TECHNICAL RECONSTRUCTION GROUP CHAIRMAN'S FACTUAL REPORT

Chattanooga, TN

HWY15MH009

(44 pages)

NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF HIGHWAY SAFETY
WASHINGTON, D.C.

TECHNICAL RECONSTRUCTION GROUP CHAIRMAN'S FACTUAL REPORT

A. CRASH INFORMATION

Location:	Interstate 75 (I-75) at milepost 11.7 Ooltewah, Hamilton County, Tennessee
Vehicle #1:	2007 Peterbilt 379 truck tractor in combination with a 2006 Great Dane refrigerated semitrailer (empty)
Operator #1:	Cool Runnings Express, Inc.
Vehicle #2:	2010 Toyota Prius
Vehicle #3:	2010 Scion tC
Vehicle #4:	2003 Mazda Tribute
Vehicle #5:	2005 GMC Savana – G1500 cargo van
Vehicle #6:	2001 Ford F-150
Vehicle #7:	2007 Chevrolet Uplander
Vehicle #8:	2014 Cadillac CTS
Vehicle #9:	2015 Toyota Tundra
Date:	June 25, 2015
Time:	Approximately 7:10 p.m. EDT
NTSB #:	**HWY15MH009**

B. TECHNICAL RECONSTRUCTION GROUP

Robert Squire - Accident Investigator, Group Chairman
NTSB Office of Highway Safety
490 L'Enfant Plaza East, S.W., Washington, DC 20594

C. CRASH SUMMARY

For a summary of the crash, refer to the *Crash Summary Report* in the docket for this investigation.

D. DETAILS OF THE TECHNICAL RECONSTRUCTION GROUP INVESTIGATION

The Technical Reconstruction Group participated in the examination and documentation of the involved motor vehicles and collision scene; reviewed scene documentation data (roadway evidence documentation and photographs) provided by the Chattanooga Police Department (CPD); and highway data acquired by the NTSB Highway Factors Group. Primary forensic documentation involved photography and laser scanning techniques. Photographs were taken in digital format, while scanning was accomplished using the FARO Focus^{3D} x330 laser scanner. The multiple scans were processed (linked) and converted to select images to illustrate three-dimensional perspectives of the scanned subjects. The FARO laser scanner effectively captures the three-dimensional characteristics of the object being scanned[1]. Further processing allowed the point cloud data to be imported into a CAD application for additional analyses. A total of 11 scan projects were completed, which included the accident location, and involved vehicles.

1. Vehicle Documentation

A total of nine vehicles, which included the Peterbilt combination and eight light duty vehicles were scanned on June 29 and 30, 2015. The Peterbilt combination was scanned while in police custody at a storage facility in Ooltewah. The eight light vehicles were in police custody at a secure facility in Chattanooga.

The NTSB Vehicle Factors Group factual report should be consulted for additional information.

1.1. Peterbilt-Great Dane Combination

The combination vehicle was identified as a 2007 Peterbilt 379 truck tractor coupled with a 2006 Great Dane refrigerated semitrailer that was empty at the time of the collision. The combination was scanned from 11 positions. The front of the truck tractor exhibited contact

[1] The FARO Focus^{3D} is a high-speed Terrestrial Laser Scanner for 3D measurement and image documentation. The scanner produces dense point cloud scans that can be combined or linked from multiple positions to create a cohesive three-dimensional point cloud rendering of the subject target. The laser will capture features only within the direct line of sight to the scanner mirror. Areas obstructed to the laser or where surfaces fail to provide a reflection will appear as hole in the image and display only the background color.

damage that encompassed the entire width of the vehicle. The scan data did not depict any offset in the alignment of the tractor frame and body aft of the engine compartment. The front bumper outboard of the frame rail on the left (driver's) side was displaced rearward as were both front fenders. The hood was canted leftward toward the driver's side. Evidence of contact damage at the front of the vehicle extended vertically about 6.2–6.5 feet to about the top of the grill and hood. The overall length of the vehicle was measured at 74.1 feet.

Evidence of contact damage was also observed at several locations along the left side of the tractor and trailer. Damage was visible to the front tire and wheel followed by a rearward displacement of the bottom step at the driver's door, about 7.5 feet aft of the vehicle front. Contact and minor damage was observed at the leading edge of the fuel tank, about 11 feet rearward of the vehicle front, with some scrapes continuing aftward along the tank. About 20.4 feet from the front of the vehicle, the outboard leading edge of the forward-facing fender at the second axle exhibited scrapes and gouges. The vertical height of the areas of contact ranged from about 1.5 to 2.2 feet.

The outboard tire and wheel on the left side leading trailer axle (axle 4) also exhibited evidence of impact. The tire sidewall had been penetrated and the tire was deflated. The wheel rim exhibited damage to a portion of the flange. The tire damage was located about 60.5 feet aft of the vehicle front.

Figures 1 and 2 depict screen capture images of the colorized three-dimensional linked scans of the vehicle post-collision. Figure 3 depicts measurements related to certain areas of damage.

Figure 1: Colorized image of linked 3D scans depicting the left side of the Peterbilt combination.

Figure 2: Colorized image of linked 3D scans depicting the right side of the Peterbilt combination.

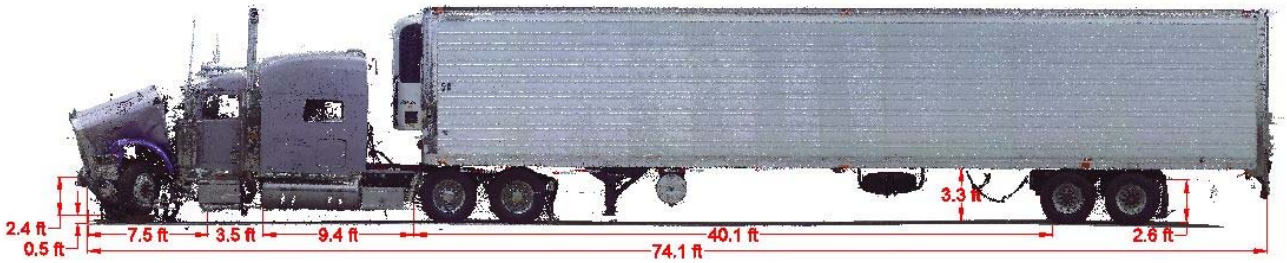


Figure 3: Point cloud image of the Peterbilt combination depicting certain dimensions. Note that the vertical measurement at the vehicle front accommodates the wheels being elevated on six-inch wood blocks.

Following the collision, the Peterbilt combination came to a stop primarily occupying the left shoulder with the trailer at a slight angle, encroaching into the left travel lane. The vehicle did not make contact with the center median barrier. The font of the truck tractor was located about 448 feet northward from the onset of the roadway evidence.

1.2. 2010 Toyota Prius

The Prius was identified as a four-door sedan that exhibited substantial damage and evidence of multiple impacts. The most significant damage was to the rear of the vehicle, which included substantial occupant compartment intrusion and override of the floor pan. The vehicle exhibited a rightward (passenger side direction) bowing as well as downward buckling of rocker panel on the passenger side. The average overall length of the vehicle was reduced by approximately 6.4 feet (76 inches) and wheelbase measurements on the right and left sides were also reduced by about 3.1 and 0.7 feet (37 and 8 inches) respectively.

The vehicle also exhibited contact damage to the right side, right front fender and left side. The right front fender exhibited multi-directional displacement that included rearward,

laterally inward and vertically downward. The static vertical height at the top of the front fender ranged from approximately 2.7 to 3.1 feet (post-collision). The right front wheel also exhibited impact damage, as did the front passenger side door.

On the left side of the vehicle, evidence of contact damage was observed to the left front wheel, front fender, driver's door and a portion of left rear door. Indentations and arced scrapes resulting in paint removal and scuffing were observed at the trailing edge of the left front fender and extended rearward to cover most of the driver's door. The diameter of the opposing arcs measured about 2.6–2.8 feet (~31–34 inches).

Figure 4 is a photograph depicting the arced scrapes observed on the driver's door. Figures 5 and 6 depict screen capture images of the six linked scans of the vehicle post-collision. Figure 7 depicts certain dimensional data measured from the point cloud rendering.

Figure 4: Photograph depicting arced scrapes and associated indentation contact damage to the driver's door on the Toyota Prius.

Figure 5: Colorized image of linked 3D scans depicting the front and forward right side of the Prius.

At its position of rest following the collision, the Prius was located on the left shoulder, perpendicular to the roadway, approximately 217 feet northward of the onset of roadway evidence.

Figure 6: Colorized image of linked 3D scans depicting the rear and right side of the Prius. The front passenger side door was removed at the crash site by emergency response personnel.

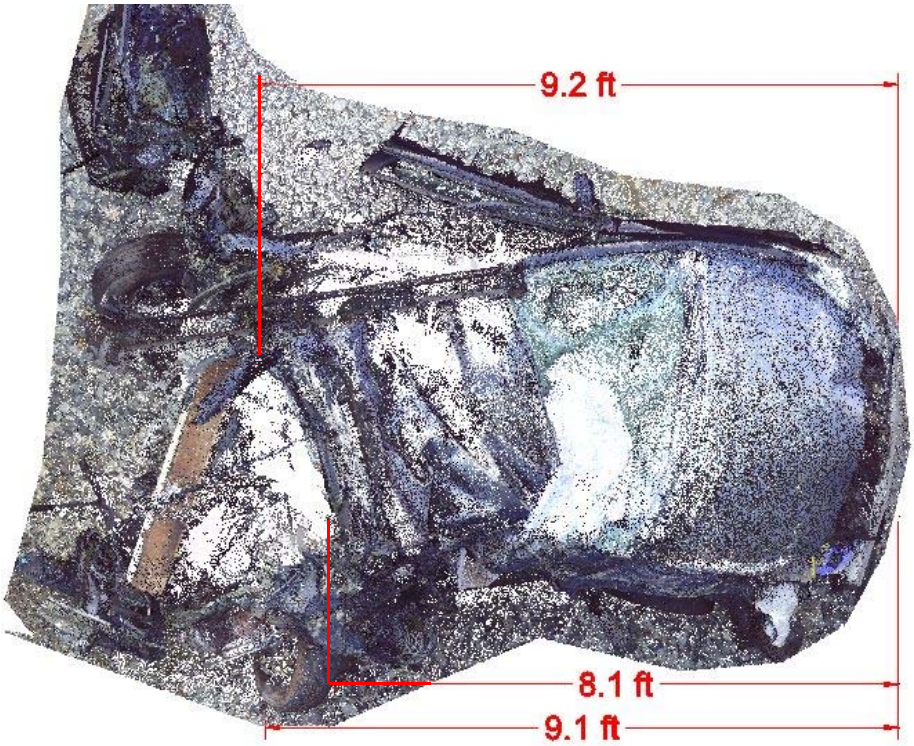


Figure 7: Point cloud image of the Prius depicting certain dimensions.

1.3. 2010 Scion tC

The Scion was identified as a two-door, hatchback sedan. The vehicle interior had been totally consumed by a post-impact fire. There was substantial rear impact damage that reduced the average overall vehicle length by about 2.5 feet. The rear impact damage was skewed toward the left. Although at the time the vehicle was documented the roof and all occupant compartment doors had been removed, CPD scene photographs depict that the doors were closed and intact after the vehicle came to rest. The police photos also depict evidence of an impact at the driver's door.

