

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN22FA081

ONBOARD IMAGE RECORDER

Specialist's Factual Report

March 2, 2023

A. ACCIDENT

Location: Fulshear, TX
Date: December 21, 2021
Time: 09:26 central standard time (CST)
15:26 coordinated universal time (UTC)
Airplane: Cessna 208, N1116N
Vehicle: Dudek Paragliders Solo 21 (A2), Unregistered

B. ONBOARD IMAGE RECORDER SPECIALIST

Specialist: Sean Payne
Sr. Engineer
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

In agreement with the Investigator-In-Charge, an Onboard Image Recorder group was not convened and a summary was prepared.

The NTSB Vehicle Recorder Division received the following image recorders and media:

Device Manufacturer/Model: GoPro HERO 10 Black
Device Serial Number: C-26531

Device Manufacturer/Model: Insta360 One X2
Recorder Serial Number: 210-145310

1.1 Device Description

GoPro HERO

The GoPro HERO is a compact, lightweight, Point of View (POV) digital camera enclosed in a ruggedized housing that allows the camera to be mounted in a variety of positions using an array of supported accessories.¹ Depending on the model, the camera supports ultra-high definition (UHD) recording, as well as other lower quality recording resolutions at higher frame rates.² The camera can be set to record still

¹ POV - Point of View Shot - A photography technique that records the character's viewpoint from a singular camera location mounted in a manner that represents the character's field of view.

² UHD - Ultra-High Definition - A resolution generally consisting of greater than 2160 lines of horizontal resolution.

images simultaneously or independently of a video stream at various user selectable resolutions. The camera supports recording to micro-SD cards.³ A built in Wi-Fi module allows users to connect to the camera either via an accessory remote control or via a smart phone app that permits camera control and image transfer.⁴

Insta360 One X2

The Insta360OneX2 is a 360-degree field of view action camera. The camera facilitates various modes of still photo capture, including panoramic images. When in dual lens video mode, the camera can capture UHD spherical video with audio. The camera uses internal gyroscope data and other sensors to facilitate reconstruction and playback of the spherical video. The device can record an audio track and has a 3.5mm mic adapter for capture of externally ported audio. The camera leverages both proprietary desktop and mobile based software to allow the user to edit and modify the files.

2.0 Device Condition and Data Recovery

GoPro HERO 10 Black

The device was damaged in the event. The device's arrival condition is shown in Figure 1. A microSD card was found in the appropriate mounting location in the camera. The microSD card was attempted to be read via a PC and a forensic write blocker. The microSD card failed to mount using this method, and a variety of other similar methods using different adapters, different PCs and different software.

The microSD card was then examined using a digital stereomicroscope. The front of the card is pictured in Figure 2. A crack is noted with yellow arrows on the front of the card. The rear of the card is pictured in Figure 3. The rear of the card has two areas in which a crack appeared; these areas are noted with yellow arrows. Figure 4 is a 100x magnification image of one of the cracked areas on the rear of the card. Figure 5 is an X-ray image of a cracked area of the device. Note that X-rays are typically ineffective at imaging damaged silicone. This X-ray image shows potential damage to the device's internal bond wires.

The device was sent to a third-party lab for attempted data recovery. The third-party lab was unable to recover data from the device.

No data was recovered from the device.

³ SD - Secure Digital - a standard for nonvolatile memory card used in portable devices.

⁴ Wi-Fi - A local area wireless technology that allows electronic devices to exchange data over a network.



Figure 1. The GoPro HERO 10 Black as received.

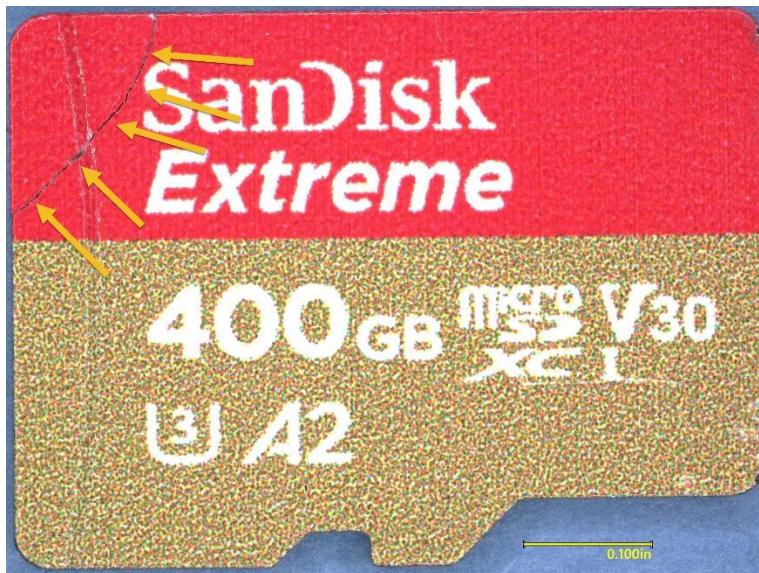


Figure 2. A stereo microscope image of the front of the microSD card. The yellow arrows note a cracked area.

