National Transportation Safety Board

Washington, D.C. 20594

Highway Accident Brief

Accident Number:	HWY-13-FH-018
Accident Type:	Multivehicle collision and subsequent vehicle fall from bridge
Location:	US Route 50/301, eastbound span of William Preston Lane, Jr., Memorial Bridge (Chesapeake Bay Bridge) near Annapolis, Maryland
Date and Time:	Friday, July 19, 2013, 8:24 p.m. eastern daylight time
Vehicles:	2010 International truck-tractor semitrailer combination unit
	2007 Chrysler Sebring passenger vehicle
	2014 Mazda CX-5 passenger vehicle
Fatalities:	None
Injuries:	1 minor, 3 uninjured

Crash Description

On Friday, July 19, 2013, about 8:24 p.m., a 2007 Chrysler Sebring passenger car operated by a 24-year-old female driver was traveling eastbound on US Route 50/301 near Annapolis, Maryland. The Chrysler had passed through the toll plaza to enter onto the eastbound span of the William Preston Lane, Jr., Memorial Bridge (Chesapeake Bay Bridge). Less than a mile past the toll plaza, after vehicles had merged from 11 toll lanes into two travel lanes, traffic began to slow as the bridge ascended above the Chesapeake Bay and curved to the left.

The Chrysler was in the right lane and had reduced speed to 4 mph due to the traffic queue ahead when it was struck from behind by a 2010 International truck-tractor and refrigerated semitrailer combination unit traveling 47 mph.[1] The truck-tractor, operated by a 29-year-old male driver, collided with the left rear corner of the Chrysler, pushing it into the concrete barrier adjacent to the right lane. As the truck-tractor and the Chrysler continued forward, the front of the Chrysler collided with a 2014 Mazda CX-5 occupied by a 65-year-old male driver and his wife. During the collision sequence, the Chrysler was pushed up onto the barrier wall and then rode along the top of it, before falling approximately 27 feet into the Chesapeake Bay. The Chrysler came to rest between two bridge piers to the south of the eastbound span, in approximately 7 feet of water. The Mazda rotated counter-clockwise and came to rest near the left front corner of the truck-tractor in the middle of the two travel lanes. (See figure 1 for the approximate location of the crash and figure 2 for the final rest of vehicles.)

[1] The speed limit at the crash location was 40 mph.

Figure 1. View of Chesapeake Bay Bridge looking east, showing crash location. (Courtesy of Maryland Transportation Authority)

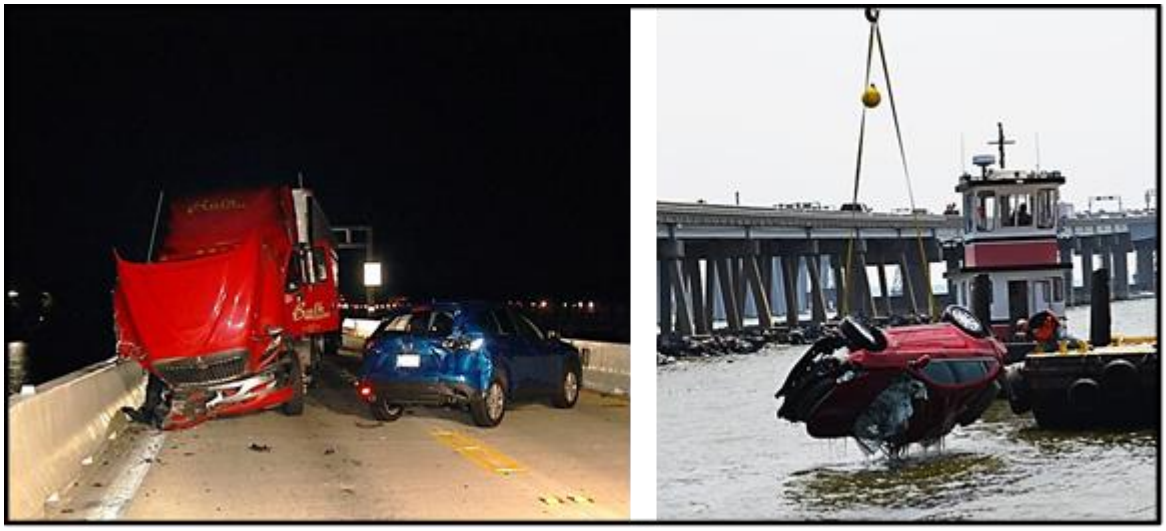

Figure 2. At left, collision scene view of 2010 International truck-tractor and 2014 Mazda CX-5 at final rest. At right, 2007 Chrysler Sebring being recovered from Chesapeake Bay. (Courtesy of Maryland Transportation Authority)