The Scion was scanned from five positions. Figures 8 and 9 depict screen captures images of the merged scans. Figure 10 depicts certain dimensional data measured from the point cloud rendering.

Figure 8: Colorized image of linked 3D scans depicting the left side of the Scion.

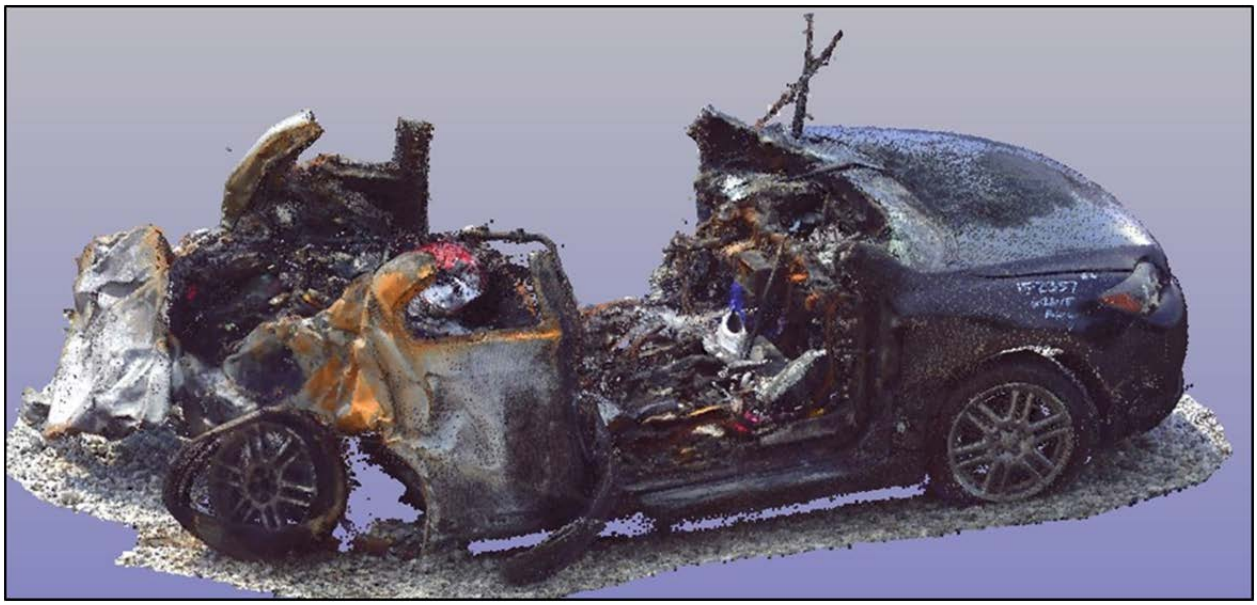


Figure 9: Colorized image of linked 3D scans depicting the right side of the Scion.

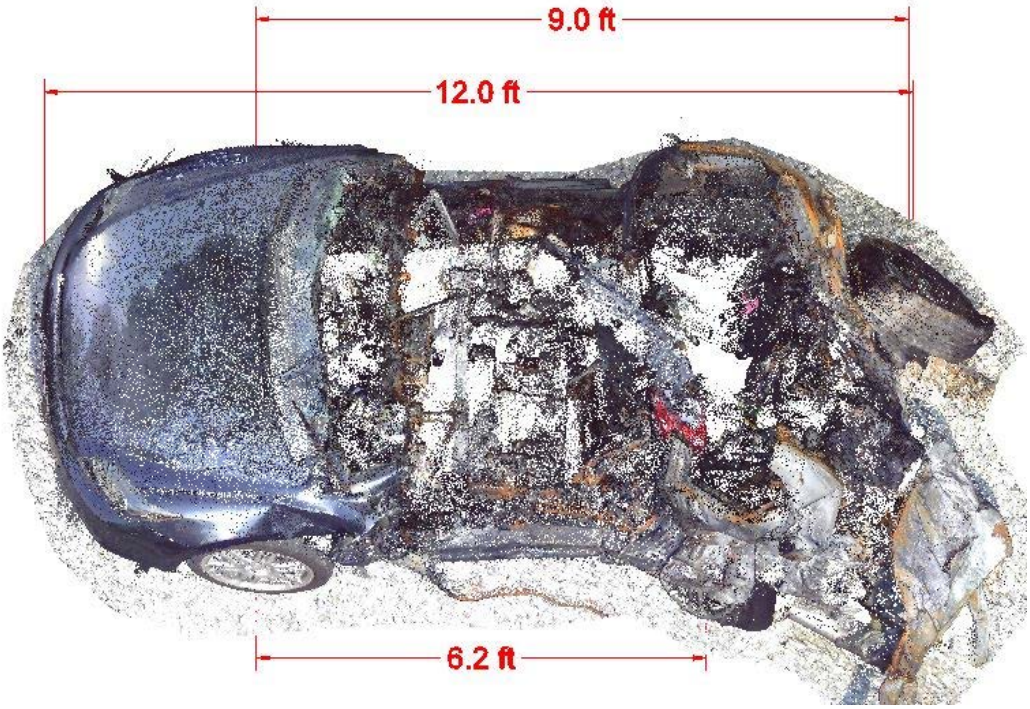


Figure 10: Overhead point cloud image of the Scion depicting certain dimensions.

At its position of rest following the collision, the Scion was facing northward (parallel to the roadway) in the gore area between the northbound I-75 travel lanes and the on-ramp from U.S. Route 11, Lee Highway. The vehicle was approximately 277 feet northward from the onset of the roadway evidence.

1.4. 2003 Mazda Tribute

The Mazda was identified as a four-door model crossover sport utility vehicle that exhibited substantial damage and evidence of multiple impacts. Following the collision, the vehicle was found entangled at the front of, and perpendicular to, the Peterbilt tractor. The driver's side of the vehicle was in contact with the Peterbilt.

The vehicle exhibited evidence of multiple impacts that resulted in substantial occupant compartment intrusion. Impact evidence and body deformation were observed at the left rear and side, and extended forward to include the driver's door. Additional impact evidence and substantial deformation was observed at the right rear and along the right side of the vehicle. Lateral intrusion on both sides of the vehicle resulted in an overall reduction in the maximum vehicle width of about 3 feet, as measured post-collision.[2] The average overall length of the vehicle was reduced by about 3.8 feet on the driver's side. The face of the front bumper also exhibited evidence of lateral scrapes and was in contact with the median barrier following the collision. Material transfer, which appeared to be paint, tire residue and concrete were observed within several areas of damage. The appearance of red paint was observed within some damage on the right side, while black color material (characteristic of tires) was observed on the left side.

At the time the vehicle was documented, the passenger side front door had been removed and the roof supports cut. Initially, the vehicle had been stored upside down as it was reportedly unstable in the upright position. The Mazda was scanned from six positions. Figures 11 and 12 depict screen captures images of the merged scans. Figure 13 depicts certain dimensional data measured from the point cloud rendering.

[2] Post-collision static measurements do not account for dynamic deformation.

Figure 11: Colorized image of linked 3D scans depicting the rear and left side of the Mazda.

Figure 12: Colorized image of linked 3D scans depicting the front and right side of the Mazda.

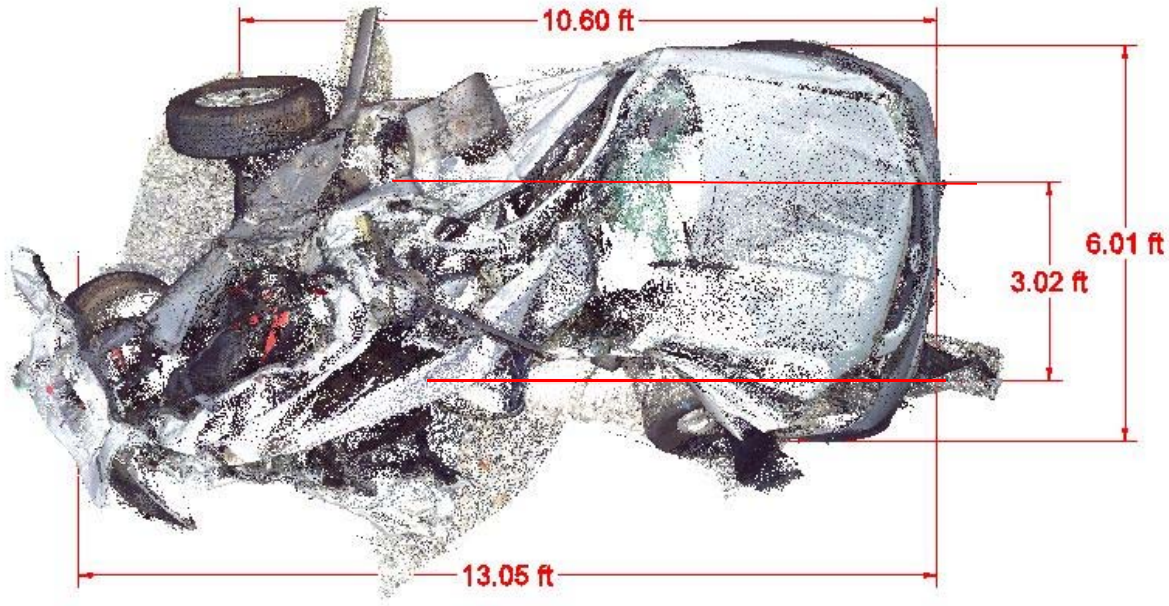


Figure 13: Overhead point cloud image of the Mazda depicting certain dimensions.

At its position of rest following the collision, the Mazda was engaged with the front of the Peterbilt on the left shoulder. The vehicle was perpendicular to the Peterbilt and roadway, and was positioned approximately 450 feet northward of the onset of roadway evidence.

1.5. 2005 GMC Savana van

The GMC was identified as a full-size, ½-ton cargo van. At the time of the collision the vehicle was laden with supplies and equipment for a commercial business, including several ladders secured to a roof rack. There was no indication that any of the cargo was displaced when the vehicle was struck.

The van sustained an impact at the right rear of the vehicle. The impact resulted in damage to the right rear cargo door and quarter panel. The area of direct contact at the rear of the vehicle was concentrated at a vertical height of about 2.5 to 2.7 feet and extended inboard about 1.2 feet (14 inches) from the right side. The impact damage was outboard of the right frame rail. The majority of induced damage extended forward about 2.5 feet.

Forward of the right rear wheel, the aft side cargo area door exhibited an indentation. Horizontal scraping to the paint and an indentation at the trailing end of the passenger door were also observed. An unidentified cylindrical piece of black plastic was found embedded in the composite wheel well trim just behind the right front tire. The door indentations exhibited a static vertical height of about 1.1 to 1.2 feet (13 to 14 inches), while the scrape marks and damage to the right front wheel well trim were measured at a height of about 1.8 feet (21.5 inches). Minor horizontal scrapes were also observed to the right corner of the front bumper. White powdery material consistent with concrete was found embedded in the bumper scrapes.

Impact damage was also observed to the rear bumper on the right side, outboard of the frame rail. The top portion of the bumper was compressed downward with the area of contact exhibiting vertical scuffing and possible black material transfer. The approximate static vertical height of the bumper contact was about 1.3 feet.

