

**CRASH DATA RESEARCH CENTER**  
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**CALSPAN SUDDEN ACCELERATION INVESTIGATION**  
**SCI CASE NO: CA08020**

**VEHICLE: 2007 TOYOTA TACOMA**  
**LOCATION: FLORIDA**  
**CRASH DATE: DECEMBER 2007**

Contract No. DTNH22-07-C-00043

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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. Abstract</p> <p>This investigation focused on the alleged sudden acceleration and the crash dynamics surrounding the single vehicle rollover crash of a 2007 Toyota Tacoma pick-up truck. The 35 year old driver reportedly lost control of the vehicle due to the alleged sudden acceleration during a left turning maneuver. During the course of the acceleration, the vehicle lost traction and began yawing counterclockwise as it departed the eastbound lanes. The Toyota crossed the center median, entered the westbound lanes, and tripped into a right side leading five-quarter turn rollover. The vehicle tripped as a result of its transition from grass back to the road surface. The Toyota came to rest on its right side on the westbound traffic lanes. The driver reported that he sustained a forearm abrasion and he denied further medical attention. The vehicle sustained disabling damage and was towed. It was subsequently deemed a total loss by its insurance carrier.</p> <p>The National Highway Traffic Safety Administration's (NHTSA's) Office of Defects Investigation (ODI) was notified of this alleged sudden acceleration crash through a Vehicle Owner's Questionnaire (VOQ) submitted by the driver. ODI requested that NHTSA's Crash Investigation Division assign an on-site investigation of the crash to the Calspan Special Crash Investigations (SCI) team. The Toyota was located at an insurance salvage facility and was available for inspection. This investigation consisted of an inspection of the Toyota Tacoma, an inspection of the crash site, and a driver interview. The vehicle inspection included a detailed inspection of the driver's interior and the foot controls to determine the possible cause of the sudden acceleration. The on-site portion of the investigation took place June 4, 2008. The cause of the sudden acceleration could not be identified.</p>			
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**TABLE OF CONTENTS**

BACKGROUND ..... 1

SUMMARY

Vehicle Data..... 2

Crash Site ..... 2

Crash Sequence..... 2

Vehicle Damage

    Exterior Damage ..... 3

    Interior Damage ..... 4

Foot Controls/Floor Mats..... 5

Manual Restraint System ..... 7

Air Bag System ..... 7

Exemplar Vehicle Inspection..... 7

Occupant Data

    Driver ..... 8

    Driver Injury ..... 8

    Driver Kinematics ..... 8

    Driver Interview ..... 9

Crash Schematic..... 11

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***BACKGROUND***

This investigation focused on the alleged sudden acceleration and the crash dynamics surrounding the single vehicle rollover crash of a 2007 Toyota Tacoma pick-up truck (**Figure 1**). The 35 year old driver reportedly lost control of the vehicle due to the alleged sudden acceleration during a left turning maneuver. During the course of the acceleration, the vehicle lost traction and began yawing counterclockwise as it departed the eastbound lanes. The Toyota crossed the center median, entered the westbound lanes, and tripped into a right side leading five-quarter turn rollover. The vehicle tripped as a result of its transition from grass back to the road surface. The Toyota came to rest on its right side on the westbound traffic lanes. The driver reported that he sustained a forearm abrasion and he denied further medical attention. The vehicle sustained disabling damage and was towed. It was subsequently deemed a total loss by its insurance carrier.



**Figure 1: Left front oblique view of the Toyota.**

The National Highway Traffic Safety Administration's (NHTSA's) Office of Defects Investigation (ODI) was notified of this alleged sudden acceleration crash through a Vehicle Owner's Questionnaire (VOQ) submitted by the driver. ODI requested that NHTSA's Crash Investigation Division assign an on-site investigation of the crash to the Calspan Special Crash Investigations (SCI) team. The Toyota was located at an insurance salvage facility and was available for inspection. This investigation consisted of an inspection of the Toyota Tacoma, an inspection of the crash site, and a driver interview. The vehicle inspection included a detailed inspection of the driver's interior and the foot controls to determine the possible cause of the sudden acceleration. The on-site portion of the investigation took place June 4, 2008. The cause of the sudden acceleration could not be identified.