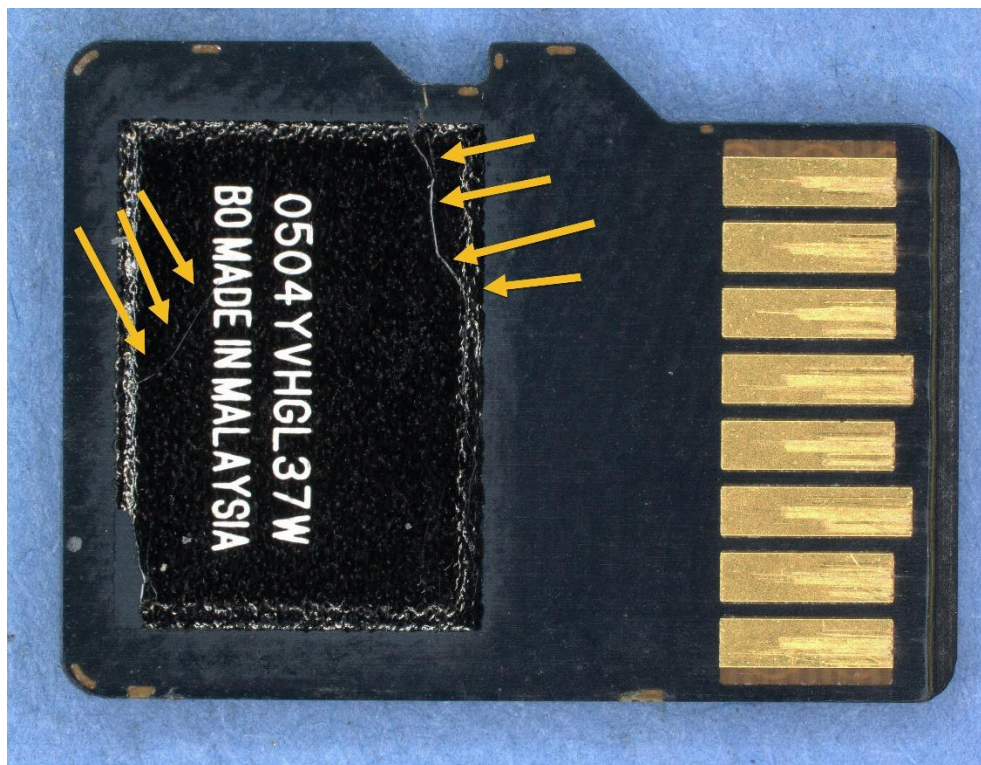


Figure 3. A stereo microscope image of the rear of the microSD card. The yellow arrows note two cracked areas.