At the time the vehicle was documented, both the right front and left rear tires were deflated.

The van was scanned from eight positions. Figure 14 depicts a screen capture image of the merged scans. Figure 15 depicts certain dimensional data measured from the point cloud rendering.

Figure 14: Colorized image of linked 3D scans depicting the right side of the GMC van.

Figure 15: Point cloud image of the GMC van depicting certain dimensions.

At its position of rest following the collision, the GMC was located on the left shoulder, parallel to the roadway, but facing opposite the direction of traffic. The right front tire was in contact with the lower edge of the median barrier, which tapered outward toward the roadway as its vertical height decreased. The median barrier exhibited evidence of tire contact (material transfer) ahead (south) of the vehicle's position of rest. The van was located about 254 feet northward from the onset of roadway evidence, or about 38 feet northward of the Prius. At this location the rear of the vehicle was also in contact with a portable, temporary traffic control sign.[3]

1.6. 2001 Ford F-150

The Ford was identified as XLT Supercrew model and exhibited evidence of multiple impacts. The vehicle sustained a substantial impact at the right rear that forced the aft corner of the rear quarter panel and cargo bed forward and to the left. The right rear wheel was likewise forced forward into the back wall of the cab.

In addition to minor deformation and scrapes at the right edge of the tail gate where it abutted the quarter panel, the middle of the gate above and below the release handle exhibited inward deformation and evidence of horizontal material transfer.

The entire left side of the vehicle exhibited contact damage and deformation consistent with a sideswipe type impact. The damage began at the trailing edge of the front bumper and continued rearward along the entire length of the vehicle. The left front wheel and hub were displaced from the axle spindle. Both cab doors were displaced inward toward the occupant compartment as well as rearward. The forward wall of the bed (left front) was also displaced rearward and overlapped the deformation that resulted from the impact at the right rear.

While at the storage facility, the left rear wheel was observed to be entrapped beneath the vehicle and the rear axle broken. When the vehicle was relocated for documenting, the left rear wheel and axle half had detached and were placed in the bed of the truck.

The Ford was scanned from five positions. Figures 16 and 17 depict screen capture images of the merged scans. Figure 18 depicts certain dimensional data measured from the point cloud rendering.

[3] The orange, diamond shaped warning sign (W20-5) displaying text stating "Left Lane Closed 1500 FT."

Figure 16: Colorized image of linked 3D scans depicting the rear and right side of the Ford F-150.

Figure 17: Colorized image of linked 3D scans depicting the front and left side of the Ford F-150.

Figure 18: Overhead point cloud image of the Ford F-150 depicting certain dimensions.

At its position of rest following the collision, the Ford was located in the roadway straddling the center and right lanes. The vehicle was oriented about 250° relative to the roadway direction of travel and in a position 321 feet northward of the onset of roadway evidence. The Ford was stopped in proximity to the Chevrolet and Cadillac.

1.7. 2007 Chevrolet Uplander

The Uplander is a minivan that sustained impacts at both the front and rear of the vehicle. Impact damage at the rear was concentrated toward the right side, but extended across the entire width of the vehicle. While the rightward end of the bumper exhibited some damage, most of the intrusion damage was above the bumper. The apparent transfer of red and black colored material was observed within the damage, primarily toward the right side of the vehicle.

Frontal impact damage extended across the entire width of the vehicle, although there was a more substantial rearward displacement of the front end structure on the left side. The front bumper bar exhibited a rearward bend just left of longitudinal vehicle centerline. More extensively the top of the bumper bar and longitudinal frame rails exhibited evidence of having been overridden. The radiator and upper radiator support were also displaced rearward.

The rear bumper cover and energy absorbing foam from the rear of the Cadillac were found entangled within the frontal damage. The cover had overridden the Chevrolet's bumper and become entrapped beneath the upper radiator support.

The Uplander was scanned from eight positions. Figures 19 and 20 depict screen capture images of the merged scans. Figures 21 and 22 depict the point cloud rendering and certain dimensional data measured from the point cloud.

Figure 19: Colorized image of linked 3D scans depicting the rear and right side of the Chevrolet Uplander.

Figure 20: Colorized image of linked 3D scans depicting the front and left side of the Chevrolet Uplander.

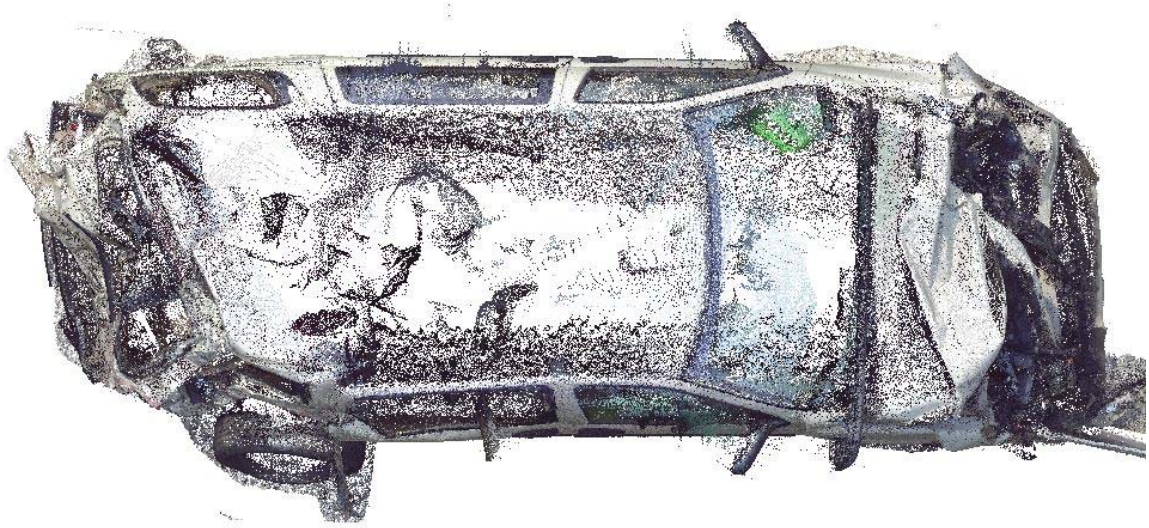


Figure 21: Overhead point cloud image of the Chevrolet Uplander.

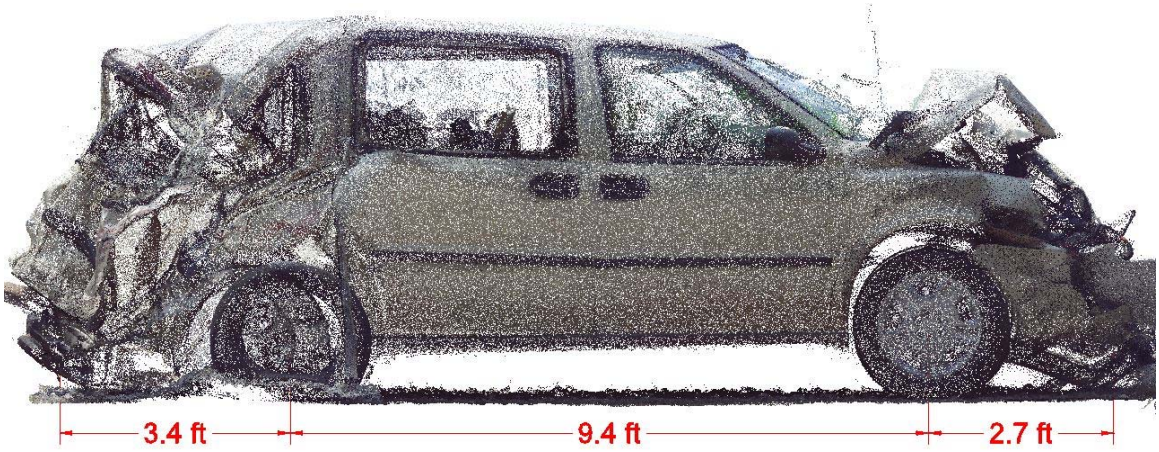


Figure 22: Point cloud image of the Chevrolet Uplander depicting certain dimensions.

At its position of rest following the collision, the Uplander was located mostly within the gore area separating the right travel lane and on-ramp from Lee Highway. The vehicle was oriented about 126^0 relative to the roadway direction of travel and positioned 315 feet northward of the onset of roadway evidence. The Uplander was stopped in proximity to the Ford and Cadillac.

1.8. 2014 Cadillac CTS

The Cadillac, a four-door sedan CTS model, exhibited evidence of multiple impacts at both the front and rear of the vehicle. The more significant contact damage at the rear encompassed the entire width of the vehicle, although there was greater forward displacement of the left quarter panel. The left rear quarter panel was displaced about 9.6 inches further forward than the right side. While at rest, the left side of the rear bumper also exhibited a greater vertical displacement as compared with right side. The damaged area exhibited evidence of having been under ridden by the striking vehicle. The rear bumper cover was missing and found entangled in the Uplander's frontal damage.

The right rear quarter panel exhibited horizontal scrapes that extended forward from the tail lamp toward the wheel well. Additional contact damage was observed around the fuel port that resulted in the quarter panel just aft of the rear door being indented and the fuel port door being removed.

The right front fender exhibited evidence of a longitudinal impact that crumped the fender rearward. The contact area extended inboard about 12 inches and exhibited signs of having been overridden by the contacting surface (vehicle being struck).

The left front fender exhibited contact damage that encompassed, and then extended rearward of, the headlamp/side marker lamp assembly. The left front (driver's) door exhibited vertical scrapes to the paint below the door handle that covered the mid-section of the door. Horizontal scrapes were observed on the left rear door in addition to an indentation to the door just forward of the rear wheel well.

The Cadillac was scanned from five positions. Figures 23 and 24 depict screen capture images of the merged scans. Figure 25 depicts the point cloud rendering with certain dimensional data measured along the left side from the point cloud.

Figure 23: Colorized image of linked 3D scans depicting the rear and left side of the Cadillac.

Figure 24: Colorized image of linked 3D scans depicting the front and right side of the Cadillac.

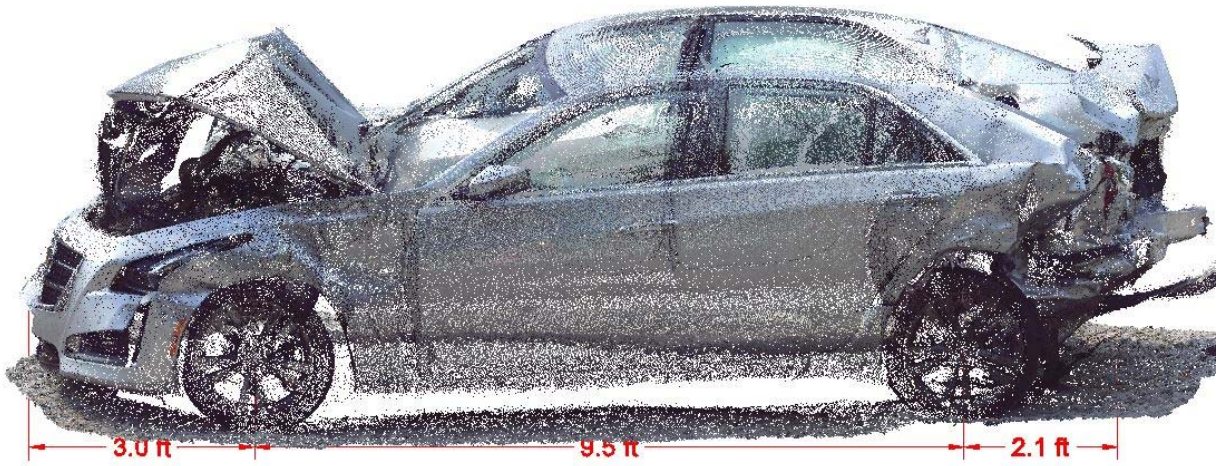


Figure 25: Point cloud image of the Cadillac depicting certain dimensions.

