HIGHWAY FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

Philadelphia, PA

DCA17FR003

(11 pages)

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

HIGHWAY FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

A. CRASH INFORMATION

Location:	Lancaster Avenue (SR 3005) east of N. 38th Street, Philadelphia, PA
Vehicle #1:	Kawasaki Heavy Industries Ltd., Single-end Light Rail Vehicle unit #9085
Operator #1:	Southeastern Pennsylvania Transportation Authority (SEPTA)
Vehicle #2:	Kawasaki Heavy Industries Ltd., Single-end Light Rail Vehicle unit #9101
Operator #2:	Southeastern Pennsylvania Transportation Authority (SEPTA)
Date:	January 4, 2017
Time:	Approximately 12:47 p.m. Eastern Standard Time (EST)
NTSB #:	DCA17FR003

B. HIGHWAY FACTORS GROUP

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C. CRASH SUMMARY

For a summary of the crash, refer to the crash summary report in the docket as provided by the NTSB Office of Railroad, Pipeline and Hazardous Materials.

D. DETAILS OF THE HIGHWAY FACTORS GROUP INVESTIGATION

The Highway Factors Group was assembled to provide investigative support through the examination and documentation of elements related to the highway infrastructure at the collision scene. Factual data was also acquired through the review of documentation provided by the City of Philadelphia Streets Department and the Pennsylvania Department of Transportation (PennDOT).

Highway scene documentation consisted of photography and 3D laser scanning techniques. Photographs were taken in digital format, while scanning was accomplished using the FARO Focus^{3D} x330 laser scanner.[1] Multiple scans of the accident scene were processed into three-dimensional point clouds for further analysis.

1. Collision Site Location and Documentation

The crash involved two Kawasaki Heavy Industries Ltd., Single-end Light Rail Vehicles (LRV), also known as trolleys, that occurred in the westbound lane of Lancaster Avenue, east of 38th Avenue in the city of Philadelphia.[2] The collision occurred when a stopped trolley, designated as unit #9101, was struck in the rear by the second trolley, designated as unit #9085. Both trolleys were on the westbound track. The approximate area of impact was identified as the westbound

[1] The FARO Focus^{3D} is a high-speed terrestrial laser scanner for 3D documentation. The scanner produces dense point cloud scans that are combined or linked from multiple positions to create a cohesive three-dimensional point cloud rendering of the subject target. The laser will only capture features within the direct line of sight to the scanner. Areas obstructed to the laser or where surfaces fail to provide a reflection will appear as a hole in the image. The point cloud data can be imported into a CAD application for additional analysis.
[2] U.S. subsidiary Kawasaki Rail Car Inc. was established in 1985 for U.S. domestic LRV sales and manufacturing.

lane of Lancaster Avenue about 120-125 feet east of the intersection with N. 38th Street (approximate geographic coordinates 39.960032N / -75.196403W).

Lancaster Avenue in the area of the collision, designated as State Route (SR) 3005, is a component of a 62-mile long highway system, also known as the Philadelphia and Lancaster Turnpike that connects Philadelphia and Lancaster, PA.[3] The SR-3005 segment runs between Belmont Avenue and 34th Street, the eastern terminus of the turnpike.[4] Through the area of the collision, Lancaster Avenue is delineated as a two lane urban street that exhibits an orientation of southeast to northwest at an approximate heading of 304º/124º relative to true north. Documentation provided by the City of Philadelphia Streets Department depict the highway right of way as 80 feet in width. Within the right of way, 48 feet comprise the paved roadway. The remaining 32 feet is allocated to 16-foot wide sidewalks that parallel both sides of the roadway.

Figure 1 depicts a Google Earth image of the highway and approximate collision location as identified through scene photographs.