***VEHICLE DATA***

The 2007 Toyota Tacoma was identified by the Vehicle Identification Number (VIN): 3TMJU62N77M (production sequence deleted). The vehicle was manufactured in December 2006 and the odometer had registered 20,765 km (12,903 miles). The four door, double-cab 4x2 pickup truck was configured on a 325 cm (127.8 in) wheelbase. The 453 kg (½ ton) pickup had a Gross Vehicle Weight Rating (GVWR) of 2,426 kg (5,350 lb). The power train consisted of a

4.0 liter, V6 engine linked to a five-speed automatic transmission. The Tacoma was equipped with power assisted front disc/rear drum brakes with four-wheel anti-lock (ABS). The interior of the vehicle was configured for five passenger seating. Each seat position was supplied with a three point lap and shoulder restraint. The front safety belts utilized retractor pretensioners. The Tacoma was equipped with Certified Advanced 280-Compliant (CAC) air bags for the driver and front right passenger. During the crash, neither the pretensioners nor the air bags deployed as a result of the rollover event. The vehicle's tires were Dunlop Grandtrek AT20 P245/75R16 steel belted radials mounted on OEM steel wheels. The vehicle manufacturer recommended cold tire pressure was 241 kPa (29 PSI), front and rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Damage
Left Front	179 kPa (26 PSI)	6 mm (8/32 in)	None
Left Rear	179 kPa (26 PSI)	6 mm (7/32 in)	None
Right Front	172 kPa (25 PSI)	6 mm (7/32 in)	Minor rim abrasion
Right Rear	172 kPa (25 PSI)	5 mm (6/32 in)	Minor rim abrasion

**CRASH SITE**

This single vehicle rollover crash occurred during the daylight hours in December 2007. At the time of the crash, the weather was clear. The asphalt road surface was dry. The crash occurred on a divided two-lane, straight, level, east/west roadway in a commercial setting. The east/west traffic flow was separated by a 6.6 m (21.7 ft) raised grass median. The median was bordered by a 0.5 m (1.7 ft) wide concrete gutter and 10 cm (4 in) curb. There was a three-leg intersection immediately west of the median that was controlled by overhead traffic signals. The intersection was the entrance/exit into/out of the parking lot of commercial businesses located on the north side of the roadway. **Figure 2** is an eastbound trajectory view of the Toyota at the intersection. Due to the passage of time between the December 2007 crash date and the SCI case assignment in June 2008, no physical evidence of the crash remained at the site.



**Figure 2: Eastbound trajectory view at the crash site.**

**CRASH SEQUENCE**

*Pre-Crash*

Prior to the crash, the 35 year old driver had been conducting business in the shopping center located on the north side of the roadway. He entered the 2007 Toyota Tacoma with the intention of leaving the shopping center and traveling back to his home that was located approximately 3 km (2 miles) southeast of the crash site. The driver was operating the vehicle southbound along the exit road. As the vehicle approached the intersection, the driver indicated he had a green

arrow and there was no other traffic in front of him. He estimated his speed was approximately 30 km/h (20 mph). As the driver initiated a left turn, he tapped the brakes and he felt the rear tires break traction. Allegedly, the Toyota then suddenly accelerated. The driver counter-steered to the right and then back to the left in an effort to regain control of the vehicle. He reported that he began to panic and the next thing he recalled was entering the center median. The engine was racing and he indicated that he attempted to apply the brake with his right foot. He stated that he braced himself by the steering wheel and elevated himself to fully apply the brake with his body weight; however, the brakes were not effective. The Toyota crossed the center median in a counterclockwise rotation. A schematic of the crash is included at the end of this report as **Figure 14**.

### ***Crash***

The Toyota rotated through the raised center median and entered the westbound lanes of the road. As the right side tires travelled from the grass back onto the concrete gutter, the sidewalls of the tires rolled under the rims and tripped the vehicle into a right side leading rollover. The Toyota rolled five-quarter turns into the westbound lanes and came to rest on its right side facing northwestward.

