth Grand Voyager redesigned passenger air bag.

1998 Ford F-150 pickup truck

The 1998 Ford F-150 pickup was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags had deployed as a result of the crash. Air bag warning labels were affixed to each sun visor. The driver air bag was housed in the center of the steering wheel with a single cover flap design. No contact evidence was identified on the air bag or exterior surface of the module cover flap. The flap measured 17.0 cm (6.7 in) in width along the upper portion and 20.0 cm (7.9 in) along the lower portion with a height of 15.0 cm (5.9 in). The NASS researcher measured the diameter of the driver air bag at 65.0 cm (25.6 in) in its deflated state (**Figure 12**). The bag was tethered by two internal straps and vented by two ports located at the 11 o'clock and 1 o'clock sectors on the rear aspect of the air bag.



Figure 12. 1998 Ford F-150 pickup redesigned driver air bag.



Figure 13. 1998 Ford F-150 redesigned passenger air bag.

The front right passenger air bag deployed from the right mid-instrument panel area with a single cover flap design hinged at the top aspect. No contact evidence was identified on the air bag or exterior surface of the module cover flap. The cover flap was rectangular in shape and measured 39.0 cm (15.4 in) in width and 18.0 cm (7.1 in) in height. The NASS researcher measured the passenger air bag at 60.0 cm (23.6 in) square in its deflated state (**Figure 13**). No vent ports or internal tether straps were present. A cutoff switch was documented to the center mid-instrument panel area and was set to the “on” position.

DRIVER DEMOGRAPHICS

1998 Plymouth Grand Voyager SE

Age/Sex: 42 year old female
Height: 175 cm (69 in)
Weight: 119 kg (262 lb) revised
Seat Track Position: Full rearward position
Manual Restraint Use: 3-point lap and shoulder belt system
Usage Source: NASS vehicle inspection, medical report, police report
Eyewear: Contact lenses
Type of Medical Treatment: Transported to a trauma center and pronounced dead 2.5 hours later (possible fatal at scene).

Driver Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
Cerebral subdural hematoma (not further specified)	Severe (140650.4,9)	Left front roof side rail
Cerebral contusion	Serious (140602.3,9)	Left front roof side rail
Cervical spine fracture (not further specified)	Moderate (650216.2,6)	Left front roof side rail
Contusion left thoracic spine region	Minor (690402.1,2)	Left B-pillar
Abrasion left thoracic spine region	Minor (690202.1,2)	Left B-pillar
Contusion left anterior upper arm to elbow	Minor (790402.1,2)	Front left air bag
Abrasion left anterior upper arm to elbow	Minor (790202.1,2)	Front left air bag
Contusion left posterior upper arm	Minor (790402.1,2)	Left B-pillar
Abrasion left posterior upper arm	Minor (790202.1,2)	Left B-pillar
Contusion right posterior hand	Minor (790402.1,1)	Rear view mirror
Abrasion central abdomen	Minor (590202.1,4)	Lap belt webbing
Contusion left hip	Minor (890402.1,2)	Left front door armrest
Contusion bilateral buttocks	Minor (890402.1,3)	Front left seat back
Contusion right anterior upper thigh	Minor (890402.1,1)	Seat armrest
Abrasion right anterior upper thigh	Minor (890202.1,1)	Seat armrest

Driver Kinematics

The 42 year old female driver of the 1998 Plymouth Grand Voyager was presumed to be seated in an upright posture with the seat track adjusted to the full rearward position. She was restrained by the available 3-point manual lap and shoulder belt system. Belt usage was confirmed by the type of injuries sustained in conjunction with the webbing cut during driver extrication from the vehicle post-crash. *It should be noted that some of the injury sources identified in the NASS case file were revised following SCI analysis of the occupant kinematic pattern.*

At impact with the Ford Escort, the driver initiated a lateral and slightly forward trajectory in response to the 2 o'clock impact force and loaded the manual restraint resulting in an abrasion to the central abdominal region. She subsequently loaded the seat armrest (right aspect) which resulted in an abrasion/contusion to the anterior aspect of the right thigh, evidenced by the displacement of this component to the right. No other injury was attributed to this initial impact. At this point, the driver was out of place forward and to the right as the vehicle traveled into the second impact.

At impact with the Ford pickup, she again initiated a lateral and slightly forward trajectory in response to this 10 o'clock impact force and loaded the left B-pillar/door panel area resulting in multiple soft tissue injuries to the left arm, pelvis and back as evidenced by the location of the injuries relative to the kinematic response pattern. She never received the full benefit of the redesigned driver air bag as this kinematic pattern directed her to the left of the deployment, but the expanding air bag propelled her right hand upward into rear view mirror resulting in a contusion to the posterior aspect. The left side of the head struck the roof side rail which resulted in a cerebral contusion and underlying subdural hematoma; and contributed to a fracture of the cervical spine, evidenced by the hair strands documented to this component. She also sustained bilateral buttock contusions as a result of loading from the (intruded) center left seat which contacted the rear aspect of the driver's seat back. This mechanism was evidenced by the longitudinal displacement of this component and subsequent movement of the driver's seat back. The surrogate interview reported that the driver expired at the scene, however, the medical documentation obtained did not confirm this statement. The driver was transported by ambulance and arrived at the trauma center 17 minutes following the crash. She was pronounced dead 2.5 hours later.