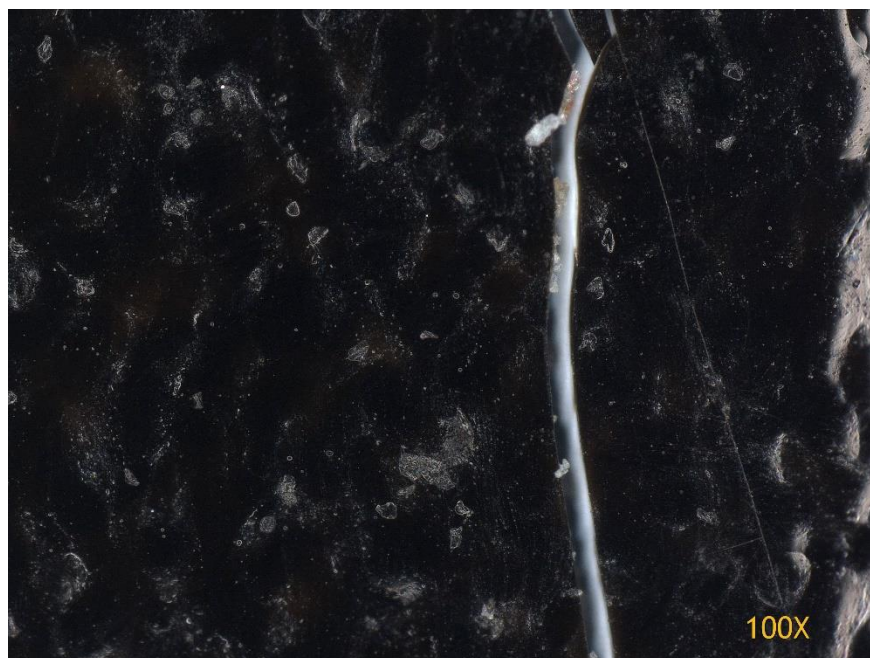


Figure 4. Close detail of one cracked area on the rear of the microSD card.

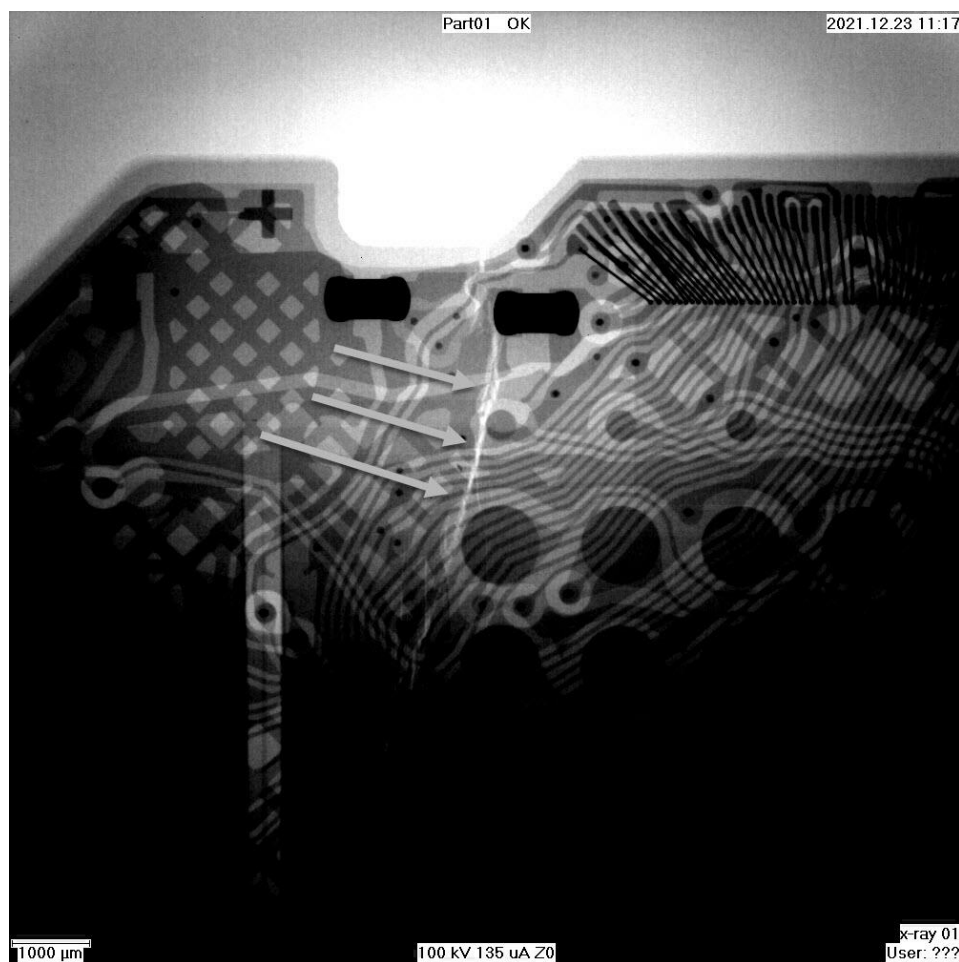


Figure 5. X-ray image showing one area of potentially damaged bond wires. The affected area is shown with grey arrows.

Insta360 One X2

The camera was destroyed in the accident, its arrival condition is shown in Figure 6. The associated microSD card was found seated in the appropriate location in the device. The microSD card was removed and is pictured in Figure 7. A visual inspection did not reveal any damage to the card. The microSD card was read via a PC and a forensic write blocker.

The device functioned and a file structure consistent with this model of device was detected. The file system contained three .INSV files.⁵ One file was associated with an .LRV type and two other files were consistent with the camera operating in 5.7K 360 degree field of view mode.⁶ The files together, based on their filenames, constituted a singular recording.