### ***Post-Crash***

The police were notified of the crash via the 9-1-1 system by witnesses to the crash and responded to the scene. The driver reportedly exited the vehicle through the left door with the assistance of the witnesses. The driver sustained an abrasion to his left forearm but declined medical attention or transport. The Toyota was towed from the scene and subsequently deemed a total loss by its insurance carrier. The day following the crash, the driver sought medical attention from his family doctor due to reported back and neck strain and intermittent numbness in his left arm. He has had additional consultation with a chiropractor and neurologist.

In April 2008, the driver submitted a Vehicle Owner's Questionnaire (VOQ) through the United States Department of Transportation's Auto Safety Hotline regarding the alleged sudden acceleration of the Tacoma.

## **VEHICLE DAMAGE**

### ***Exterior Damage***

**Figures 3 through 5** are exterior views of the Toyota Tacoma. The Tacoma sustained damage to the right, top and left planes consistent with a right side leading five-quarter turn rollover event. The right side plane exhibited body panel abrasions that were oriented in two different directions indicative of ground contact at two different points in time. The top and left planes exhibited body panel abrasions that were oriented in a single direction. The exterior mirrors on both side planes fractured and separated from their respective doors. There was



**Figure 3: Right side view.**

no change in the longitudinal dimensions of the vehicle; the wheelbase was unchanged. The windshield fractured during the rollover. At the time of the SCI inspection, the windshield was lying on the instrument panel. It had separated from the header and sagged due to heat exposure. The side window glazing in the rear right door had disintegrated. The remaining side windows were intact. The driver indicated during his SCI interview that the front left and front right windows were in their full downward positions at the time of the crash.

The maximum lateral deformation was located at the right A-pillar and measured 4 cm (1.5 in). The maximum vertical deformation was located within the right B-pillar roof area, 16 cm (6.2 in) inboard of the right roof rail and 24 cm (9.5 in) forward of the right B-pillar. The maximum deformation measured 11 cm (4.3 in). The Collision Deformation Classification (CDC) was 00-TPDO3



Figure 4: Top view of the Tacoma.



Figure 5: Left side view of the Toyota.

### *Interior Damage*

The interior damage of the Tacoma was limited to the intrusion of the vehicle’s roof structures. There were no identified points of occupant contact. The measured intrusion into the interior compartment is identified in the table below:

<i>Position</i>	<i>Component</i>	<i>Intrusion</i>	<i>Direction</i>
Row 1 Left	Roof Side Rail	5 cm (2.0 in)	Vertical
Row 1 Right	Roof Side Rail	9 cm (3.5 in)	Vertical
Row 1 Right	Roof	15 cm (6.0 in)	Vertical
Row 1 Right	Roof Side Rail	5 cm (2.0 in)	Lateral
Row 1 Right	B-pillar	5 cm (2.0 in)	Lateral
Row 2 Right	Roof Side Rail	8 cm (3.0 in)	Lateral

The driver seat was located in a full rear track position at the time of the SCI inspection. The total seat track travel measured 24 cm (9.5 in). The seat back was reclined 7 degrees aft of vertical. The horizontal distance between the seat back and air bag module was 64 cm (25 in). The tilt and telescoping steering column was unlocked at the time of the inspection. The column



was located at the lowest and most forward position. The column's position at the time of the crash could not be determined. There was no steering wheel rim deformation or shear capsule displacement.

### ***FOOT CONTROLS/FLOOR MATS***

**Figure 6** is an interior view of the driver position as it was first observed. The foot controls were not damaged and operated properly. The accelerator did not bind; its return spring was strong. It was observed that the rubber pad covering the steel brake pedal was partially displaced. Refer to **Figure 7**. Normally, the pad was attached to the steel pedal by inserting the four edges of the pedal under molded flaps on the back side of the rubber pad. At the time of the SCI inspection, the pad was only attached to the pedal by the lower outboard corner. This implied to this investigator that the driver's foot may have been trapped and/or captured under the pedal and as the driver attempted to free his foot, the pad became dislodged. It was possible that his foot becoming trapped may have been associated with the loss of control. The brake pedal was firm when depressed and the system held pressure.