At its position of rest following the collision, the Cadillac straddled the right and center travel lanes about 330 feet northward of the onset of roadway evidence. The vehicle was oriented about 290^0 relative to the roadway direction of travel and was stopped in proximity to the Ford and Chevrolet Uplander.

1.9. 2015 Toyota Tundra

The final vehicle involved in the collision sequence was a Toyota four-door model pickup truck. The vehicle exhibited evidence of a longitudinal impact at the left rear. The rear bumper on the left side was displaced forward as was the aft portion of the rear quarter panel. The primary area of contact extended inboard about 12 to 13 inches from the left side and exhibited evidence of having been under ridden by the impacting vehicle. Additional damage to the lower edge of the tail gate was observed between 14 and 24 inches inboard of the left side.

The Toyota was scanned from eight positions. Figure 26 depicts a screen capture image of the merged scans.

Figure 26: Colorized image of linked 3D scans depicting the rear and left side of the Toyota Tundra.

Video evidence depicted the Toyota coming to a controlled stop following the collision. At its indicated position of rest, the vehicle was stopped on the right shoulder, nearly parallel with the travel lanes about 484 feet northward of the onset of roadway evidence.

2. Roadway and Collision Evidence

The collision occurred on Interstate 75 just north of U.S. Route 11, Lee Highway. Roadway evidence was documented by CPD investigators who provided NTSB investigators with photographs and total station documentation of the roadway evidence and vehicles at final rest. The data provided by CPD investigators was supplemented with 3D scanning at the scene by NTSB investigators. The NTSB Highway Factors Group factual report should be consulted for additional and, more specific highway information.

In the area of the collision, the highway generally exhibits a northeast to southwest orientation with the two opposing roadways separated by a concrete median barrier. The collision events occurred on the northbound roadway, which had three travel lanes and an orientation of about 65° to the northeast through the area.

Roadway evidence of the collision events consisted of tire friction marks in addition to pavement surface scrapes and charring. Vehicle debris had been removed from the scene before the arrival of NTSB investigators. The onset of roadway evidence was observed in the center travel lane approximately 461.5 feet south of mile marker 11.8. This area was also adjacent the southern end of the pavement gore area that separated the right travel lane from the Lee Highway on ramp (approximately 495 feet north of the Lee Highway overpass). The roadway marks were characteristic of substantial vertical loading where the undercarriage of the lead vehicle was forced into contact with the road surface as well as the over-deflection of the vehicle tires. Interspersed with the tire marks were linear pavement scrapes and gouging. The marks

continued northward within the center travel lane and, although some of the marks dissipated, their heading did not change.

The tire marks did not exhibited characteristics of vehicle braking and no tire marks were observed preceding this area.

Approximately 74 feet northward from the area of the onset of roadway evidence, another area of tire marks and surface scrapes was observed. The onset of tire marks at this location likewise exhibited evidence of vertical loading and over deflection. Some of marks also exhibited a change in heading toward the left shoulder.

Approximately 142 feet northward from the initial onset of roadway evidence, a third area of friction marks that exhibited characteristics of loading was observed. Just south of this area (about 116 feet north of the initial evidence) other tire friction marks exhibited a change in heading toward the gore area that separated the right lane from the Lee Highway on ramp.

Approximately 173 feet northward of the initial onset of evidence, additional tire friction marks that exhibited characteristics of loading and over deflection were observed. Some of the marks occupied either the center or left travel lanes, while other marks traversed the two.

Tire friction marks were observed extending southward from the position of rest for the Prius. Likewise tire friction marks and pavement charring was observed extending southward from the position of rest for the Scion. The tire marks leading to both vehicles exhibited characteristics of wheel loading and vehicle rotation. The charred pavement leading to the Scion began about 71 feet southward from the vehicle's position of rest. An occupant of the Scion, who was later identified as the driver, was found lying on the right shoulder approximately 67 feet southeastward from the vehicle's position of rest.

Extending southward from the position of rest for the Peterbilt combination and Mazda, tire friction marks and road surface scrapes were observed. The tire friction marks appeared to extend southward at least 320 feet where they transitioned from the center lane to the left lane. The tire marks exhibited characteristics of loading and occasional scuffing or sideslip, and terminated at the Mazda's wheels. Pavement scrapes were interspersed with the tire marks. A powdery debris trail on the road surface became more prominent where the vehicle crossed onto the left shoulder. This debris was observed to accumulate circumferentially on several tires of the Peterbilt combination.

Faint tire friction marks extending southward from the front wheels of the Peterbilt were also observed. Both front wheels were substantially engaged into the side of the Mazda and at rest following the collision, the right front tire was found to have debeaded from the wheel rim. None of the tire marks exhibited characteristics of discernible vehicle deceleration due to braking.

Numerous tire friction marks, some characteristic of vehicle rotation, were observed extending southward from the area of rest occupied by the Ford, Chevrolet and Cadillac. The only tire marks observed near the GMC van were located at the base of the median barrier and extended a short distance southward from the area of the right front wheel.

The entire collision scene comprised an area approximately 495 feet in length. All vehicles and evidence remained on the pavement.

Figure 27 depicts a post-collision diagram of the collision scene. The diagram is a composite of data acquired from CPD and NTSB investigators.

2.1. Roadway Sight Line and Speed Limit

The immediate northbound approach to the first impact was essentially straight, with a slight ascending grade. A longer descending grade, however, preceded the interchange at Lee Highway (refer to the Highway Factors Group factual report for details). The roadway had a slight leftward curvature near the bottom of the descending grade and the first collision occurred near the beginning of a sweeping, large radius, left curve. Line of sight observations were made on the highway from positions within the three travel lanes. Observations revealed that at a minimum, the relative area of impact and, therefore the end of the developing traffic queue could be seen from a distance of about one mile (measured at 5260 feet) to the south. This location was in the area of a vertical curve crest and presented an unobstructed view of the roadway surface leading to the area of impact. While the observations were based on a driver eye height of about 3.5 feet, it is likely that the line of sight available to the Peterbilt driver sitting higher above the roadway would have been somewhat greater. The available line of sight could extend further south but would be limited to the extent permitted by the vertical curve. Despite the minor roadway curvatures, the eccentricity of the sight line from the grade crest to the traffic queue was minimal. Figure 28 is a photograph of the northbound approach to the collision scene as observed from the minimum line of sight position.

The highway speed limit preceding the work zone was posted at 65 mph for cars and 55 mph for trucks. The last posted speed limit signs before the collision were located on both sides of the northbound roadway about 2.2 miles before the collision. Figure 29 depicts the location of certain signage and the possible driver line of sight relative to the area of the collision.

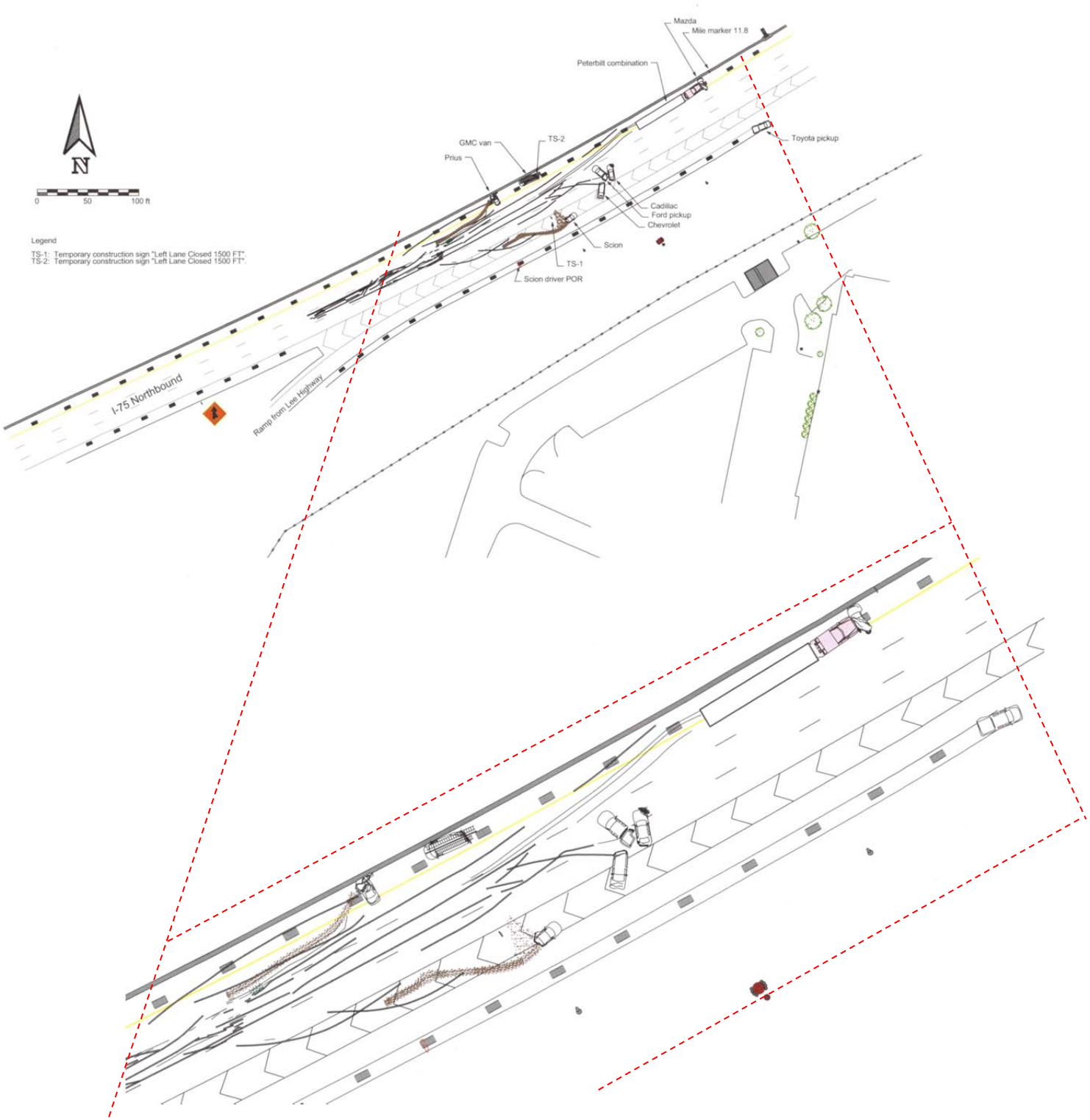


Figure 27: Illustration of the post-collision crash scene with an enlargement of area encompassing the vehicle positions of rest. Data was derived from CPD total station mapping and NTSB 3D scans.