As a result of the collision, the driver of the Chrysler received minor injuries. She was able to swim to one of the nearby bridge piers, from which she was rescued and transported to an area hospital. The driver of the truck-tractor and both occupants of the Mazda were uninjured. Weather conditions were clear and dry, and it was near sunset at the time of the crash.

Commercial Driver and Carrier Information

The driver of the truck-tractor reported to Maryland Transportation Authority (MDTA) police—and to his employer—that he had been traveling in the right lane just prior to the crash and had turned his attention to his driver-side rear view mirror due to lights and sounds behind him. He said that when he looked forward again, he saw that traffic was stopped, and he attempted to avoid colliding with the Chrysler by moving to the left.

Bulk Carriers PEI Limited, based in Cornwall, Prince Edward Island, Canada, operated the truck-tractor. The company has been in operation since 1973 and is authorized to operate within the United States. Bulk Carriers last received a compliance review (CR) from the Federal Motor Carrier Safety Administration (FMCSA) in September 2012. This review was a "focused" CR, and the carrier was not rated.[2] Its safety rating in Canada is "satisfactory unaudited."[3]

The truck driver had been employed by Bulk Carriers since April 2013, when he emigrated from Hungary to Canada as part of its Temporary Foreign Worker (TFW) pilot project. The TFW—a provincial/territorial project—allows foreign workers to obtain temporary work visas to fill worker shortages in certain fields. The truck driver had approximately 4 years of experience driving commercial vehicles in Hungary between 2008 and 2012. Once in Canada, he obtained a "class 1" license,[4] attended Bulk Carrier's new employee training program, and began driving long distance within Canada. In July 2013, he was paired with a Canadian driver who had experience driving in the United States, and he rode with that driver for 2 weeks. The accident trip, which began in Dedham, Massachusetts, was the truck driver's first time driving in the United States on his own.

On July 18, 2013, the driver picked up the accident truck and trailer, loaded with peat moss, from Cummins Northeast in Dedham, where the truck-tractor had recently undergone engine repairs.[5] He began his route to Orange, Virginia, and made his delivery on the afternoon of the following day (the day of the crash). Transporting an unloaded trailer, he then began the trip to Rhodesdale, Maryland, to pick up his next load. The crash occurred approximately 3.5 hours into the route, as he began his first drive across the Chesapeake Bay Bridge. Table 1 shows details of the driver's activities based on the electronic logbooks obtained from Bulk Carriers.

[2] Under the FMCSA Compliance, Safety, Accountability (CSA) program, both US and Canadian carriers who receive a "focused" CR, which is targeted to a specific rating area and is limited in scope, do not typically receive a safety rating.

[3] Each Canadian province or state has its own motor carrier division or highway safety office that monitors and issues safety ratings to its domiciled carriers. The "satisfactory unaudited" rating is assigned to any carrier that has not received sufficient demerit points to warrant an audit.

[4] A "class 1" license in Canada is similar to a "class A" commercial driver's license in the United States.

[5] The engine repairs were for a failed camshaft lobe that damaged the engine cylinder head and one cylinder fuel injector, which caused excess engine noise and resulted in the truck being towed into the Cummins Northeast repair facility on July 8, 2013. Repairs were completed by July 18, 2013.

Table 1. Truck driver's activities, July 17–19, 2013.