**Figure 6: Interior view with the OEM carpet mat.**



**Figure 7: Displaced brake pedal pad.**

An OEM carpeted floor mat was installed in the left position and clipped into place. On top of the carpeted mat, an OEM rubber all-weather mat was also in use. It should be noted that this mat, an additional rubber mat for the front right position and a mat for the rear right position were found within the bed of the pickup. Refer to **Figure 8**. The OEM rubber mat was contoured to fit within the left floor pan (**Figure 9**) and was flexible. There were cut-outs on the forward left and forward right sides of the mat for the dead pedal and accelerator, respectively. There were no abrasions or damage to the floor mat. It was not possible to bunch-up the mat and cause it to interfere with the accelerator. **Figure 10** is a view of the rubber mat displaced to its most forward position. In this displaced position, the forward right corner of the mat remained



**Figure 8: Mats found in the open truck bed.**

clear of the accelerator. The mat could not be shifted laterally due to the vertical side wall of the console. There was a warning molded into the mat stating: *“Do Not Place On Top Of Existing Floor Mats”*. **Figure 11** is a close-up view of the forward right corner of the mat and the molded warning.



**Figure 9: Interior view with the OEM rubber floor mat in place.**



**Figure 10: Rubber Mat displaced to its most forward position.**



**Figure 11: Forward aspect of the OEM rubber mat.**

The engine of the Toyota Tacoma was started at the end of the SCI inspection. The vehicle's battery was still energized and the engine started normally. The cold engine initially idled at approximately 1500 RPM and decreased to 1000 RPM as it warmed. There were no warning lights illuminated in the instrument cluster. The accelerator pedal was depressed and released; the engine speed increased and decreased appropriately. A mechanical cause for the alleged sudden acceleration could not be identified.

### ***MANUAL RESTRAINT SYSTEMS***

The Toyota Tacoma was equipped with three-point lap and shoulder belts in the five seat positions. The driver's restraint consisted of continuous loop webbing, sliding latch plate, adjustable D-ring and an Emergency Locking retractor. The retractor was equipped with a pretensioner. The pretensioner did not actuate in the crash. The driver's D-ring was adjusted to the full down position. The driver's webbing was stowed within the retractor at initial inspection. Examination of the webbing was unremarkable for crash related evidence. The latch plate exhibited historical use indicators consistent with the vehicle's age. The friction surface of the latch plate exhibited very minor abrasions that were associated to restraint use at the crash.

### ***AIR BAG SYSTEM***

The Toyota Tacoma was equipped with CAC air bags for the driver and front right passenger. A CAC air bag is certified by the vehicle manufacturer to meet the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The air bags did not deploy during the crash. The Tacoma was not equipped with side impact or curtain air bags.

### ***EXEMPLAR VEHICLE INSPECTION***

The Office of Defects Investigation (ODI) of the NHTSA has identified a condition where an unsecured OEM rubber all-weather floor mat may become displaced forward and entrap the accelerator in an open position. Although this condition could not be replicated during the SCI inspection of the Florida Toyota Tacoma, exemplar vehicle testing has shown the possibility does exist that the accelerator may become entrapped by the raised molding of the displaced mat. **Figures 12 and 13** are interior views of a Toyota Tacoma obtained from ODI that depict the displaced mat and accelerator pedal entrapment.



**Figure 12: View of the displaced floor mat obtained from ODI.**



**Figure 13: Close-up view of the entrapped accelerator pedal in Figure 12.**

A 2007 Toyota Four-Runner, equipped with both the OEM carpet floor mat and OEM all-weather rubber floor mat, was used for the exemplar vehicle testing due to its availability. The configuration and layout of the cab and foot controls were identical to the Toyota Tacoma. The unsecured OEM rubber mat was displaced forward and inboard underneath the accelerator pedal. In this displaced position, it was possible to catch the lower edge of the depressed accelerator

pedal on the floor mat. However, in this position the accelerator was nearly 100 percent open. The accelerator only caught and remained engaged with the edge of the mat one time out of numerous tries during the SCI exemplar inspection; however the mat was covered in an “Armor All” type protectant/cleaner and was slippery.

Additionally during the exemplar testing, the SCI investigator was able to peel the brake pedal pad off the brake pedal quite easily with the sole of his right shoe. This created a condition similar to the brake pedal pad found during the Tacoma vehicle inspection. The possibility of the driver’s foot/shoe getting caught up between the pedals during the crash existed, as well. The pad could also have been displaced due to the occupant kinematics caused by the rollover.

