NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

UAS Aerial Imagery Report

7/16/2018

A. ACCIDENT HWY18MH005

Location: Crozet, VA
Date: January 31, 2018

B. PERSONNEL

UAS RPIC[1]: Michael Bauer
National Transportation Safety Board
Washington, D.C.

C. ACCIDENT SUMMARY

For a summary of the accident, refer to the *Accident Summary Report*, which is available in the docket for this investigation.

D. DETAILS OF IMAGERY

1.0 Equipment and Procedures

Equipment

Mapping flights of the wreckage area and inspection flights to collect photo and video documentation were conducted on February 1, 2018 and February 2, 2018, using the NTSB DJI Phantom 4 Professional small unmanned aircraft system (sUAS, commonly known as a drone). The drone is equipped with a dual GPS/GLONASS receiver which provides georeference information on all still photos. The drone is equipped with an FC6310 camera using the Sony Exmor 1" CMOS sensor, with a focal length of 8.8 mm. Still photo resolution is 20 megapixels in JPG or RAW format. Videos were taken in MP4 format, with 4K resolution at 30 and 48 frames per second.

Ground control points, and significant wreckage locations were documented with a Trimble GEO7X differential GPS receiver.

Procedures

The accident site was in Class G airspace, no airspace authorization was required, and the

[1] RPIC – Remote Pilot In Command

flight was conducted under 14 CFR 107. The wreckage was contained in an open area in the vicinity of the grade crossing on Lanetown Road. The railway and road leading up to grade crossing was lined with deciduous trees approximately 60-80 feet in height. During drone operations Lanetown road access was limited to investigative personnel only and flights were within the established law enforcement perimeter.

The Phantom 4 Pro (P4P) was flown in an automated overlapping grid over the main wreckage area from 100-120 feet above home point to ensure clearance from tall trees and effective overlap[2]. Additional oblique stills were taken of the refuse truck and compactor to aid in photogrammetry processing and documentation of the site. The P4P was also hand-flown along the railroad tracks from approximately 2700 feet from the grade crossing on Lanetown Road in the direction of the train travel to just before the Lanetown Road grade crossing. Operations on the railway were suspended during the drone video flights with safety oversight while on the railway provided by railroad personnel. Total flight time using drone was approximately 1 hour.

Processing

Geo-referenced still imagery was processed using Pix4D photogrammetry software to produce a 3D point cloud and an orthomosaic map of the wreckage site. Relative accuracy (within the map) was calculated at 0.68 inches, twice the ground sample distance.

DGPS data was corrected using the continuously operating reference station (CORS) at Fan Mountain, VA (UVFM). DGPS data was used to correct elevation and provide ground control points and checkpoints for accuracy. Elevation was corrected by 52 inches, positional accuracy (to features outside the map) was measured to 16 inches.

2.0 Imagery products

Approximately 965 high resolution photos and 7 videos were gathered. Select photos, snapshots from video, and excerpts from the 3D point cloud are included in this report in section 5.0. A list of images and select output products attached to this report and contained in the docket are listed in section 4.0.

Figure 1 through Figure 4 are still images taken from the drone of the grade crossing and the refuse truck and compactor.

Figure 5 and Figure 6 are screenshots from the video imagery taken from both the road and railway approaching the grade crossing in the direction of travel for both vehicles.

Figure 7 through Figure 11 are still images taken from the drone during the during the sight distance observations work. For further information regarding refer to the appropriate highway or rail factual report.

[2] Depending on the area being mapped the altitude was adjusted for the whole mission to remain clear of the trees in the area.

Figure 12 contains a screenshot of the orthomosaic map in Google Earth .kmz format. Figure 13 contains a screenshot of the processed Pix4D point cloud of the accident scene.

Figure 14 is a sample of the panoramic view taken during the sight distance observations work. The image was created using commercially available software which stitched together 34 individual images taken using a programmed sequence from the drone control software. The product is intended to be used with a 360 Panoramic viewer software and it is projected onto 2D for this report, creating various distortions. The original panoramic image is an attachment to this report and located in the accident docket.

3.0 Recorded positional information

As part of the drone operations, additional ground reference points, in addition to the ground control points, were taken using the Trimble GEO7X differential GPS receiver to assist the investigation[3]. The following table contains the positional information of the points. For further information regarding the location references, refer to the appropriate highway or rail factual report.

Table 1 - Additional Ground Reference Point Information

Point ID	Latitude (degrees) North Positive	Longitude (degrees) East Positive	Height (meters) Mean Sea Level
Hwy Pt 1 (P1)	38.07749498	-78.715702	244.771
Hwy Pt 2 (P2)	38.07749275	-78.71580892	246.27
Hwy Pt 3 (P3)	38.07741448	-78.71666135	246.091
Hwy Pt 4 (P4)	38.07743871	-78.71660717	246.283
Rail Pt 1 (R1)	38.07703534	-78.71284049	240.621
Rail Pt 2 (R2)	38.07707759	-78.71305757	241.055
Rail Pt 3 (R3)	38.07718183	-78.71368822	241.806
Rail Pt 4 (R4)	38.07734671	-78.71575713	244.338

[3] The additional ground reference points were corrected using the continuously operating reference station (CORS) as described in the processing section of this report.