DRIVER DEMOGRAPHICS

1998 Ford F-150 pickup truck

Age/Sex:	34 year old male
Height:	193 cm (76 in)
Weight:	104 kg (230 lb)
Seat Track Position:	Full rearward position
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	NASS vehicle inspection, driver interview, medical report
Eyewear:	Sunglasses
Type of Medical Treatment:	Transported to a local hospital and released

Driver Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
Abrasion left clavicle region	Minor (790202.1,2)	Shoulder belt webbing
Abrasion sternum region	Minor (490202.1,4)	Shoulder belt webbing
Abrasion bilateral anterior forearms	Minor (790202.1,3)	Front left air bag
Lacerations left arm (2 small lacerations - dorsal wrist with glass fragments embedded) (1cm laceration - anterior upper arm)	Minor (790602.1,2)	Flying glass

Driver Kinematics

The 34 year old male driver of the 1998 Ford F-150 pickup truck was seated in an upright posture with his hands placed at the 9 o'clock and 3 o'clock positions on the steering wheel rim. The seat back was slightly reclined and the seat track was adjusted to the full rearward position. He was properly restrained by the available 3-point manual lap and shoulder belt system. Belt usage was confirmed by the type of injuries sustained and lack of significant contact points within the vehicle. *It should be noted that some of the injury sources identified in the NASS case file were revised following SCI analysis of the occupant kinematic pattern.*

At impact, the driver initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of both forearms resulting in bilateral abrasions, evidenced by the location of the injury relative to the pre-crash placement of the hands on the steering wheel rim. He loaded the manual restraint which resulted in abrasions to the left clavicle and sternum area. The redesigned driver air bag provided additional restraint against further contact to the steering wheel hub/rim. He also sustained multiple (superficial) lacerations to the left inner (upper) arm and posterior wrist from flying glass. This mechanism was evidenced by the glass fragments removed during his subsequent medical treatment at a local hospital (treated and released).

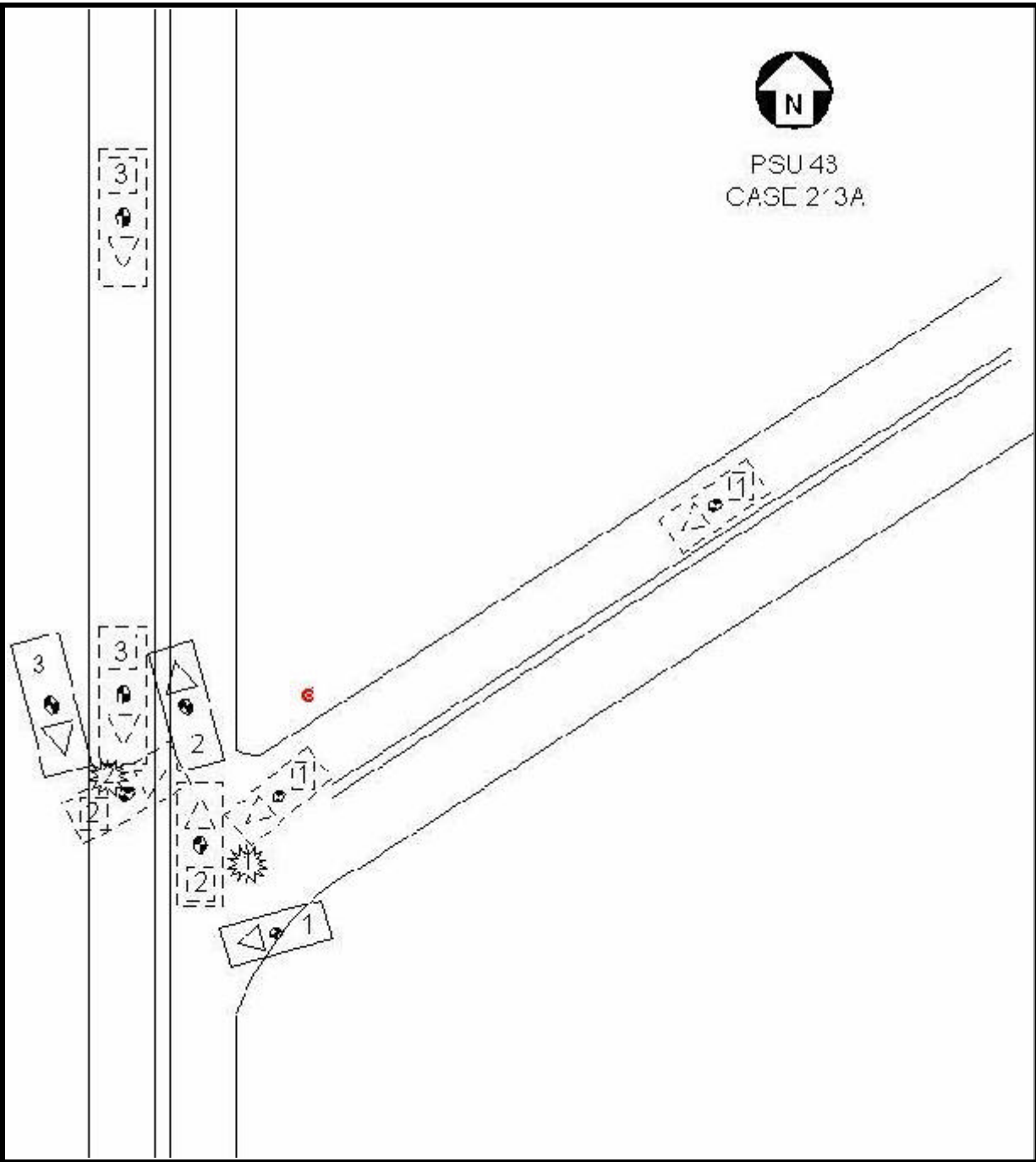


Figure 14. NASS Scene Diagram (physical plant erroneously documented as the physical evidence was omitted by the NASS researcher).