Time	Event	Location
Wednesday, July 17, 2013		
6:59 a.m.	Begins driving after being off duty for 6.5 hours	Charlottetown, PEI (Canada)
12:16 p.m.	Resumes driving after being off duty for 38 minutes	Woodstock, NB (Canada)
6:07 p.m.	Goes off duty and rides with another driver from New Hampshire to Massachusetts	Dedham, Massachusetts
Thursday, July 18, 2013		
12:22 p.m.	Begins driving accident truck after being off duty for 17.5 hours, first time driving on his own in the US	Dedham
7:53 p.m.	Resumes driving after being off duty for 34 minutes	Newark, Delaware
11:48 p.m.	Goes off duty near delivery location	Louisa, Virginia
Friday, July 19, 2013		
4:57 p.m.	Begins driving after being off duty overnight and delivering his load in Orange, Virginia	Louisa
5:38 p.m.	Resumes driving after being on duty not driving for 10 minutes	Culpeper, Virginia
7:31 p.m.	Resumes driving after being off duty for 36 minutes to refuel	Fredericksburg, Virginia
8:24 p.m.	Crash occurs	Annapolis, Maryland

Vehicle Information

Both the 2010 International truck-tractor and the 2007 Chrysler Sebring were significantly damaged as a result of the crash, though the 2006 Great Dane refrigerated semitrailer was not damaged. The 2014 Mazda CX-5 sustained relatively minor damage to the rear end. All vehicles were removed from the scene and transported to North Country Recovery in Odenton, Maryland, for further inspection.

The MDTA conducted a commercial vehicle postcrash inspection of the truck-tractor and semitrailer and found that all of the brakes were within the allowable adjustment limits. The right front brake assembly on the truck-tractor sustained collision damage and was inoperable. No mechanical defects were discovered during the MDTA inspection. National Transportation Safety Board (NTSB) investigators also inspected the brakes on the truck-tractor and semitrailer and noted no defects. The Maryland State Police Automotive Safety Enforcement Division conducted postcrash inspections of the Chrysler and Mazda passenger vehicles and found no mechanical defects.

Both the truck-tractor and the Chrysler were equipped with systems capable of recording event data relative to the crash. The truck-tractor was equipped with a Cummins engine control module (ECM). In the case of certain deceleration or trip termination events, the ECM stores vehicle speed, throttle, brake status, and other data. A consultant working with the MDTA

downloaded the ECM on July 26, 2013, while it was still in place on the left side of the truck's engine. The recorded data included a "sudden deceleration event" leading up to the time of the crash and indicated that in the 60 seconds prior to the collision, the truck-tractor had accelerated from 8 to 51 mph, and it had just reduced throttle input to 47 mph at the time of the crash.

The Chrysler's driver side curtain airbag and both frontal airbags deployed. In the event of an airbag deployment or near deployment event, data are stored in the vehicle's airbag control module (ACM). The MDTA removed the ACM from the vehicle and allowed it to dry out prior to being downloaded on July 30, 2013. The recorded data indicated that in the 5 seconds prior to the collision, the Chrysler had slowed from 15 to 4 mph. The data also indicated that the driver was seat belted and had been applying the brakes intermittently during the deceleration.

Highway Information

Bridge Description

The Chesapeake Bay Bridge is approximately 4.3 miles long and consists of two parallel spans connecting the western (Anne Arundel County) and eastern shores (Queen Anne's County) of Maryland. The eastbound span of the bridge carries two lanes of traffic, and the westbound span carries three lanes of traffic. The eastbound span was the original two-lane bridge, completed in 1952. By the early 1960s, the bridge's vehicular capacity had been reached. Construction of a second span—located parallel and 450 feet to the north—began in 1969. The new bridge, completed in 1973, became the westbound span.

An 11-lane-wide toll plaza is located on the west end of the eastbound span at mile marker 32. The crash occurred about 0.5 mile past the toll plaza, near mile marker 32.5, after traffic had merged into two travel lanes. Just past this location, near mile marker 33, the bridge begins to curve to the left as it ascends farther above the Chesapeake Bay. (See figure 3 for a map showing the crash location.)

