

Train collision with fallen tree and derailment near Balderton, Cheshire, 26 November 2021

Important safety messages

This accident demonstrates the importance of railway companies:

- considering all relevant meteorological parameters, including wind direction, when determining and applying weather-related risk mitigation
- promptly adjusting mitigation measures required for safety of the line during extreme weather events, to take account of any incidents that have occurred due to the weather.

Summary of the accident

At about 23:13 hrs on Friday 26 November 2021, an empty passenger train collided with part of a fallen tree while travelling at 46 mph (74 km/h). The train involved, reporting number 5D77, consisted of a class 150 diesel multiple unit which was being operated by Transport for Wales between Wrexham General and Chester. The collision caused the leading axle of the train to derail. There were no injuries, but minor damage was caused to the train and to local signalling equipment.



The derailed train following the collision (image courtesy of Network Rail)

Before this collision, train 5D77 had already collided with trees obstructing the railway on two other occasions after leaving Wrexham. All these collisions occurred while storm Arwen was causing high winds that affected much of the UK, including the intended route of the train.

Cause of the accident

The derailment occurred on the down Wrexham line, in a tree-covered cutting about 68 metres beyond the exit of Balderton tunnel. The tree that fell across the railway was an ash tree, with a trunk around 0.5 metres in diameter. This had been growing just beyond the crest of the cutting, about 9 metres from the railway track and about 0.5 metres outside the railway boundary fence.

After the accident, Network Rail staff inspected the remains of the tree which caused the derailment and found that it had been in 'apparent good health' before it fell. This inspection concluded that the cause of the tree falling was 'extremely high wind speeds' coming from an unusual direction.

A Meteorological Office weather station was located about 2.5 miles (4 km) north-west of the accident site. This weather station recorded wind blowing from a north-north-westerly direction with an average speed of 36 mph (58 km/h), and gust speeds of 64 mph (103 km/h), between 22:00 hrs and 23:00 hrs. Wind speeds increased to 39 mph (63 km/h) and 69 mph (111 km/h) in the following hour, during which the accident occurred. These conditions are likely to be indicative of those present at the locations where trees fell in front of train 5D77.

A Meteorological Office report about storm Arwen stated: 'Thousands of trees were felled across the north of the UK - including large mature trees [...] The unusual direction of the strongest winds - northerly as oppose[d] to prevailing westerly - may have been an additional factor influencing the number of trees brought down.'

At 22:12 hrs, train 5D77 departed from Wrexham General station. At 22:17 hrs, after it had travelled for 2.2 miles (3.5 km), it struck two trees close together at a speed of 38 mph (61 km/h). The driver called the signaller to report the incident, inspected the train (finding only superficial damage) and then removed those portions of the trees still obstructing the railway line. At 22:29 hrs he called the signaller stating that the train was able to proceed and was told by the signaller to 'take time going down [the remainder of Gresford bank because] it wouldn't surprise me if there weren't a few more [trees] down.'

At Gresford bank the railway descends, in the direction of travel, at a gradient of 1:83 for a distance of about 4.1 miles (6.5 km), and the driver interpreted the signaller's response as an instruction to proceed at caution. Proceeding at caution is described in module TW1 of GERT 8000, the railway Rule Book, as proceeding at a speed, taking account of conditions such as the distance the driver can see to be clear, that will allow the train to be stopped short of any obstruction.

At 22:30 hrs, train 5D77 continued on its journey, with the driver proceeding at caution. About a minute later, and after travelling a further 0.6 miles (1 km), it struck a third tree while travelling at 18 mph (30 km/h). At 22:34 hrs the driver called the signaller to report this collision. He then reversed the train to clear the obstruction, removed portions of the tree and inspected the train.

At 22:46 hrs the signaller reported the two collisions involving train 5D77 to Network Rail's North West route control room, located in Manchester and responsible for managing infrastructure in north-west England. He also reported another weather-related accident about 0.3 miles (0.5 km) east of Chester station in which another train had collided with a metal shed blown onto the line.