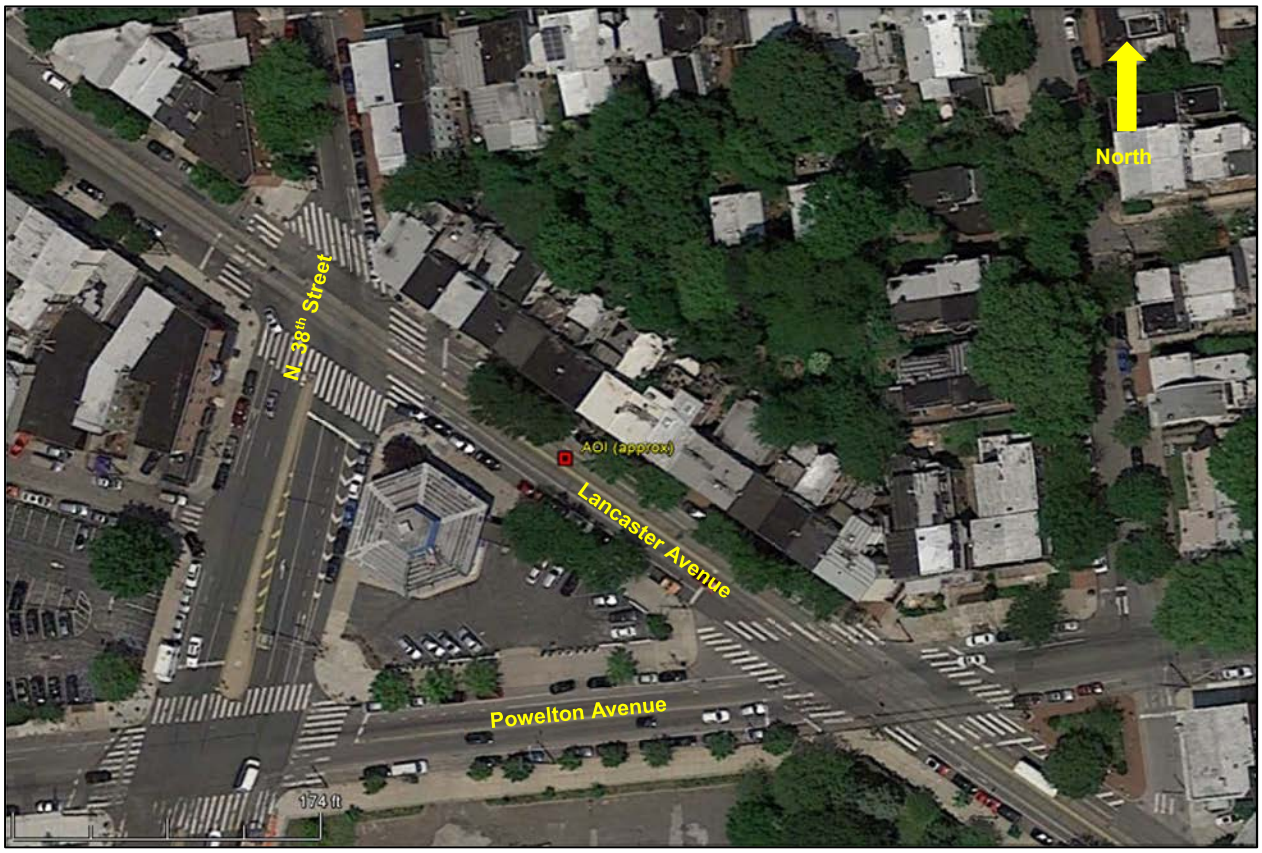

Figure 1: Google Earth image depicting approximate location of crash.

[3] Some references extend the western terminus of the turnpike about 11.5 miles west of Lancaster in Columbia, PA.
[4] The area of the collision was located approximately 1.05 miles east of Belmont Avenue and 0.34 miles west of 34th Avenue respectively.

The area featured a mix of small business and multi-occupant residential buildings. Figure 2 depicts a photographic image of the westbound direction on Lancaster Avenue facing the area of the collision.

Figure 2: Photograph depicting westbound view of Lancaster Avenue toward the crash location as photographed on January 6, 2017. The area of impact is approximated by the red horizontal line.

1.1. Highway Delineation

The roadway surface is delineated by painted striping that includes 4-inch wide double yellow lines that separate the east- and westbound travel lanes - each of which are 11 feet in width. Outboard of each travel lane is a five (5) foot wide bicycle lane, delineated by 6-inch wide pavement striping and symbols. An eight (8) foot wide parking lane is delineated by 4-inch wide pavement striping and is contiguous with the bike lane. The parking lanes abuts the sidewalks.

The pavement striping plan provided by the Philadelphia Streets Department depicts parking restriction markings, parking boxes, as authorized for the westbound side of the roadway extending up to approximately 70 feet east of the N. 38th Street intersection. The restriction markings were not present but as indicated in the plan, should extend 40 feet eastward from the

stop line, which has a 10-foot setback from a 20-foot wide marked crosswalk.[5] The crosswalk and stop line were present.[6]

Despite the absence of parking restriction pavement markings, a sign stating, "No Parking Bus Zone" was erected along the westbound curb approximately 53 feet east of the intersection with N. 38th Street. Another sign denoting the presence of the trolley stop[7] was located about 23 feet west or 30 feet from the intersection.

Information from the Pennsylvania Department of Transportation (PennDOT) staff indicated that Lancaster Avenue between N. 38th Street and Powelton Avenue was repaved September 13-14, 2016, under project designation ST-09. PennDOT stated that the line striping shadow lines were applied immediately after the paving, with the permanent thermoplastic lines installed within the following week. Staff confirmed that many of the parking boxes were not installed due to the presence of conflicting signage and parking meters. Additionally, the proposed plan for the parking boxes did not allow for the crosswalks being enlarged to a 20-foot width (instead of the typical 10-foot width) and the stop lines setbacks of 12 feet. Future installation of the parking boxes is being studied.