#### OCCUPANT DATA

##### *Driver*

Age / Sex:	35 year old / Male
Height:	180 cm (71 in)
Weight:	82 kg (180 lb)
Seat Track Position:	Full rear track position
Restraint Use:	Three-point lap and shoulder
Usage Source:	SCI vehicle inspection
Medical Treatment:	No treatment or transport at the time of the crash

##### *Driver Injury*

<i>Injury</i>	<i>Injury Severity (AIS Update 98)</i>	<i>Injury Source</i>
Left forearm abrasion, NFS	Minor (790202.1,2)	Ground, possible
Cervical Strain, NFS	Minor (640278.1,6)	Crash force
Back Strain, NFS	Minor (640678.1,8)	Crash force

*Source – Driver Interview.*

##### *Driver Kinematics*

The restrained 35 year old male driver was seated in a full rear track position in an upright posture. The front windows were fully open. The driver lost directional control of the vehicle possibly due to an alleged sudden acceleration causing the driver to sharply steer counterclockwise (left). The Toyota departed the inboard lane and entered the center median in a counterclockwise yaw. As the vehicle entered the opposing traffic lanes, the vehicle tripped into a right side leading five-quarter turn rollover.

As the vehicle began to roll, the ELR retractor of the safety belt locked. The driver was displaced toward the left and loaded the lap section of the locked safety belt. During the roll event, the driver continued to load the safety belt system and rode down the force of the crash. As the vehicle rolled three quarter turns the driver’s left forearm possibly contacted the ground (via the open window) and was abraded. The vehicle then rolled an additional two quarter turns and came to rest. The driver came to rest within the driver seat. The driver was assisted from

the vehicle by witnesses to the event and refused medical treatment on the day of the crash. The driver indicated that he sustained neck and back strain due to the force of the rollover crash. These symptoms did not present themselves until the day following the crash. On that day, the driver sought treatment for neck and back strain from his family doctor. Subsequently, he has followed up with a chiropractor and a neurologist.

### ***Driver Interview***

The driver was interviewed by the SCI team 6 days post-vehicle inspection by telephone. The following is a summation of that conversation.