Figure 28: Photograph depicting the approximate minimum driver line of sight as viewed from the center lane of northbound I-75 looking north toward the collision area.

Figure 29: Illustration using Google Earth imagery depicting the relative locations of certain features along the northbound heading toward the collision area.

3. Vehicle Electronic Data

NTSB investigators obtained electronic data from the Peterbilt combination and several of the passenger vehicles involved in the collision. For the Peterbilt truck-tractor, telemetric trip data was acquired from the carrier and fault code snapshot data was acquired from the vehicle's antilock brake system control module. Electronic event data from the passenger vehicles was acquired through interrogation of the respective vehicle's airbag control module.

Additional information is also available in other NTSB group factual reports.

3.1. Tractor Data

3.1.1. Trip Data

The carrier employed a subscription service managed by Transcore Link Logistics to provide for tracking of the truck-tractor. As reported by Transcore, the vehicle communications hardware was identified as a SkyWave Mobile Communications Globalwave MT3000 (MT3000) satellite communications terminal. According to SkyWave product specifications, the Globalwave MT 3000 is satellite communication terminal designed for applications that require remote monitoring and control capabilities. The system uses a network of geostationary satellites and a two-way satellite communications protocol to send pre-scheduled status polls or reports; inform the user of events; receive "over-the-air" commands; and receive poll requests for instantaneous GPS location and information reporting. The product specifications claimed a GPS accuracy of 11 meters, 95% of the time. According to Transcore, the type of data sent by the vehicle is configured by the customer and may utilize different parameters such as time, distance or events, to trigger a location or event message transmission. The carrier provided no information on how or whether they configured the system.

Transcore provided NTSB investigators with a "Position Report" spreadsheet that contained seven data columns including unit ID, date/time, battery voltage, location, latitude, longitude and external data. The date/time entry apparently conveyed when the data was sent. The location data referenced the approximate mileage and ordinal direction from a nearby city and state. The external data entry was described by Transcore as event type codes which represented the event or command that triggered the data transmission. Six external data codes were associated with the data records. Those codes and the number of records associated with them were identified as:

- "BPS" – scheduled report, 159 position records
- "SSR" – start/stop position report, 133 position records
- "DTX" – state line crossing position report, 12 position records
- "MPR" – stop report (motion sensor stop report), 10 position records
- "4PO" – poll reply report, 24 position records
- "TPR" – performance report, 21 position records

A total of 360 vehicle position records covering the dates of June 1, 2015 (~01:01 am) through June 29, 2015 (~04:31 am) were reported in the spreadsheet. External data codes were

reported for 359 positions while one position location had no external code recorded. Of the 360 location records, the last 25 records were identified as post-collision.

Examination of the data indicated that while it provided limited detail to assist with reconstruction of the collision or events immediately preceding the collision, it provided valuable information regarding the driver's trip. Location data covering the driver's trip during the dates of June 21 through the time of the collision were available for review. This period began about 01:23am on June 21 with the final location entry at 07:15pm at the vehicle's position of rest following the crash. There were 124 location data points reported during this period. On June 25, the last position reported before the collision was at 6:23pm at a rest area located on northbound I-75 in Adairsville, FL, about 47 miles south of the collision site.

The basic data acquired from Transcore covering the vehicle trip are presented in an appendix to this report. Additional information regarding the driver's trip is available in the NTSB Motor Carrier Group factual report.

3.1.2. Antilock Brake System (ABS) Fault Code Data

The truck-tractor was equipped with an ABS system manufactured by Bendix Commercial Vehicle Systems, LLC (Bendix). As part of the vehicle examination, NTSB vehicle factors investigators acquired the ABS controller (identified as a Bendix EC-60 ABS/ATC/ESP controller) for examination of possible stored data. Bendix was able to provide NTSB investigators with a diagnostic event report.

The event report conveyed a history of diagnostic trouble codes (DTC) as experienced by systems monitored by the EC-60 controller. The report conveyed both active and inactive DTCs, as well as a DTC event history. The history data report included parameters that provided a brief description of the trouble, an engine-hours' time stamp, time of occurrence since system power-up and vehicle velocity (speed in mph) at the time of the event.

With regard to data useful for reconstruction of the collision, two of the final recorded events included trouble detection with the pressure modulator valve and wheel speed sensor at the right steer axle wheel. This wheel was damaged and the tire debeaded during the collision events. The recorded events occurred at some point after the initial impact, but during the entirety of the collision. Those two events were identified as occurring more than one hour (">1h") after power-up and reflected an identical engine hours' time stamp. The velocity values reported were 62 mph and 67 mph for pressure modulator valve DTC and wheel speed sensor DTC respectively.

The Heavy Vehicle Onboard Electronics report prepared by the NTSB Office of Research and Engineering should be consulted for additional details.

3.2. Passenger Vehicle Airbag Control Module/Event Data Recording Data

CPD and NTSB investigators were able to image certain event data stored in the airbag control modules (ACM) for seven of the eight passenger vehicles. The type of data acquired varied by vehicle and model year. Two of the newer vehicles – the Cadillac CTS and Toyota

Tundra – were equipped with modules compliant with 49 CFR Part 563.[4] Some data was of value for reconstructing the impact or multiple impacts involving the specific vehicle. Data from other vehicles reflected only a portion of the collision events or were not associated with this crash. All ACM EDRs have limitations as to the resolution, data range, sampling interval, time period of the recording, and the items recorded. In some situations the entire crash may not be captured. All of the ACM EDR reports interpreted by the Bosch Crash Data Retrieval (CDR) System provide information concerning data limitations and those limitations should be considered with respect to the data presented in the report.

With most ACM EDRs crash data includes capturing acceleration (crash pulse), a calculated change in velocity, and system status parameters that may include, but are not limited to, deployment timing, multiple event occurrences, and diagnostic trouble codes (DTC). Some EDRs buffer and then record pre-crash data that is reported when system thresholds are met. Pre-crash data is communicated to the ACM asynchronously through other vehicle systems. Pre-crash data can include parameters such as vehicle speed, engine speed, and brake switch circuit status. Newer ACM EDRs may capture additional data and modules that are Part 563 compliant will report on a minimum number of parameters as defined by the regulation.

The type of data recorded and its potential for use in reconstructing the impacts involving each vehicle was vehicle dependent. The following subsections convey an overview of certain data retrieved from the respective vehicles. Additional information regarding the data collection can be found in the Light Passenger Vehicle Recorders factual report prepared by the NTSB Office of Research and Engineering.

3.2.1. 2010 Toyota Prius

The ACM was identified as an 06EDR, Generation-2 (Denso) module that was not Part 563 compliant. The module is capable of recording multiple events. When multiple events occur within ½ second (500ms) pre-crash data for the 1st event and impact (crash) data for all events are recorded. Pre-crash vehicle speed data is reported at a resolution of 1.2 mph and rounded down.

The report included three events, two of which were consistent with this collision. No DTCs were recorded and the freeze signal (data locked) was active ("on"). The most recent event (last event recorded) was a passenger side impact that resulted in a deployment command for a passenger side curtain airbag.

The first previous event, which occurred immediately before the side impact, was classified as a front/rear impact and triggered 26ms before the side impact. This event recorded a maximum longitudinal change in velocity of 72.7 mph in the forward (positive) direction at 200ms following the event trigger. Although this generation ACM has a recording time of up to 200ms, the cumulative change in velocity exhibits characteristics of leveling off which indicates that most, if not all of the crash pulse was recorded. There was no restraint system deployment

[4] In summary, 49 CFR Part 563 defined the minimum data set that must be collected if a manufacturer decides to voluntarily install an EDR (event data recorder) in their vehicle, along with requirements for the range and accuracy of EDR data. Part 563 is applicable to vehicle manufactured after September 1, 2010 and applies to vehicle with a GVWR of 8,500 pounds or less.

command for this event. This event occurred within 400ms of the time zero (trigger event) for the pre-crash data record.

Pre-crash data was reported for six samples at ½ second intervals, beginning 4.4 seconds before the most recent event trigger. That data indicated that the brake lamp circuit was closed ("on") and the vehicle was at idle (accelerator voltage = 0.78) during the entire pre-crash time period. The data indicated that the vehicle was slowing from an initial speed of 13.7 mph to 5 mph (at time 0). Since the vehicle was a hybrid, no engine RPM was reported (data not collected).

3.2.2. 2010 Scion tC

The ACM was identified as an 02EDR, Generation-1 (Denso) module that was not Part 563 compliant. The module is capable of recording multiple events. If recorded, engine speed in revolutions per minute (RPM) is reported at a resolution of 400 rpms and rounded down. Similarly, pre-crash vehicle speed is reported at a resolution of 1.2 mph and rounded down.

The report included one event, which was consistent with this collision. No DTCs were recorded and the freeze signal was active ("on). The report indicated that data recording was complete. The recorded event was classified as a front/rear impact with a maximum longitudinal change in velocity of 36.8 mph in the forward (positive) direction at 150ms following the event trigger. The data exhibits an increasing cumulative change in velocity until the recording ends indicating that the entire crash pulse was not captured. This particular ACM has a maximum recording time of 150ms. There was no restraint system deployment command for this event.

No pre-crash data was reported for this event. The system did report that for both front seats, the seat belt buckles were engaged.

3.2.3. 2005 GMC Savanna work van

The SDM (sensing and diagnostic module) in this vehicle (type SDM-GF) was capable of storing both supplemental restraint system deployment and non-deployment events. Non-deployment events, of which the SDM will only store one, can be overwritten by more severe events or events that result in a deployment command. The data retrieved from the van included a single event that was classified as a non-deployment. The report indicated that the recording was complete, but not locked with no multiple events detected. A total of eight (8) ignition cycles had been recorded between the event and the data download.

Although an event was reported, no change in velocity or crash pulse was recorded. The data table and graph indicated an algorithm run time of 150ms (maximum recording time for a ND event), but the velocity change was reported as zero. This model SDM is configured to record negative acceleration, such as with a frontal impact.

Pre-crash data was reported and certain parameters were reported for a period of five seconds before algorithm start (algorithm enable or "AE"), in one second intervals. Similarly, the brake switch circuit status was reported, although the reporting time extended to eight seconds. During the five seconds before algorithm enable, the reported vehicle speed decreased from 37 mph to 29 mph exhibiting a moderate deceleration of 0.09g. Similarly, during this five

second interval the brake switch circuit was reported as active ("on"). The additional three seconds of brake switch circuit data reported between six and eight seconds before AE indicated the circuit was "off".

Examination of the event data in combination with the collision events, including surveillance video footage, indicates that the pre-crash data reported by the module is inconsistent with this collision and likely related to a prior event.

3.2.4. 2001 Ford F-150

The Ford restraint control module (RCM) in this vehicle was identified as a single point module that captured only longitudinal acceleration events during a run time of 116ms following algorithm start. The event exhibited a longitudinal negative acceleration with increasing values for the cumulative change in velocity. The increasing change in velocity throughout the recording indicates that the entire crash pulse was not captured. The data likely corresponds to one of the subsequent impacts experienced by the vehicle (sideswipe impact), as the data indicates a negative acceleration.

No DTCs were recorded and deployment of the frontal airbags and seat belt pretensioners were commanded.