4.0 Attachments

Attachment 1 – Original Photograph used in Figure 1
Attachment 2 – Original Photograph used in Figure 2
Attachment 3 – Original Photograph used in Figure 3
Attachment 4 – Original Photograph used in Figure 4
Attachment 5 – Orthomosaic map in Google Earth kmz format
Attachment 6 – Video taken along Lanetown Road towards grade crossing
Attachment 7 – Video taken along railway towards grade crossing
Attachment 8 – Original Photograph used in Figure 7
Attachment 9 – Original Photograph used in Figure 8
Attachment 10 – Original Photograph used in Figure 9
Attachment 11 – Original Photograph used in Figure 10
Attachment 12 – Original Photograph used in Figure 11
Attachment 13 – Panoramic Image shown in Figure 14

5.0 Oversized Imagery

Figure 1 – Photo, Grade Crossing and Refuse Truck (directional arrow approximated)

Figure 2 – Photo - Grade Crossing, Refuse Truck and Refuse Truck Compactor (directional arrow approximated)

Figure 3 – Photo - Refuse Truck in final location (directional arrow approximated)

Figure 4 – Photo - Refuse Truck Compactor in final location (directional arrow approximated)

Figure 5 - Video Snapshot from drone video on Lanetown Road approaching grade crossing (directional arrow approximated).

Figure 6 - Video Snapshot from railway approaching Lanetown Road grade crossing (directional arrow approximated).

Figure 7 - Train positioned at Rail Point 1 (directional arrow approximated)

Figure 8 - Train positioned at Rail Point 2 (directional arrow approximated)

Figure 9 - Train positioned at Rail Point 3 (directional arrow approximated)

Figure 10 - Train positioned at Rail Point 4 (directional arrow approximated)

Figure 11 - Train approaching grade crossing with refuse truck positioned in crossing (directional arrow approximated).

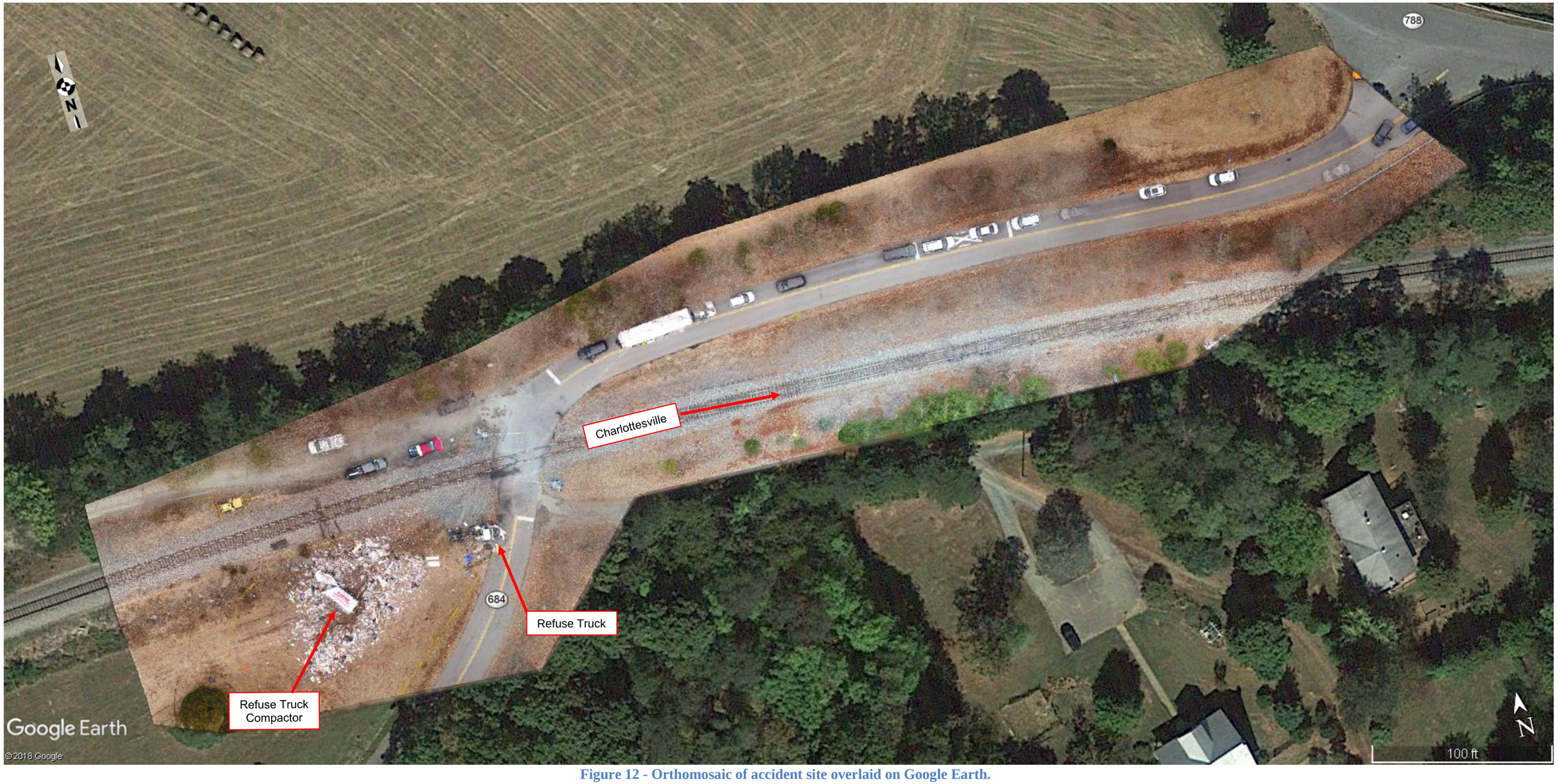

Figure 12 - Orthomosaic of accident site overlaid on Google Earth.

Figure 13 - View of the processed point cloud from Pix4D

Figure 14 - Panoramic image of scene reconstruction (Image as shown contains distortions)[4].

[4] The image is intended to be viewed with 360 Panoramic viewer software and it is projected onto 2D for this report, creating various distortions (i.e. roadway and rail track curvature leading to grade crossing).