⁵ .INSV File type - a video format associated with Insta360 devices.

⁶ .LRV file type - Low Resolution video. A filetype typically associated with a lower resolution version of a recording captured on a video device that facilitates playback via an associated connected portable

Playback of the .INSV files were attempted in the manufacturer's software. The software indicated that the files were corrupted and were unable to be played.

The files were examined using a hex editor, and were modified in attempts to playback the file.⁷ A combination of file carving in a hex editor and using a commercially available video recovery software allowed a few frames of the .INSV files to be reconstructed. Those frames were consistent with persons and equipment described in the accident flight. Further attempts were unable to produce a playback duration that amounted to the size data contained in the full .INSV files.

A third-party vendor was utilized under a Non-Disclosure Agreement that had limited experience in 360 field of view file recovery. The third-party vendor was able to recover a single .MP4 file that was approximately 7 minutes and 13 seconds in length and captured the accident. This file was not a complete recovery of all the data from the .INSV file, but rather a video recording from one of the two camera lenses. The vendor was unable to recover a complete audio track. The audio track recovered was determined to be not in alignment with the portion of recovered video and is not discussed in this report. Details are discussed below in section 4.0, Summary of Recording Contents.



Figure 6. Photo of the Insta360 OneX2 as received.

device.

⁷ Hex editor - A software program for manipulating Hexadecimal entries.



Figure 7. Memory module (if figure is not full width, then center)

3.0 Timing and Correlation

No time correlation was constructed for the recording from the Insta360 One X2. Instead, the summary below contains a time history in elapsed time format MM:SS, where MM stands for the number of elapsed minutes and SS stands for the number of elapsed seconds.

4.0 Summary of Recording Contents

The recording began at 00:00, the imagery was consistent with the paraglider operator (PO) starting the Insta360 One X2 camera.

Around the start of the file, a view of a personal electronic device (PED) was briefly captured.⁸ The screen of the PED was consistent with the PO using an application called FlySkyHY. Some of the user displayed data was able to be correlated with an exemplar version of the same app, however, the selected units were not able to be read. The FlySkyHY screen indicated the following:

- Altitude – 3400 (unknown units)
- Wind Force – 13.0 (unknown units)
- Lift – 7.0 (unknown units) – Upward/Climb Trend Indicated by an upward arrow
- No other user data fields could be read

Additionally, a square digital wrist mounted gauge was visible. The gauge said “ACURITE” and displayed the number “49.” An internet search of “ACURITE” shows Acurite is a manufacturer of weather data devices, including temperature measurement devices, however, the specific model of the unit the PO was using could not be identified.

The PED running the application consistent with the FlySkyHy app, and the ACURITE gauge were not visible for the remainder of the recording.

⁸ The PED associated with the PO was not recovered from the accident site.

In the next few seconds, the PO began extending the camera on a device consistent with a product offered by the manufacturer called the "Invisible Selfie Stick." As the operator extended the selfie stick, the PED went out of view. The PO's actions indicated that he positioned the selfie stick near his thigh which held the camera on a pole at a distance forward of the PO. A field of view that captured almost the entirety of the PO and the paraglider rig, including the paraglider's wing were visible in this position for the remainder of the recording.

The paraglider wing had a light blue base color with a light blue trailing edge, pale red/orange wingtips and the leading edge quarter was white with a banded black color scheme⁹. The lines were neon orange and neon green. Figure 8 is partial screenshot that describes the colors of the paraglider wing against the sky. The PO appeared to be wearing a flight suit over clothing. The flight suit was a dark brown or olive color. The PO was wearing a white helmet with a headset. The type of headset was consistent with other commercially available devices that have passive noise attenuation features. The paraglider harness appeared to be mostly black with some blue elements, and the cage of the paramotor was of raw aluminum color.

The area of the ground near the PO operations was mostly brown and green. The area to the west of the PO was similar.

The sky was clear blue and no clouds were noted throughout the recording.



Figure 8. The color of the paraglider wing against the sky.

⁹ This describes the outside portion of the wing. Wreckage photos indicate the inside portion of the wing was white. The camera's field of view was looking through the white portion of the wing, through to the colored outside portion of the wing.

An ephemeris was used to calculate the position of the sun on the accident day around the reported time of the accident. A screenshot of the ephemeris with the given conditions are attached below as figure 9. The ephemeris indicated the sun was approximately out of the southeast (an azimuth of 132 degrees true, at an altitude of approximately 18 degrees) at the time of the accident. Given the position of the sun, and visible roads captured in the recovered footage, the PO was approximately on a northerly heading, north of the Brazos River, in the vicinity of Fulshear Farms Road, west of the Weston Lakes Village.