3.2.5. 2007 Chevrolet Uplander

The SDM (sensing and diagnostic module) in this vehicle (type SDM-DW) was capable of storing both deployment and non-deployment events. Non-deployment events, of which the SDM will only store one, can be overwritten by more severe events or events that result in a deployment command. The data retrieved from the Uplander included a single event that was classified as a non-deployment. The report indicated that the recording was incomplete. The SIR warning lamp was not active ("off") and multiple events were not detected. A total of 91 ignition cycles had been recorded between the event and the data download.

Pre-crash data was contained in the report and certain parameters were reported for a period of five seconds before AE, in one second intervals. Similarly, the brake switch circuit status was reported, although the reporting time extended to eight seconds. During the five seconds before algorithm enable, the reported vehicle speed was constant at 61-62 mph, with no activation of the brake switch circuit. Although an event was reported, no change in velocity or crash pulse was recorded in the data table; however, only 40ms of run time was reported for the 150ms available.

Examination of the event data in combination with the collision events, including surveillance video footage, indicates that the pre-crash data reported by this vehicle is tied to a previous event and not associated with this collision.

3.2.6. 2014 Cadillac CTS

The ACM was identified as an Autoliv SDM-30 module that was Part 563 compliant. The module is capable of recording multiple events and two events were captured. The first event was identified as rear impact that was classified as a non-deployment event. The

subsequent event, which was triggered 230ms later, was a frontal impact that resulted in a deployment command for the supplemental restraint system. The data reflected a positive change in velocity of 38 mph (at 298ms) as a result of the rear impact, followed by a negative change in velocity of 17 mph (at 112ms) from the frontal impact. The data was reported as locked.

Pre-crash data was reported for ten samples at ½ second intervals, beginning five seconds before the first event trigger. That data indicated an initial speed of one mph with a gradual increase to four mph followed by a decrease to three mph in the final second. The brake lamp circuit was mostly "off", but was active ("on") during the 2.5 to 1.0 second samples.

No DTCs were recorded until after the deployment command, after which a code is set indicating that a deployment had been commanded. The deployment command included seat belt pretensioners, frontal airbags and side curtain airbags. The data also indicates that an OnStar notification was sent.[5]

The ignition cycle counter recorded at the time of the two events matched the download counter indicating the events occurred just before the download. The data is consistent with the collision.

3.2.7. 2015 Toyota Tundra

The ACM was identified as a 13EDR module that was Part 563 compliant. The module is capable of recording multiple events, although only one event was captured. That event was identified as front/rear impact and was classified as a non-deployment event. The data reflected a positive change in velocity of 17.7 mph (at 199ms) indicating a rear impact. The data was not locked (consistent with non-deployment events).

Pre-crash data was reported for eleven samples at ½ second intervals, beginning five seconds before the first event trigger. The last sample is reported at time zero or event trigger. That data indicated an initial speed of 2.5 mph for two seconds followed by an increase to 3.1 mph then 5 mph at the ½ second sample. The time zero sample indicates a speed of 9 mph in combination with a 100% application of the accelerator pedal and engine throttle. Certain elements reported at the time zero (trigger) sample were likely acquired after the impact. The brake switch circuit status indicated active ("on") until two seconds before time zero. The switch status was reported as "off" following the two second time sample.

The resolution of the vehicle speed parameter is 0.6 mph and is rounded down for reporting. No DTCs were reported. The ignition cycle counter recorded at the time of download had increased by six from the count at the time of the event; however, this vehicle was still drivable following the collision. The data is consistent with the collision.

[5] OnStar Corporation is a subsidiary of General Motors that provides subscription-based communications service that offers in-vehicle security, hands free calling, turn-by-turn navigation, and remote diagnostics.

4. Video Data

Portions of the highway to the south of the collision scene and at the northern end of the scene were captured on video surveillance systems employed by two businesses located along the highway. Both businesses were located on the east side of the highway, adjacent the northbound roadway. The highway was captured in the background of their respective camera fields of view.

The first video footage originated at the Cracker Barrel Restaurant located on Old Lee Highway, just south of the exit to Lee Highway. The camera field of view is estimated to include about 275 feet of the northbound roadway, excluding some additional distance that was partially obstructed. The video recording that was acquired was just over seven minutes in length and included imagery of the Peterbilt combination passing through the field of view.

Preceding and throughout the appearance of the Peterbilt in the video, the flow of traffic is uncongested and apparently traveling at highway speeds. All travel lanes were observed to be open and unhindered.

The second video originated at the Hampton Inn hotel located on Weir Way, north of Lee Highway. The camera field of view is estimated to include about 250 feet of the northbound roadway, excluding some additional distance that was partially obstructed. The video recording that was acquired was almost seven and a half minutes in length. The imagery captured the final events of the collision that include the Peterbilt combination and the Toyota Tundra coming to a stop. The preceding impacts involving the other vehicles are outside the camera field of view, although the Chevrolet Uplander, and to some degree the Ford and Cadillac, can be seen moving to their positions of rest just inside the camera field of view.

Preceding the collision, traffic was observed to be congested within the center and left travel lanes, but moving at a slow pace exhibiting a sinusoidal flow with only momentary stoppages. The right lane was mostly clear with occasional traffic passing at a more rapid pace. Figure 30 is a frame capture from the Hampton Inn video that depicts the traffic conditions shortly before the collision.

The approximate distance within the center lane between the camera fields of view for the two cameras was about 1896 feet. The distance was approximately 1600 feet from the north end of the field of view for the Cracker Barrel camera to the initial area of impact. The camera locations relative to the highway were also documented by 3D scanning. For reference, Figure 31 provides an illustration that depicts the approximate camera locations and their respective fields of view.

Additional analyses of the two videos are being conducted by the NTSB Office of Research and Engineering.

Figure 30: Still image captured from Hampton Inn surveillance video depicting traffic movement on northbound I-75 shortly before the collision. Traffic is moving slowly in the center and left travel lanes while the right travel lane is unoccupied in this image.

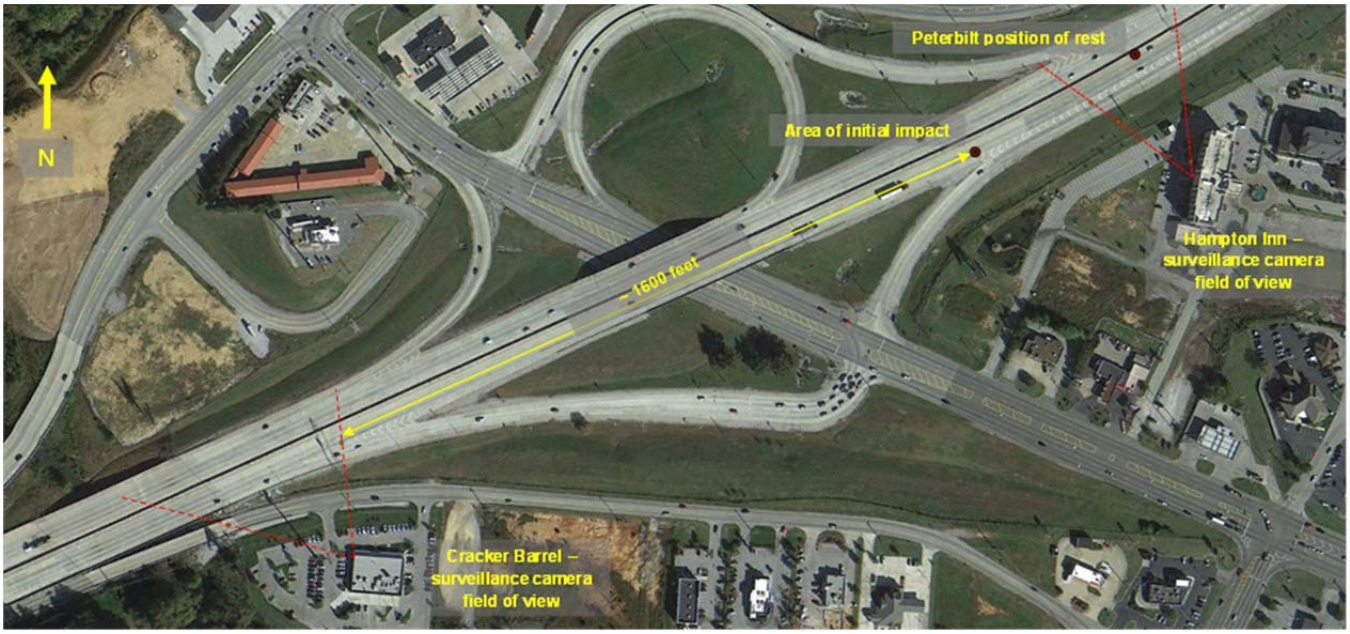


Figure 31: Illustration using Google Earth imagery depicting the relative locations of the video surveillance cameras and their approximate fields of view. The major roadway intersecting with I-75 is Lee Highway.

E. REPORT APPENDICES

Appendix 1 – post-crash scene diagram

Appendix 2 – summary of the Peterbilt trip data that was provided by the carrier's subscription with Transcore Link Logistics.

Appendix 3 – vehicle reference data

F. DOCKET MATERIAL

Docket attachments will be included as may be necessary.