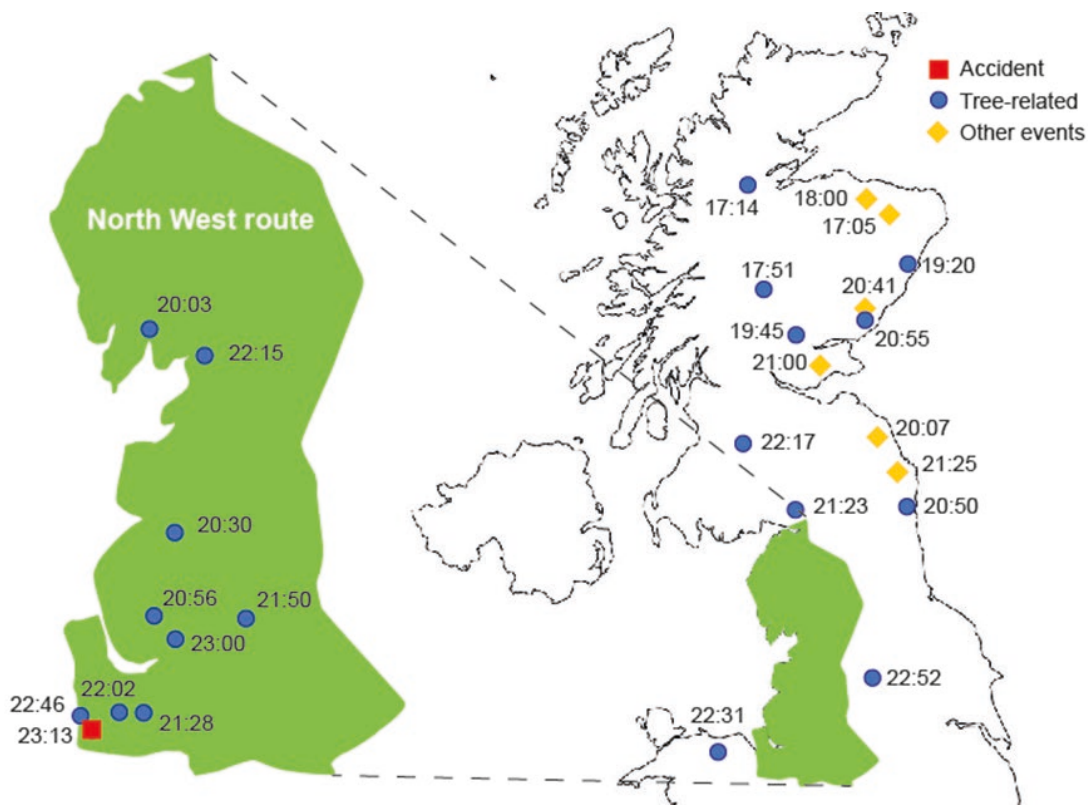
At 22:54 hrs the driver of train 5D77 called the signaller again, having cleared the tree from the line and checked the train, and they came to a mutual understanding that the train should continue to proceed at caution until the bottom of Gresford bank. At 23:09 hrs, the train driver informed the signaller that he had reached the bottom of Gresford bank without incident. The driver then accelerated to maintain a speed of around 46 mph (74 km/h), which was less than the permitted line speed of 60 mph (97 km/h), until striking the tree shortly after exiting Balderton tunnel. This caused the leading axle of the train to derail.

Drivers and signallers are required to take appropriate action if they become aware of a risk to the safety of the line in accordance with the relevant operating rules and procedures. For example, in the case of forecast or actual extreme weather conditions requiring restrictions on train movements before there is evidence of actual damage, the relevant rules and procedures require staff in Network Rail route control to instruct signallers on the actions they must take. These actions can include giving instructions to train drivers. These instructions can include implementing a blanket emergency speed restriction (BESR), a restriction applied across a broad area without requiring the installation of signage.

Following a report by a train driver of a collision with an obstruction, module M3 of the Rule Book requires signallers to contact route control, and not to allow the train driver to proceed until control approves this. On the night of the accident, however, the signaller did not contact route control until after the second collision, and route control staff did not then instruct the signaller to restrict the movement of train 5D77 in any way.