Once the PO had stabilized the camera, he placed both hands to the toggles. The PO was ungloved at this time. The PO appeared to be exerting a slight amount of downward pressure on each toggle. The PO continued tracking on a northerly heading. It was not clear if the paraglider was climbing at this time.

At 01:54, the PO removed his right hand from the right toggle. The PO had his left hand on the left toggle for a bit, and then released it around 3:00.

Around 3:00, when the PO had removed his left hand from the toggle (both hands now removed from the toggles), the PO began removing a pair of gloves from a bag strapped near his left thigh area. The position of the sun indicated that the paraglider had begun a slow left 360 turn. The left 360 degree did not appear to be prompted by the PO.

By 04:20, the PO had completed putting on both gloves. The position of the sun indicated the paraglider was still performing a slow left 360 degree turn. The 360 degree turn appeared to be unprompted by the PO. As the paraglider performed the slow 360 degree turn, the ground to the west of the paraglider (the direction the caravan would be headed) was visible. Patchwork of green and brown.

At 04:49, the PO removed his left glove and used his left hand to manipulate a lap mounted bag.

By 05:29, the PO had replaced both hands to the toggles. His left hand was still ungloved. The PO was using his left hand to hold the left toggle, as well as manipulate the paraglider's throttle.

Around 05:45, the paraglider completed the slow left 360-degree turn based on the position of the sun. The PO was manipulating both toggles now and appeared to be making slight heading corrections periodically. The paraglider had returned to a northerly track.

As the paraglider returned to a northly track, the positions of roads and streets below the PO indicated that he had not made much forward (northerly) progress. The PO

was in a similar geographic position as noted before but was east of the last noted position.

Around 06:00, the PO continued with both hands on the toggles, and his left hand on the throttle additionally. The PO was slightly manipulating the controls and was looking ahead (northerly). In these earlier portions of the recording, when the PO moved his head, he did not fixate his head in a specific direction for a notable amount of time.

Little changed until 07:06.

The following descriptions denote approximately the next eight seconds of recording until the cessation of recovered imagery.

At 07:06, the PO turned his head approximately 45 degrees right. The manner in which the PO moved his head was such that he quickly oriented his attention. From this time until the end of the recording, the PO's head motion can be described as various angles to the right of his present track.

At 07:08, the PO began pulling the left toggle. The PO toggled such that the sun was almost directly behind him (approximately 312 heading when referencing the sun's position). The PO's head was still turned right.

With the sun at the PO's back (approximately 312 degrees true heading), the PO began looking sharply right now. The distinct shape of an approaching high wing aircraft was captured slightly above the horizon of the image (to the PO's right).

By 07:11, the PO toggled downward aggressively on both toggles. The PO was still looking sharply right. The sun was still at the PO's back.

Around 07:12, the PO began toggling to initiate a right turn. Downward pressure on the left toggle appeared relieved and downward pressure was sharply increased on the right toggle. The PO was still looking sharply right. The shape of a high wing aircraft (nose on, approximately level with the horizon) was visible and was closing on the PO quickly. The aircraft was straight and level and was not changing heading or roll condition.

The initiation of the right turn, pendulum the PO to the left (right bank angle increased, PO's body displaced to the left and upward). The PO was still looking sharply right.

In the next second, the PO pulled the right toggle downward significantly. The bank angle to the right increased (PO and paraglider pendulum to the left). The high wing aircraft was in the same position but had grown larger in the recorded image quickly.

The PO and the high wing aircraft appeared almost directly in line (PO off the nose of the caravan).

The PO was now looking 45 degrees right, the paraglider was in a hard right bank (PO and paraglider pendulum significantly outside of the turn and to the left). The high wing aircraft grew larger in the image frame. The image was such that it could be associated specifically with a Cessna Caravan type aircraft¹⁰.

The last recovered frame (approximately 07:14 elapsed) of the recorded file showed the PO in a hard right bank (PO and paraglider pendulumed significantly left and upward). Due to the distortion of the recovered image, it was difficult to determine exactly the position of the Cessna Caravan in relation to the PO. The PO at this time was looking 45 degrees right and had both hands on the paraglider's toggles. Both toggles were being extended downward slightly. As the toggles were being extended downward, the PO's arms were bent in a brace-like position. The leading edge of the Cessna Caravan's wing, outboard of the right wing lift strut attach point, appeared in line with the PO's body. The caravan was straight and level and did not appear to be changing heading or roll. The camera's field of view appeared to have a direct line of sight to the left windscreen of the caravan (the center post of the windscreen did not appear to be obstructing the view of the Caravan pilot to the PO).