1.2. Trolley Rail Lines

The trolley rails are recessed within the pavement of both travel lanes. The top of the rails is generally level with the pavement surface. The rails are offset slightly toward the roadway centerline, approximately 2.25 feet inward of the roadway centerline as compared with 3.25 feet outward from the lane right edge line (bike lane). The general construction of the roadway was asphalt, although the rail bed between the rail pairs on both sides of the roadway was concrete.

Both trolley rails merged onto Lancaster Avenue from N. 36th Street about 930 feet east of the crash location (although a pair of rails there is a short spur in the eastbound lane, east of the intersection). After the trolley rails merged onto Lancaster Avenue, they passed through two intersections, N. 37th Street and Powelton Avenue, before collision location.

1.3. Highway Jurisdictional Oversight

As conveyed by staff with the Philadelphia Streets Department, multiple agencies exercise responsibility for certain aspects of the highway. The asphalt pavement surface is under State jurisdiction through PennDOT, while the concrete surface supporting the rail bed is overseen by SEPTA. The City of Philadelphia exercises control over pavement striping, signage, traffic signals and other infrastructure.

[5] On site measurements placed the stop line set back about 14.25 feet from the crosswalk.
[6] The pavement marking plan approval date was indicated as August 2016.
[7] #10 trolley line.

1.4. Highway Alignment

Through the area of the collision between N. 37th and N. 38th Streets the highway is straight with a slight ascending grade of about 1.27% in the westbound direction. The highway exhibits an orientation of southeast to northwest at an approximate heading of 304º/124º relative to true north. The posted speed limit is 25 mph.

Preceding the collision, the N. 36th Street and Powelton Avenue intersections are controlled by an automatic stop-and-go signal. Near the collision site, N. 38th Avenue is also controlled by an automatic signal.

1.5. Traffic Volume and Motor Vehicle Classification Data

PennDOT staff provided data on average daily traffic (ADT) volume and vehicle classification for Lancaster Avenue through the area of the collision. The data covered both directions of the highway between Spring Garden Street and N. 34th Street, a distance of about 0.58 miles. The surveyed distance was divided into two segments – one covering N. 34th Street to Powelton Avenue and the second covering Powelton Avenue to Spring Garden Street, with the latter segment encompassing the collision site. The data comprised a "current estimate" and reference to a base year.[8] The data referenced only motor vehicle traffic and not rail vehicles.

Table 1 depicts the current estimate of total vehicle ADT and general vehicle classification counts from the two highway segments.

[8] The first segment between N. 34th Street and Powelton Avenue cited April 2012 as the base year with data compiled over a 24-hour period using axle volume counts. The segment between Powelton Avenue and Spring Garden Street cited June 2014 as the base year with data compiled manually over an hourly period. The counts were made from a single location along each segment.

Table 1: Current estimates for Annual Daily Traffic (ADT) and vehicle classification as recorded at two locations along Lancaster Avenue.

	34th Street - Powelton Avenue	Powelton Avenue - Spring Garden Street
Total Vehicle ADT	4,143	6,367
Total Trucks	83 (2%)	374 (5.6%)
	106 weekday estimate	479 weekday estimate
Motorcycle	50 (1%)	26 (0.4%)
Pickup - Van	704 (17%)	1973 (31%)
Cars	3306 (80%)	3994 (63%)

Figure 2 depicts additional details for the ADT that includes buses and certain truck configurations as referenced in the current estimate.

Table 2: Current estimates for Annual Daily Traffic (ADT) and vehicle classification for buses and certain truck configurations as recorded at two locations along Lancaster Avenue.

	34th Street - Powelton Avenue	Powelton Avenue - Spring Garden Street
Bus	3 (4%)	239 (64%)
2 axle - 6 tire	59 (72%)	93 (25%)
3 axle - Single unit	11 (13%)	19 (5%)
4 axle - Single unit	3 (3%)	15 (4%)
Other Truck	7 (8%)	8 (2%)

Travel and crash data related to the LRV operations was not collected by PennDOT or Philadelphia Streets Department. Other investigative groups partnered with SEPTA will acquire this data.

2. Three-Dimensional Scan Project and Site Diagram

The collision site scan project was undertaken January 8, 2017. The scene was scanned from four (4) positions and covered a distance of approximately 325 feet along Lancaster Avenue. Figure 3 depicts one aspect of the 3D scans.

Figure 3: Screen capture depicting a portion of the 3D point cloud rendered from the scans. Movement of vehicles and person through the scene created color anomalies and stray objects.

The examination and documentation of the highway in the area of the collision revealed no highway deficiencies, nor was any collision-related highway evidence observed. Based on scan data, post-collision photographs and other site information, a scaled site diagram was prepared. The scaled post-collision diagram is depicted in Figure 4.