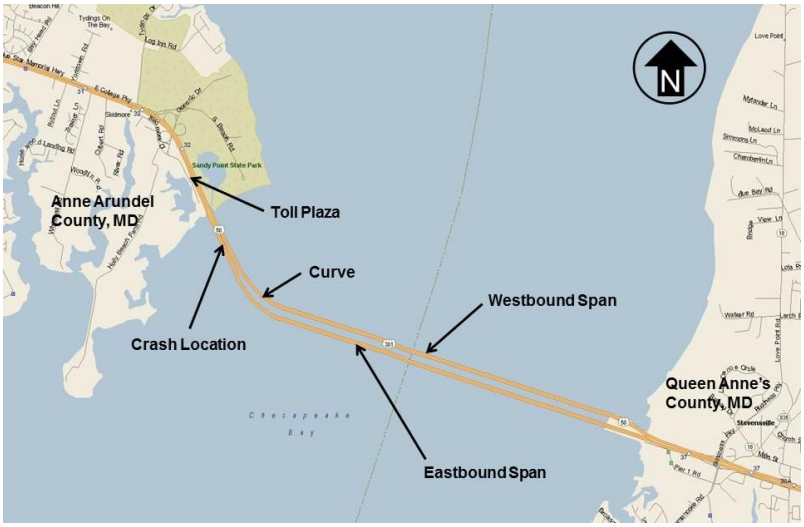

Figure 3. Map of Chesapeake Bay Bridge, showing eastbound and westbound spans, eastbound toll plaza, crash location, and roadway curve.

The posted speed limit on the eastbound span between the toll plaza and the leftward curve is 40 mph. The speed limit for the remainder of the eastbound span and the entire westbound span is 50 mph.

Bridge and Barrier Construction

The superstructure of the Chesapeake Bay Bridge—or type of bridge construction—varies throughout its length. In the vicinity of the crash, the superstructure is beam span construction, as shown in figure 4.

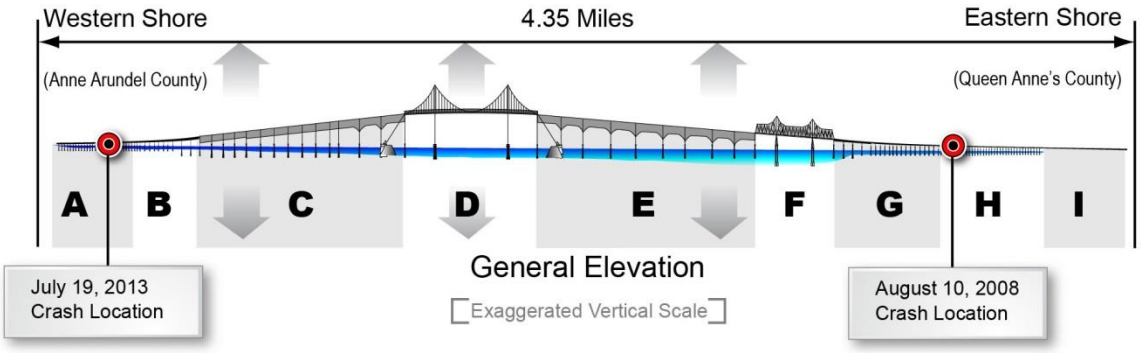

Figure 4. General elevation diagram of Chesapeake Bay Bridge eastbound span, noting locations of July 19, 2013, and August 10, 2008, crashes. Sections A and H are both beam span construction. Other construction types within the eastbound span include girder spans, deck truss spans, suspension spans, deck cantilever truss spans, and through cantilever truss spans.

The NTSB investigated a crash that occurred on August 10, 2008, in which a truck-tractor semitrailer combination unit struck and dislodged a concrete barrier in a beam span portion on the eastern end of the eastbound span of the bridge.[6] In that case, the combination unit and a 12-foot section of barrier fell into the Chesapeake Bay, and the truck driver was fatally injured.

Following the August 10, 2008, crash, the MDTA upgraded the concrete barrier lining the outside travel lanes in the beam span portions of the eastbound span (sections A and H in figure 4). Prior to the upgrade, however, the concrete barrier on these portions of the bridge satisfied height and strength requirements equivalent to test level 2 (TL-2)[7] traffic railings.

The upgrade consisted of adding 1-inch-diameter high-strength anchoring bolts extending down through the traffic side face of the barrier, securing it through the bridge deck. In addition, W-beam guardrail was installed on the outside face of the barrier to provide longitudinal

[6] NTSB Highway Investigation HWY-08-FH-023, Annapolis, Maryland.

[7] The American Association of State Highway and Transportation Officials (AASHTO) recommends the following heights for traffic railings: at least 27 inches for TL-1–TL-3, 32 inches for TL-4, 42 inches for TL-5, and 90 inches for TL-6.

continuity. The upgrade brought the previously TL-2 concrete barrier located in the beam span portions of the eastbound span of the bridge to an equivalent TL-4 high-performance barrier.[8] The concrete barrier itself remained 34 inches high.