Storm Arwen had caused serious disruption on Network Rail infrastructure before the derailment of 5D77 at around 23:13 hrs. By this time, nineteen events involving falling trees had been reported on Network Rail infrastructure, including nine within the North West route. Before this derailment, North West route control staff were monitoring these events and had considered whether to apply BESRs. They decided against this, as they believed the incidents were mostly minor and manageable.

Following the derailment of a passenger train at Carmont ([RAIB Report 02/2022](#)) Network Rail issued an emergency change to national operating procedure (NOP) 3.17 'Weather Arrangements'. This adjusted the instructions for control staff to follow after the failure of a structure or earthwork. The new instructions required them to consider imposing limits on train speeds on other parts of the network, taking account of weather conditions. There was no comparable requirement made relating to trees falling on the line.



Weather-related incidents on 26 November 2021, with time reported, as recorded in Network Rail national log. Some incidents are not recorded on this log.

Network Rail's procedures for managing operational risk from extreme weather are set out in Network Rail process NR/L2/OPS/021, 'Weather – managing the operational risks'. This requires routes to produce planned responses for actual or forecast breaches of specified weather-related thresholds (for example, high winds, heavy rain or low temperatures). Procedure NOP 3.17 gives thresholds for 'extreme' and, less onerous, 'adverse' conditions. Network Rail describe extreme weather as 'so severe that consideration has to be given as to the level of service which can be safely operated'. Adverse weather is that 'known to be challenging to reliable operations'.

If an 'extreme' weather threshold, or multiple 'adverse' weather thresholds, are forecast to be (or are) breached within the area comprising a route, the relevant route control staff are required to convene an extreme weather action teleconference (EWAT). This is intended to co-ordinate weather-related responses from various parts of the rail industry and to provide a forum for 'structured expert judgement' where this is needed to support decision-making. In addition to convening an EWAT before an extreme weather event, NR/L2/OPS/021 requires route control staff to conduct an EWAT during an extreme weather event if appropriate.

The wind speeds expected for the day of the accident within the North West route escalated from 'adverse' to 'extreme' when the forecast was updated on the morning of the accident. Although NR/L2/OPS/021 required an EWAT to be convened in these circumstances, North West route control staff did not convene one because they believed that an EWAT held the previous day had sufficiently considered the weather-related risks. As an alternative, they instigated hourly monitoring of both forecast and observed weather conditions. Network Rail states that this did not show wind speeds breaching thresholds in those areas where the maximum permitted line speeds were greater than the emergency speed restrictions that would have been required by its procedures.

It is unlikely that holding an EWAT would have prevented this accident. This is because the most likely mitigation which would have resulted was the imposition of a 50 mph (80 km/h) speed restriction and train 5D77 was travelling at less than this speed when the accident occurred. In addition, although NR/L2/OPS/021 lists topics to be considered during an EWAT, this list does not include wind direction, and the wind thresholds in procedure NOP 3.17 do not take account of wind direction either. This means that the potential for greater than expected tree falls due to the unusual direction of the wind may not have been realised by those forming the EWAT, even had one been convened.

Previous similar occurrences

RAIB has reported on three accidents involving collisions between trains and trees that have fallen across the railway line (see [RAIB report 08/2011](#), [RAIB safety digest 02/2020](#) and [RAIB safety digest 04/2021](#)). These were all caused by trees in a poor condition which went undetected by Network Rail and the owner of the land where the tree stood.

[RAIB report 02/2022](#) describes a derailment due to a washout caused by extreme rainfall at Carmont, Aberdeenshire on 12 August 2020. Three people died in this accident. Causal factors identified by RAIB included Network Rail's processes not addressing weaknesses in the way it mitigated the consequences of intense and volatile rainfall events. RAIB also observed that EWAT meetings had not been held as required by Network Rail procedures.

Recommendations made to Network Rail in RAIB's Carmont report address some of the factors present in the Balderton accident. These cover improving processes for mitigating the effects of extreme weather conditions and enhancing route control staff skills and resources to improve incident management. Additionally, RSSB has commenced a project (T1252) to assess the effectiveness of blanket speed restrictions in mitigating risks from trains colliding with trees or landslips.

A wider summary of previous RAIB learning, including previous incidents relating to the safe management of weather-related events, can be found on [RAIB's website](#).