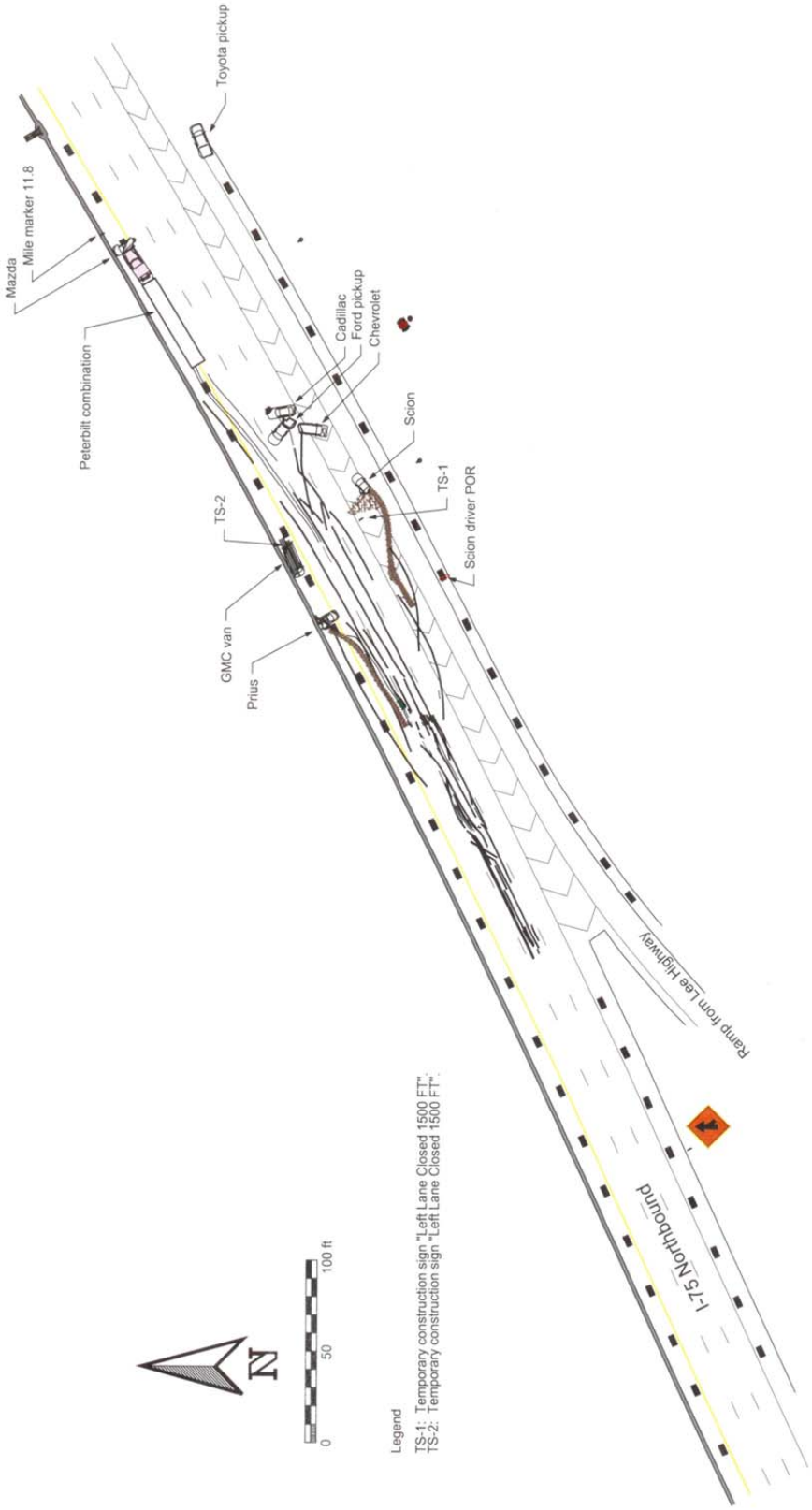
LIST OF ATTACHMENTS

None

END OF REPORT

Robert Squire
Highway Accident Investigator

Appendix 1: Scene Diagram



Appendix 2: Peterbilt truck-tractor trip data

The geographic coordinates, date, time, and log code were reported in the data acquired from the motor carrier. The time, distance (straight distance between geographic corrdinates) and location noted under comments were derived from the geographic coordinates.

Latitude	Longitude	Date-Time Stamp of Data	Time Between Data Reporting (hh:mm:ss)	Distance Between Position in Miles	Distance Between Positions in Feet (where d<1 mile)	Log Code	Comments
37.1444015503	-84.1151199341	6/21/2015 01:23:57 AM				BPS	Position indicates vehicle at a facility
37.1444015503	-84.1150970459	6/21/2015 05:23:57 AM	4:00:00	0.00	6.7	BPS	Position indicates vehicle at a facility
37.1444168091	-84.1151504517	6/21/2015 09:23:57 AM	4:00:00	0.00	16.5	BPS	Position indicates vehicle at a facility
37.1443672180	-84.1151199341	6/21/2015 01:23:58 PM	4:00:01	0.00	20.1	BPS	Position indicates vehicle at a facility
37.1446838379	-84.1151962280	6/21/2015 05:23:57 PM	4:00:00	0.02	117.6	BPS	Position indicates vehicle at a facility
37.1433334351	-84.1149978638	6/21/2015 06:01:57 PM	0:38:00	0.09	496.0	4PO	Position indicates vehicle at a facility
37.1433334351	-84.1149978638	6/21/2015 08:14:27 PM	2:12:30	0.00	0.0	4PO	Position indicates vehicle at a facility
37.1444015503	-84.1151809692	6/21/2015 11:23:29 PM	3:09:01	0.07	393.3	BPS	Position indicates vehicle at a facility
37.1444664001	-84.1151809692	6/22/2015 01:02:45 AM	1:39:17	0.00	23.7	TPR	Position indicates vehicle at a facility
37.1444320679	-84.1151809692	6/22/2015 03:23:27 AM	2:20:42	0.00	12.5	BPS	Position indicates vehicle at a facility
37.1444015503	-84.1151962280	6/22/2015 06:08:02 AM	2:44:35	0.00	12.0	SSR	Position indicates vehicle at a facility
37.1444511414	-84.1151962280	6/22/2015 07:23:27 AM	1:15:25	0.00	18.1	BPS	Position indicates vehicle at a facility
37.1444664001	-84.1151351929	6/22/2015 11:23:27 AM	4:00:00	0.00	18.6	BPS	Position indicates vehicle at a facility
37.1490173340	-84.1168670654	6/22/2015 12:26:33 PM	1:03:06	0.33	1734.9	SSR	Position indicates on Route 80 (London Road) less than 800 feet from starting location
36.9938011169	-85.8793334961	6/22/2015 02:19:33 PM	1:53:00	97.75	NA	SSR	On highway
36.9938011169	-85.8793334961	6/22/2015 02:20:42 PM	0:01:10	0.00	0.3	SSR	On highway
36.9938163757	-85.8793640137	6/22/2015 02:26:33 PM	0:05:50	0.00	10.5	SSR	On highway

36.9938163757	-85.8793640137	6/22/2015 02:27:43 PM	0:01:10	0.00	0.0	SSR	On highway
36.9938316345	-85.8793182373	6/22/2015 02:31:32 PM	0:03:50	0.00	14.5	SSR	On highway
36.9929847717	-85.8817977905	6/22/2015 02:35:33 PM	0:04:01	0.15	785.8	SSR	On highway
37.1791992188	-85.9079818726	6/22/2015 03:13:03 PM	0:37:30	12.95	NA	SSR	Position indicates vehicle at a facility
37.1791496277	-85.9079818726	6/22/2015 03:18:02 PM	0:04:59	0.00	18.1	SSR	Position indicates vehicle at a facility
37.1791648865	-85.9080810547	6/22/2015 03:23:33 PM	0:05:31	0.01	29.4	SSR	Position indicates vehicle at a facility
37.1791152954	-85.9080200195	6/22/2015 03:24:07 PM	0:00:35	0.00	25.3	BPS	Position indicates vehicle at a facility
37.1757507324	-85.9084167480	6/22/2015 03:48:34 PM	0:24:27	0.23	1232.8	SSR	Position indicates on highway along Route 31W, just south of position above
37.1591491699	-85.9162368774	6/22/2015 04:01:38 PM	0:13:04	1.23	NA	SSR	Position indicates vehicle at a facility
37.1591835022	-85.9162521362	6/22/2015 06:35:32 PM	2:33:55	0.00	13.3	SSR	Position indicates vehicle at a facility
37.1591835022	-85.9162521362	6/22/2015 06:40:28 PM	0:04:56	0.00	0.3	SSR	Position indicates vehicle at a facility
37.1591835022	-85.9162673950	6/22/2015 07:23:29 PM	0:43:01	0.00	4.4	BPS	Position indicates vehicle at a facility
37.1592178345	-85.9162521362	6/22/2015 11:23:28 PM	3:59:59	0.00	13.3	BPS	Position indicates vehicle at a facility
37.1592330933	-85.9162368774	6/23/2015 01:02:28 AM	1:39:00	0.00	7.1	TPR	Position indicates vehicle at a facility
37.1590652466	-85.9166488647	6/23/2015 02:51:33 AM	1:49:05	0.03	134.5	SSR	Position indicates vehicle at a facility
37.1589508057	-85.9166336060	6/23/2015 02:57:03 AM	0:05:30	0.01	42.0	SSR	Position indicates vehicle at a facility
37.1589317322	-85.9166336060	6/23/2015 03:23:29 AM	0:26:26	0.00	7.0	BPS	Position indicates vehicle at a facility
37.1623840332	-85.9170303345	6/23/2015 04:44:03 AM	1:20:34	0.24	1264.7	SSR	On highway
37.1443328857	-84.1157989502	6/23/2015 07:01:13 AM	2:17:10	99.20	NA	SSR	Position indicates vehicle at a facility
37.1433334351	-84.1149978638	6/23/2015 07:01:48 AM	0:00:35	0.08	432.7	4PO	Position indicates vehicle at a facility
37.1443481445	-84.1158142090	6/23/2015 07:03:03 AM	0:01:15	0.08	439.8	SSR	Position indicates vehicle at a facility
37.1451683044	-84.1148300171	6/23/2015 08:48:34 AM	1:45:31	0.08	414.0	SSR	Position indicates vehicle at a facility
37.1073150635	-84.1006317139	6/23/2015 09:01:33 AM	0:12:59	2.73	NA	SSR	Position indicates vehicle at a facility

37.1073150635	-84.1006698608	6/23/2015 10:09:28 AM	1:07:55	0.00	11.1	BPS	Position indicates vehicle at a facility
37.1066665649	-84.0999984741	6/23/2015 11:32:28 AM	1:23:01	0.06	306.8	4PO	Position indicates vehicle at a facility
37.1073341370	-84.1006164551	6/23/2015 11:38:32 AM	0:06:03	0.06	302.7	SSR	Position indicates vehicle at a facility
37.1073150635	-84.1006164551	6/23/2015 11:44:33 AM	0:06:01	0.00	7.0	SSR	Position indicates vehicle at a facility
37.1100997925	-84.0986862183	6/23/2015 02:11:04 PM	2:26:30	0.22	1160.8	SSR	On highway
37.1439018250	-84.1153182983	6/23/2015 02:24:33 PM	0:13:29	2.51	NA	SSR	Position indicates vehicle at a facility
37.1437683105	-84.1154174805	6/23/2015 02:26:33 PM	0:02:01	0.01	56.6	SSR	Position indicates vehicle at a facility
37.1439666748	-84.1155700684	6/23/2015 02:32:02 PM	0:05:29	0.02	84.9	SSR	Position indicates vehicle at a facility
37.1456489563	-84.1148529053	6/23/2015 02:40:32 PM	0:08:30	0.12	648.2	SSR	Position indicates vehicle at a facility - Possibly start of departure
37.1465682983	-84.1148986816	6/23/2015 02:46:03 PM	0:05:30	0.06	335.7	SSR	Movement toward departing facility
37.1465492249	-84.1125640869	6/23/2015 03:01:33 PM	0:15:30	0.13	678.9	SSR	On highway - ramp to I-75
37.1082496643	-84.1007308960	6/23/2015 03:13:27 PM	0:11:54	2.73	NA	SSR	Position indicates vehicle at a facility
37.1084823608	-84.0998992920	6/23/2015 03:14:38 PM	0:01:11	0.05	256.4	SSR	Position indicates vehicle at a facility
37.1084175110	-84.0998992920	6/23/2015 03:19:02 PM	0:04:24	0.00	23.7	SSR	Position indicates vehicle at a facility
37.1074333191	-84.1008300781	6/23/2015 03:21:34 PM	0:02:32	0.09	449.7	SSR	Position indicates vehicle at a facility
37.1074333191	-84.1006469727	6/23/2015 03:27:03 PM	0:05:30	0.01	53.3	SSR	Position indicates vehicle at a facility
37.1074485779	-84.1006011963	6/23/2015 03:35:02 PM	0:07:59	0.00	14.4	SSR	Position indicates vehicle at a facility
37.1083335876	-84.0999984741	6/23/2015 05:05:28 PM	1:30:26	0.07	367.4	4PO	Position indicates vehicle at a facility
37.1103668213	-84.0985641479	6/23/2015 05:08:33 PM	0:03:05	0.16	851.1	SSR	On highway (outside Peterbilt facility)
37.1116676331	-84.0983352661	6/23/2015 05:11:57 PM	0:03:24	0.09	479.2	4PO	On highway
36.9750175476	-84.1061859131	6/23/2015 06:52:33 PM	1:40:36	9.45	NA	SSR	Position indicates near entrance of facility
36.9745178223	-84.1064987183	6/23/2015 06:58:03 PM	0:05:30	0.04	203.8	SSR	Position indicates vehicle at a facility
36.9751167297	-84.1061325073	6/23/2015 07:06:33 PM	0:08:30	0.05	243.2	SSR	Position indicates vehicle at a facility