The recording ended, and no other imagery was recovered by the time this report was published.

Submitted by:

Sean Payne
Sr. Engineer

¹⁰ Due to the spherical nature of the recording, objects tend to appear further away in the recording. Distances are not necessarily representative of the perceived sight distance of either the Caravan pilot or the PO.

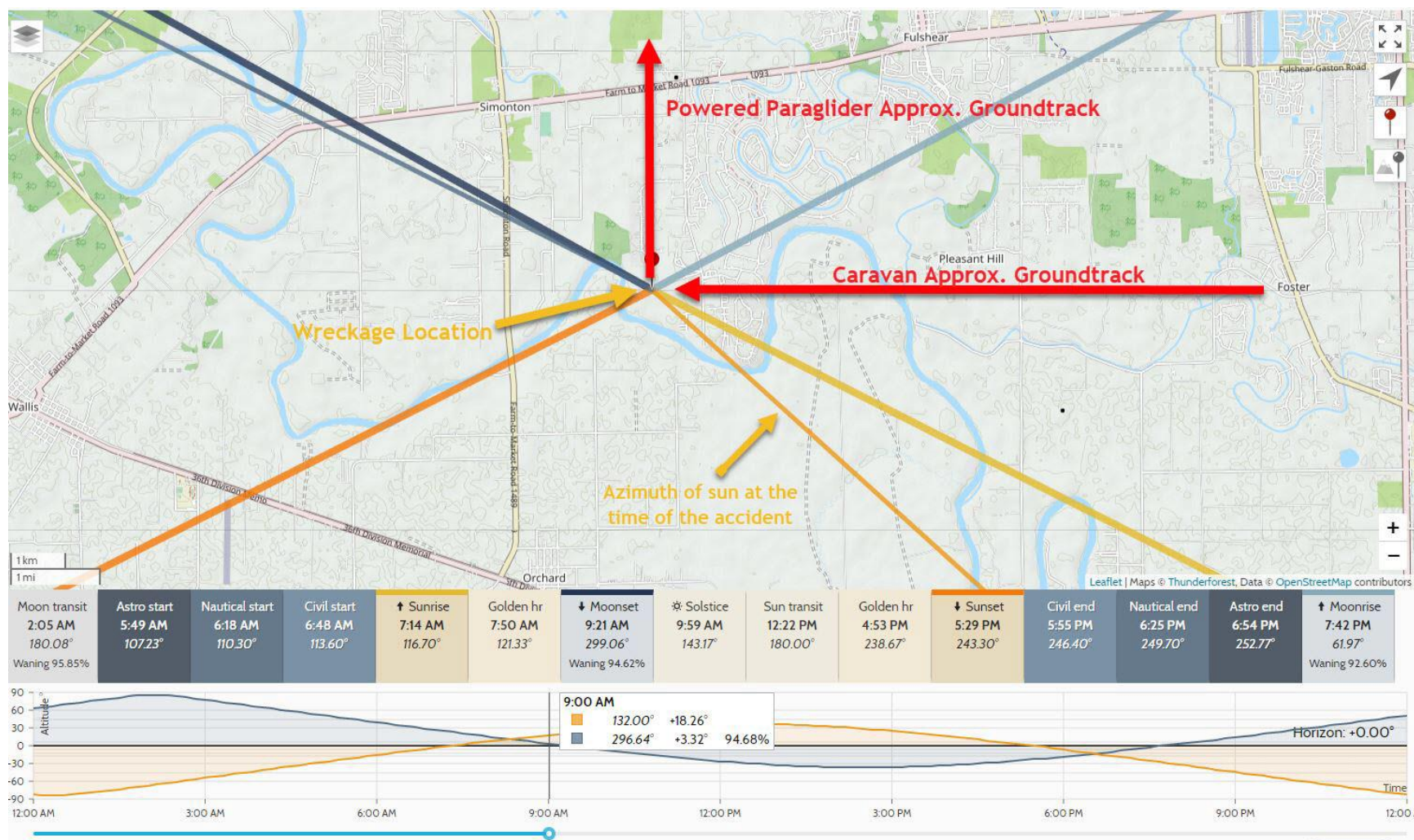


Figure 9. Ephemeris data for the time and position of the reported accident site.