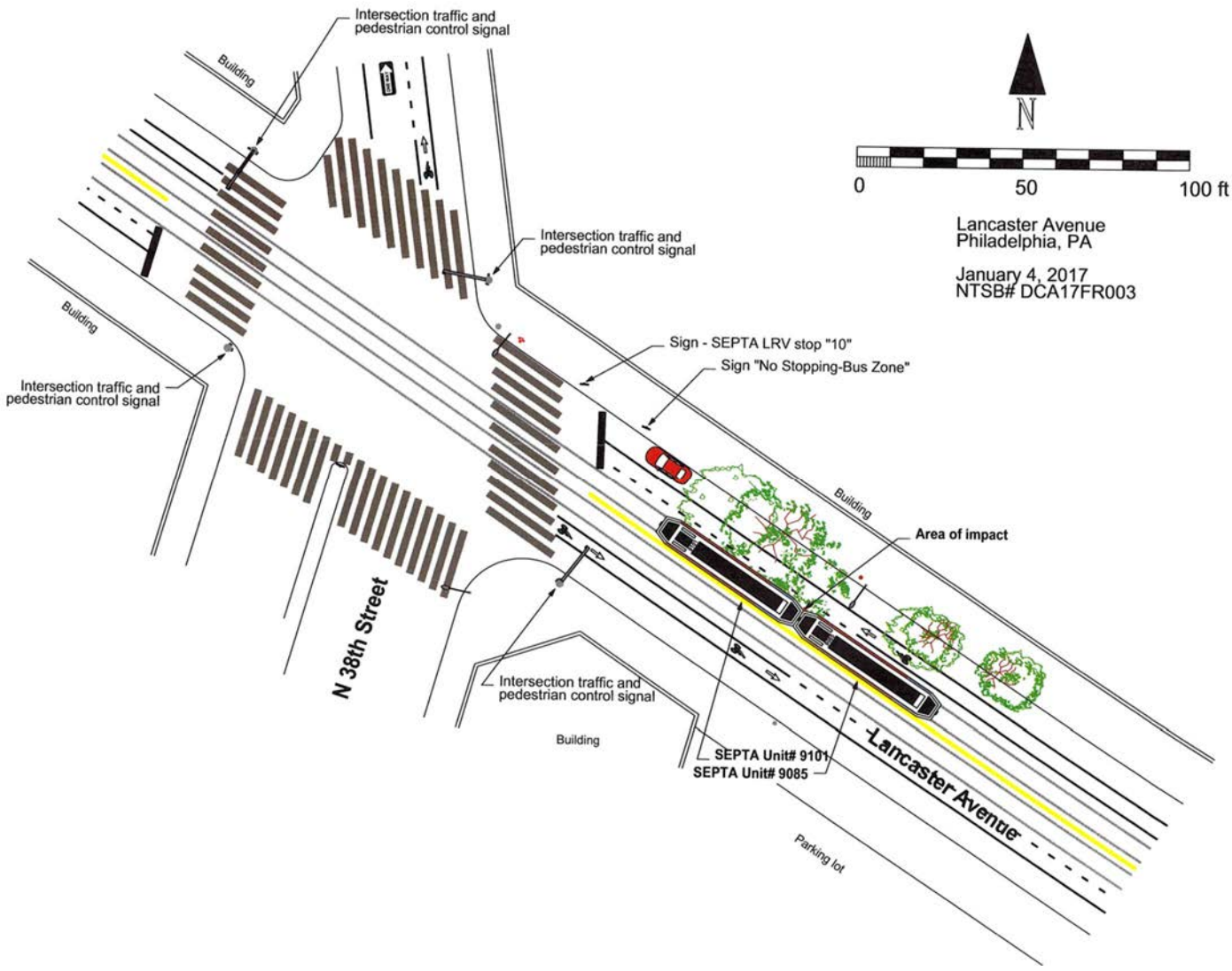

Figure 4: Scaled post-collision site diagram.

E. DOCKET MATERIAL

The following attachments and photographs are included in the docket for this investigation:

LIST OF ATTACHMENTS

Highway Attachment 1 - Highway plans for Lancaster Avenue between 37th Street and Baring Street, dated 1970. Provided by Philadelphia Streets Department.

Highway Attachment 2 - Pavement marking plan for Lancaster Avenue between 35th Avenue and Brandywine Street, dated August 2016. Provided by Philadelphia Streets Department.

Highway Attachment 3 - Signal construction plan for the N 38th Street intersection signal, dated 2003. Provided by Philadelphia Streets Department.

Highway Attachment 4 – Motor vehicle ADT and vehicle classification data. Provided by PennDOT.

LIST OF PHOTOGRAPHS

None

END OF REPORT

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