Because of this upgrade, the 34-inch-high barrier in place at the time of the July 19, 2013, crash was equivalent to a TL-4 high-performance barrier. Following the collision, the barrier remained intact and in place on the bridge deck.

The MDTA has investigated various rehabilitation options to increase the height of the concrete barrier. It has determined that substantial reconstruction would be required on the bridge deck, and that the most suitable course of action is deck replacement.

At the time of the August 10, 2008, crash, the concrete barriers located in the remaining sections of the eastbound span of the bridge had anchorage systems that met the equivalent of a TL-4 high-performance barrier. The steel barrier in the suspension span portion met the equivalent of a TL-4 high-performance barrier and was bolted directly to the steel floor beams, independent of the bridge deck.

The barriers on the westbound span of the bridge consisted of a 50-inch-tall concrete barrier with metal rail in the through truss spans, a 50-inch-tall steel barrier in the suspension span, and a 46-inch-tall steel barrier in the remaining sections. The 50-inch-tall concrete and steel barriers met the equivalent of a TL-5 high-performance barrier.

Bridge Capacity

According to the MDTA, each travel lane of the bridge can process 1,500–1,600 vehicles per hour depending on driver habits and conditions. This lane estimate provides a maximum travel capacity of 3,000–3,200 vehicles per hour on the eastbound span during normal operations and 4,500–4,800 vehicles per hour on the westbound span during normal operations. However, average daily traffic counts conducted by the MDTA in April 2012 indicate that between the hours of 3:00 and 5:00 p.m., traffic volumes on the bridge exceed the capacity of the eastbound span by at least 265–441 vehicles per hour.[9] As a result, delays and backups occur as traffic volumes increase both throughout the week, culminating on Friday evenings, and in the summer months due to seasonal beach traffic.

To increase lane capacity in a particular direction of travel, or to manage traffic during bridge maintenance or emergencies, a single lane of either span can be reversed from its typical direction of travel, an operating condition known as "contra-flow." During contra-flow operations, unreversed lanes remain at 50 mph and the contra-flow lane has a speed reduction to 40 mph. When eastbound span traffic volumes exceed 3,000 vehicles per hour, the MDTA opens one lane of the westbound span to eastbound traffic. Contra-flow is discontinued when eastbound span traffic volumes fall below 3,000 vehicles per hour.

[8] AASHTO considers barriers equivalent to TL-4 or higher to be high-performance barriers.

[9] The MDTA hourly traffic and vehicle classification count was conducted on Thursday, April 5, 2012, at US Route 50, west of MD Route 8, on the eastern shore (Queen Anne's County) side of the bridge.

Contra-flow operations were not in effect on either span at the time of this crash.[10]

Bridge Crash History

According to MDTA accident reports, 624 crashes occurred on the eastbound and westbound spans of the bridge from 2002 to 2012. Table 2 presents summary data on these crashes, three of which were fatal and resulted in five deaths. Two of the three fatal crashes occurred during contra-flow operations. Rear-end collisions account for 443, or just over 70 percent, of these crashes. The July 19, 2013, and August 10, 2008, crashes are the only known instances in which vehicles have fallen from the bridge into the water.

Table 2. Chesapeake Bay Bridge accident history, 2002–2012

Year	Fatal Crashes	No. of Fatalities	Injury Crashes	No. of Injured	Property Damage Crashes	Total Crashes
2002	0	0	26	46	43	69
2003	0	0	25	45	54	79
2004	0	0	28	56	48	76
2005	0	0	21	39	22	43
2006	0	0	14	19	23	37
2007	1[a]	3	17	23	28	46
2008	1[b]	1	19	35	36	56
2009	0	0	16	25	40	56
2010	0	0	19	26	39	58
2011	1[c]	1	20	31	36	57
2012	0	0	21	29	26	47
Total	**3**	**5**	**226**	**374**	**395**	**624**

[a] Westbound span during contra-flow operations.
[b] Eastbound span during contra-flow operations.
[c] Eastbound span during normal operations.