36.9173164368	-84.1343994141	6/23/2015 07:20:33 PM	0:14:01	4.29	NA	SSR	On highway
36.9178504944	-84.1321182251	6/23/2015 07:28:29 PM	0:07:55	0.13	693.3	SSR	On highway
36.5133323669	-84.1965637207	6/23/2015 07:58:03 PM	0:29:34	28.18	NA	DTX	On highway (I-75)
36.1706848145	-84.0854797363	6/23/2015 08:26:02 PM	0:27:59	24.47	NA	BPS	On highway (I-75)
36.1109504700	-84.0201492310	6/23/2015 08:35:02 PM	0:09:00	5.51	NA	SSR	Position indicates vehicle at a facility
36.1084175110	-84.0225982666	6/23/2015 08:59:02 PM	0:24:00	0.22	1172.6	SSR	On highway
34.9315185547	-85.1540985107	6/23/2015 10:43:03 PM	1:44:00	103.25	NA	DTX	On highway
34.5639495850	-84.9457168579	6/23/2015 11:17:03 PM	0:34:00	28.02	NA	SSR	Highway rest area, southbound I-75
34.5622329712	-84.9444351196	6/23/2015 11:22:39 PM	0:05:36	0.14	735.2	SSR	Highway rest area, southbound I-75
33.7835159302	-84.4955978394	6/24/2015 12:22:28 AM	0:59:49	59.61	NA	BPS	On highway
33.3927345276	-84.1474151611	6/24/2015 01:02:06 AM	0:39:38	33.62	NA	TPR	On highway (I-75)
33.2079658508	-84.0654830933	6/24/2015 01:21:58 AM	0:19:52	13.61	NA	SSR	Position indicates vehicle at a facility
33.2064514160	-84.0628967285	6/24/2015 01:50:32 AM	0:28:34	0.18	963.6	SSR	Position indicates vehicle at/adjacent a facility
33.2080001831	-84.0643005371	6/24/2015 01:58:33 AM	0:08:01	0.13	709.1	SSR	Position indicates vehicle at a facility
33.2065849304	-84.0628356934	6/24/2015 02:32:33 AM	0:34:00	0.13	683.0	SSR	On highway
31.6342334747	-83.5851516724	6/24/2015 04:21:33 AM	1:49:00	112.15	NA	SSR	Highway rest area #9, southbound I-75
31.6342658997	-83.5851516724	6/24/2015 04:24:02 AM	0:02:29	0.00	11.8	BPS	Highway rest area #9, southbound I-75
31.6331157684	-83.5835494995	6/24/2015 05:03:33 AM	0:39:30	0.12	650.9	SSR	Highway rest area #9, southbound I-75
30.7530670166	-83.2716140747	6/24/2015 06:07:33 AM	1:04:01	63.54	NA	SSR	Position indicates vehicle at a facility

30.7539672852	-83.2723693848	6/24/2015 06:31:33 AM	0:24:00	0.08	404.9	SSR	On highway outside facility
30.6124668121	-83.1482162476	6/24/2015 06:45:33 AM	0:14:00	12.25	NA	DTX	Highway rest area
30.6124839783	-83.1482467651	6/24/2015 06:47:58 AM	0:02:24	0.00	11.4	SSR	Highway rest area
30.6126670837	-83.1444015503	6/24/2015 07:01:37 AM	0:13:39	0.23	1209.1	SSR	On highway - departing rest area
29.9793491364	-82.5794525146	6/24/2015 07:56:33 AM	0:54:56	55.23	NA	SSR	Highway rest area
29.9787826538	-82.5791473389	6/24/2015 08:09:32 AM	0:13:00	0.04	228.1	SSR	Highway rest area
29.7659168243	-82.5051498413	6/24/2015 08:22:33 AM	0:13:00	15.36	NA	BPS	On highway (I-75)
28.8494167328	-82.0823974609	6/24/2015 09:28:04 AM	1:05:31	68.25	NA	SSR	On highway - STOP
28.8493824005	-82.0823822021	6/24/2015 12:22:28 PM	2:54:24	0.00	13.4	BPS	On highway - STOP
28.8483333588	-82.0816650391	6/24/2015 12:43:57 PM	0:21:29	0.08	446.1	4PO	On highway - STOP
28.8483333588	-82.0816650391	6/24/2015 01:22:28 PM	0:38:31	0.00	0.0	4PO	On highway - STOP
28.8489170074	-82.0816802979	6/24/2015 01:37:03 PM	0:14:34	0.04	213.0	SSR	On highway - STOP
28.8394832611	-82.0453491211	6/24/2015 01:46:33 PM	0:09:30	2.29	NA	SSR	On highway - Possible Stop
28.8398494720	-82.0455703735	6/24/2015 02:41:33 PM	0:55:00	0.03	151.2	SSR	On highway - Possible Stop (U-turn)
28.2280158997	-81.6481704712	6/24/2015 04:28:03 PM	1:46:30	48.67	NA	SSR	Position indicates vehicle at a facility
28.2274169922	-81.6469650269	6/24/2015 04:29:13 PM	0:01:10	0.08	444.8	SSR	On highway - departing facility
28.2075157166	-81.6399841309	6/24/2015 04:30:58 PM	0:01:45	1.44	NA	BPS	On highway - US 27
28.1192340851	-81.6393966675	6/24/2015 04:50:03 PM	0:19:04	6.10	NA	SSR	Position indicates vehicle at a facility
28.1191005707	-81.6392135620	6/24/2015 08:30:58 PM	3:40:55	0.01	76.4	BPS	Position indicates vehicle at a facility
28.1191005707	-81.6392135620	6/25/2015 12:30:58 AM	4:00:00	0.00	0.0	BPS	Position indicates vehicle at a facility
28.1190662384	-81.6391830444	6/25/2015 01:01:35 AM	0:30:37	0.00	15.9	TPR	Position indicates vehicle at a facility

28.1190834045	-81.6391830444	6/25/2015 04:30:58 AM	3:29:22	0.00	6.3	BPS	Position indicates vehicle at a facility
28.1209831238	-81.6397018433	6/25/2015 05:16:33 AM	0:45:35	0.14	712.9	SSR	On highway
28.0811328888	-81.6145858765	6/25/2015 05:32:04 AM	0:15:31	3.15	NA	SSR	Position indicates vehicle at a facility
28.0811328888	-81.6157531738	6/25/2015 07:45:58 AM	2:13:54	0.07	375.7	SSR	Position indicates vehicle at a facility - roadway departing facility
28.0944671631	-81.9566497803	6/25/2015 08:30:58 AM	0:45:00	20.80	NA	BPS	On highway
28.2161502838	-82.3680648804	6/25/2015 09:12:02 AM	0:41:04	26.44	NA	SSR	Highway rest area
28.2161159515	-82.3680191040	6/25/2015 09:21:32 AM	0:09:30	0.00	19.3	SSR	Highway rest area
30.4516830444	-82.9354324341	6/25/2015 12:02:32 PM	2:41:00	158.20	NA	SSR	Position indicates vehicle at a facility
30.4526329041	-82.9340362549	6/25/2015 12:27:03 PM	0:24:30	0.11	559.3	SSR	Position indicates vehicle at a facility
30.4820499420	-82.9915008545	6/25/2015 12:30:58 PM	0:03:55	3.98	NA	BPS	On highway (I-75)
30.6638660431	-83.2076492310	6/25/2015 12:47:03 PM	0:16:04	17.98	NA	DTX	Highway rest area
30.6638336182	-83.2076187134	6/25/2015 12:51:33 PM	0:04:30	0.00	15.2	SSR	Highway rest area
30.6653995514	-83.2094345093	6/25/2015 01:10:02 PM	0:18:30	0.15	806.9	SSR	Highway rest area - departing ramp
30.7529163361	-83.2714004517	6/25/2015 01:23:32 PM	0:13:30	7.08	NA	SSR	Position indicates vehicle at a facility
30.7525825500	-83.2702865601	6/25/2015 01:26:58 PM	0:03:26	0.07	369.8	SSR	Position indicates vehicle at a facility
30.7530002594	-83.2699356079	6/25/2015 01:33:03 PM	0:06:05	0.04	188.0	SSR	Position indicates vehicle at a facility
30.7534160614	-83.2712631226	6/25/2015 01:41:04 PM	0:08:01	0.08	443.0	SSR	Position indicates vehicle at a facility
33.5842666626	-84.3739166260	6/25/2015 04:33:03 PM	2:51:59	205.95	NA	BPS	On highway (I-75)
34.4077491760	-84.9183349609	6/25/2015 06:21:32 PM	1:48:29	64.88	NA	SSR	Highway rest area
34.4078674316	-84.9181976318	6/25/2015 06:23:33 PM	0:02:01	0.01	59.7	SSR	Highway rest area
35.0876007080	-85.0646362305	6/25/2015 07:15:29 PM	0:51:56	47.70	NA	SSR	Crash site
35.0875511169	-85.0645675659	6/25/2015 08:30:57 PM	1:15:28	0.01	27.3	BPS	Crash site

Appendix 3: Vehicle reference data

						Published Data					
Vehicle Make	Vehicle Model	Model Year	Vehicle Type	VIN	Weight Post Crash[1]	Curb Weight	OAL (feet)	OAW (feet)	WB (feet)	FOH (feet)	ROH (feet)
Peterbilt	379	2007	Truck tractor 3-axle	IXP5DB9X07Dxxxxxx	35,900	NA	74.1				
Great Dane	7011TZ-1ASLT	2005	Semi-trailer 2-axle	1GRAA06266Bxxxxxx				8.5	50.9	-	
Toyota	Prius	2010	4S	JTDKN3DU8A0xxxxxx	2,720	3,036	14.64	5.75	8.90	2.96	2.79
Scion	tC	2010	2S	JTKDE3B75A0xxxxxx	2,700	2,987	14.50	5.76	8.86		
Mazda	Tribute	2003	SUV	4F2CZ96103KMxxxxx	3,200	3,447	14.45	6.01	8.60	2.79	3.02
Ford	F150 XLT	2001	PU	1FTRW07W61KFxxxxx	4,660	4,618	18.42	6.63	11.59	3.28	3.61
GMC	Savana G1500	2005	Van	1GTFG15X551xxxxxx	6,080	5,207	18.68	6.63	11.26	3.32	4.08
Chevrolet	Uplander	2007	Mini van	1GNDV23W37Dxxxxxx	4,480	4,266	17.04	6.01	10.08	3.28	3.68
Cadillac	CTS	2014	4S	1G6AU5S88E0xxxxxx	3,880	3,817	16.32	6.01	9.56	2.86	3.91
Toyota	Tundra	2015	PU	5TFAW5F14FXxxxxxx	6,040	5,677	19.08	6.66	12.14	2.95	3.70