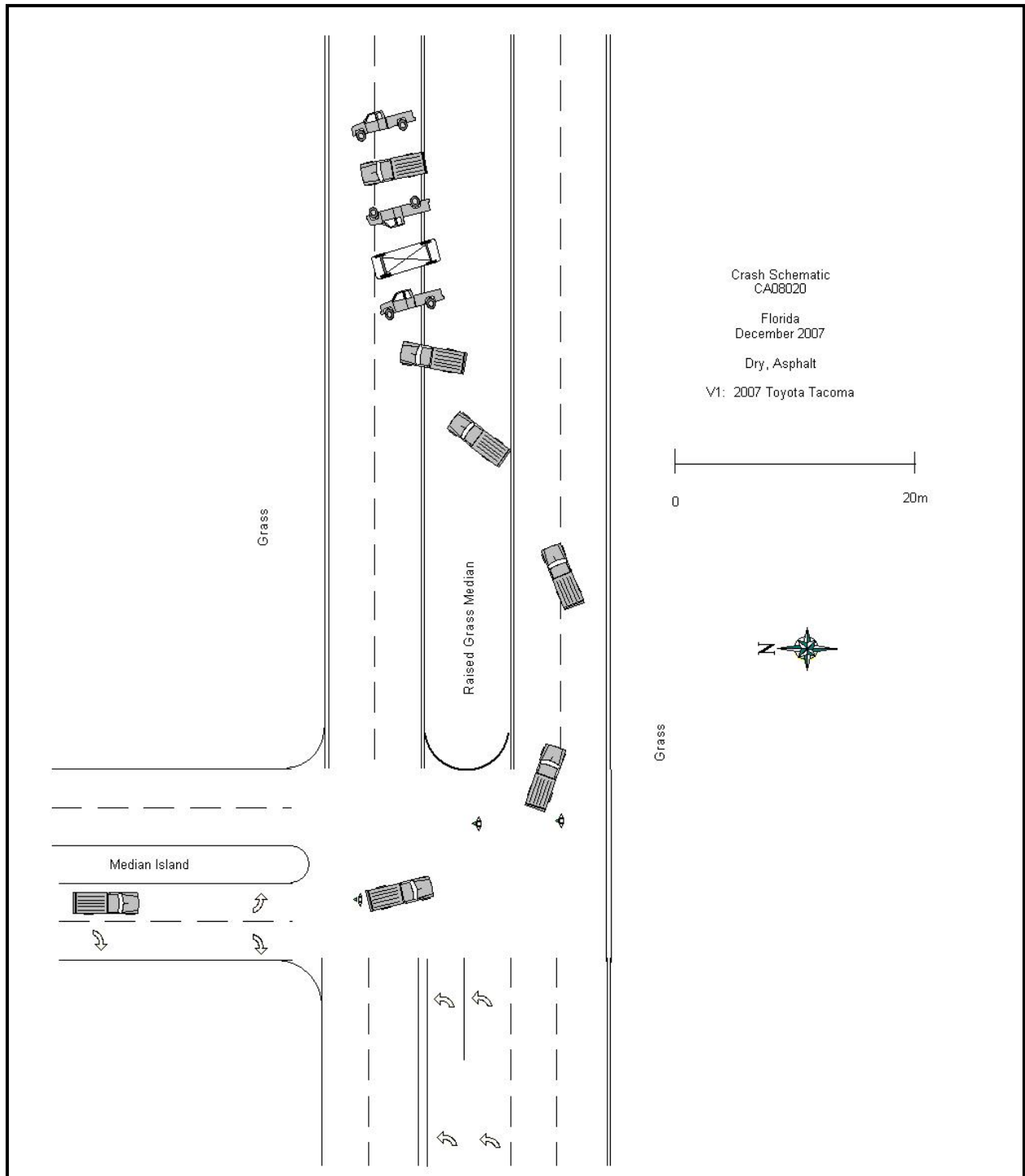
The driver leased the Toyota Tacoma approximately 1 year prior to the crash and had not experienced any previous problems with the vehicle. The weather was reported as clear and dry with a temperature of 65 to 70 degrees F. He was very familiar with the area and drove through this route daily for his employment. The driver was dressed in jeans, a tee shirt, and leather (low top) loafer style shoes. He was restrained by the lap and shoulder belt and was seated full rear. The driver indicated that he was a “one-footed” driver, operating the foot controls with only his right foot. His left foot was typically on the dead pedal. There was no cargo in the truck bed.

As stated earlier in this report, the driver indicated he was exiting the parking lot at the time of the crash. The traffic light was green and there was no other traffic in front of him. As the driver initiated the left turn, he estimated his speed was approximately 30 km/h (20 mph). He tapped the brake and then felt the rear-end of the truck “slide out” to the right. Allegedly the vehicle then began to suddenly accelerate. He recalled the sound of the engine as “racing”. The driver countersteered to the right and began to panic. His next recollection was entering the center median. He recalled attempting to apply the brake with his right foot. He braced himself with his hands on the steering wheel and his left foot on the floor and raised his body to fully apply (“stand on”) the brake. The brakes were not effective and the vehicle rolled over. When the vehicle came to rest, he recalled the engine was still running but did not recall if it was still “racing”. His concern was shutting the engine off to prevent a fire; so he quickly turned the ignition off. He was then assisted out of the truck by the witnesses.

After filing the VOQ, the driver had a conversation with the NHTSA regarding the sudden acceleration and the floor mats. He had never experienced a problem with his floor mats bunching up or sliding and interfering with the foot controls. After that conversation, the driver went to an exemplar vehicle and tried to slide the rubber mat forward into the foot controls. He stated he was kicking and scuffing them with his feet and could not get them to slide forward. Further, he indicated that there was too much clearance around the accelerator pedal to get the floor mat to interfere with the accelerator and cause an open throttle condition. He stated directly to the investigator that the floor mats were not a factor in his crash.

The question of pedal confusion was raised during the interview. Since the time of the crash, the driver has replayed the events of the crash over in his mind and he was adamant that he was not depressing the accelerator instead of the brake. He was aware of the difference in the pedal heights; the brake pedal slightly higher than the accelerator. It was his recollection that as he “stood on” the brake pedal, he was depressing something that was raised; not depressing the accelerator to the floor.





**Figure 14: Crash Schematic.**