Based on the accident history for the years 2008–2010, figures 5 and 6 present hotspot maps showing the location of crashes on the eastbound and westbound spans of the bridge. The data show a greater concentration of crashes between the toll plaza and the leftward curve in the bridge on the eastbound span, with smaller concentrations near the center peaks of the bridge. During this 3-year period, 79 crashes occurred on the eastbound span and 54 on the westbound span, though the data show that the westbound span had a greater concentration of crashes in the center of the bridge.

[10] On July 19, 2013, contra-flow operations ended at 7:56 p.m., approximately 28 minutes prior to the crash.

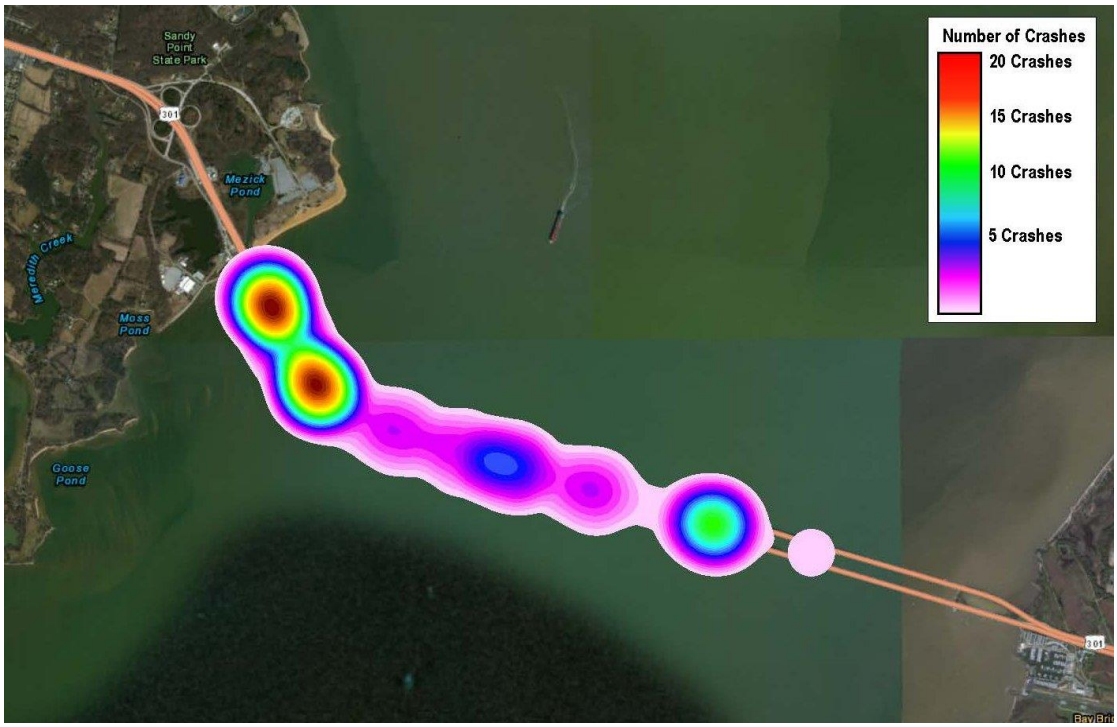

Figure 5. Hotspot map showing location of crashes on eastbound span from 2008 through 2010. (Courtesy of Maryland Transportation Authority)

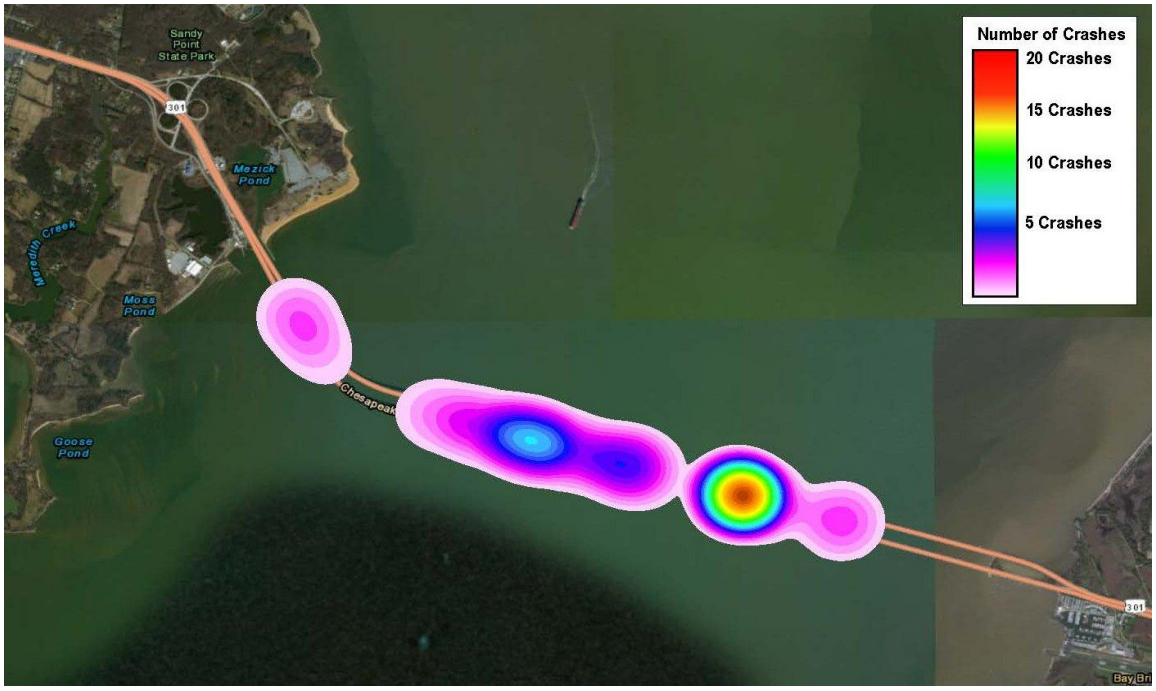

Figure 6. Hotspot map showing location of crashes on westbound span from 2008 through 2010. (Courtesy of Maryland Transportation Authority)

Postcrash Actions

Long-Term Plans

To address the condition of the deteriorating bridge deck, the MDTA is currently studying the eastbound span for major deck rehabilitation. If a decision is made to proceed with improvements to the bridge deck, the MDTA would also upgrade the barrier system.

A nondestructive evaluation of the bridge deck was completed in April 2013. Destructive testing, including core samples of the bridge deck, is scheduled to begin in March 2014, with a final report anticipated by the end of the year.

The MDTA completed a task force report on traffic capacity across the Chesapeake Bay Bridge in July 2006 and noted four zones in which a new crossing over the bay could be considered. A National Environmental Policy Act (NEPA) study would be required prior to initiating such a project. At the time of this report, funds have not been allocated to commission the NEPA study, estimated to cost $30–35 million. Construction costs for a new crossing are estimated to be $4 billion.

Short-Term Plans

The MDTA has initiated a short-term action plan to be implemented in spring 2014, which will include the following changes:

- Require headlight use on both the eastbound and westbound spans at all times.
- Improve speed limit signage and speed transition areas by:
    - Installing 40-mph speed limit signs at the beginning of the eastbound span to remind motorists of the speed limit departing the toll plaza.
    - Extending the 40-mph zone on the eastbound span beyond the curve.
    - Relocating the 50-mph speed limit sign on the eastbound span beyond the curve.
    - Installing curve warning signs and 40-mph advisory speed plates on the left and right sides of the roadway approaching the curve on both the eastbound and westbound spans of the bridge.
- Install mounted static signs with flashing lights to be illuminated only during congestion or heavy traffic to warn operators of the potential for stopped vehicles at strategic locations on the bridge.
- Install mounted electronic digital speed readout signs ("YOUR SPEED IS") at strategic locations on the bridge.
- Install a "DO NOT TAILGATE" sign on the eastbound bridge approach to be illuminated during congestion or heavy traffic.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the July 19, 2013, crash on the Chesapeake Bay Bridge was the failure of the truck-tractor driver to slow for traffic due to his inattention to the forward roadway while looking in his side view mirror. Contributing to the crash were the truck driver's unfamiliarity with the area and lack of knowledge that traffic routinely slows on the eastbound span of the bridge after exiting the toll plaza and before entering the leftward curve. Contributing to the severity of the crash were the unusual collision dynamics that allowed for a passenger vehicle to be pushed over the barrier wall and into the water.

Adopted: March 14, 2014