



Investigation Report 08073101



Collision between a train and a road vehicle at level crossing

XN125, Cappadine, on the Ballybrophy to Killonan line

31st of July 2008

Document history

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Function of the Railway Accident Investigation Unit

The Railway Accident Investigation Unit (RAIU) is a functionally independent investigation unit within the Railway Safety Commission (RSC). The purpose of an investigation by the RAIU is to improve railway safety by establishing, in so far as possible, the cause or causes of an accident or incident with a view to making recommendations for the avoidance of accidents in the future, or otherwise for the improvement of railway safety. It is not the purpose of an investigation to attribute blame or liability.

The RAIU's investigations are carried out in accordance with the Railway Safety Act 2005 and European railway safety directive 2004/49/EC.

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Executive Summary

On the 31st of July 2008 at approximately 17.20 hours, a Diesel Multiple Unit train collided with a road vehicle at level crossing XN125, Cappadine. The train involved was the 16.45 hours Iarnród Éireann service from Limerick to Ballybrophy (train identification number A463). As the train approached Level Crossing XN125, located in the townland of Cappadine in County Tipperary, the train driver saw a road vehicle stopped with its front protruding onto the railway line. The train driver sounded the horn and made an emergency brake application. The train struck the road vehicle, a Toyota Corolla car, and then continued to travel approximately 130 metres past the level crossing before coming to a stop. The car had been travelling towards XN125 from the direction of Ballinahinch when it stopped fouling the railway line. The train was crewed by a driver and a ticket checker with four passengers on board at the time of the collision. The car was occupied by a driver and a front seat passenger. There were no injuries, the front of the car was extensively damaged and there was minor damage to the train.

Immediate cause, causal factors and contributory factors

The immediate cause of the collision:

- The road vehicle stopped in a position fouling the railway line.

The causal factors were:

- The lack of clear marking of a safe stopping position clear of the railway line for road users;
- The lack of effectiveness of the whistleboards as a mitigation for inadequate sighting distance.

The contributory factors were:

- The condition of the level crossing surface;
- The angle at which the road crosses the railway;
- The changing orientation of the road through the crossing;
- The overgrown condition of the vegetation.

Recommendations

- Iarnród Éireann should assess the risks relating to road users' behaviour in identifying a safe stopping position at User Worked Level Crossings and based on the outcome of this risk assessment, Iarnród Éireann should introduce measures to allow safe use of this type of level crossing;

- Iarnród Éireann should carry out risk assessments on level crossings that fail to meet the viewing distances specified in the Railway Safety Commission guidance and implement appropriate measures in order to meet this guidance as a minimum.

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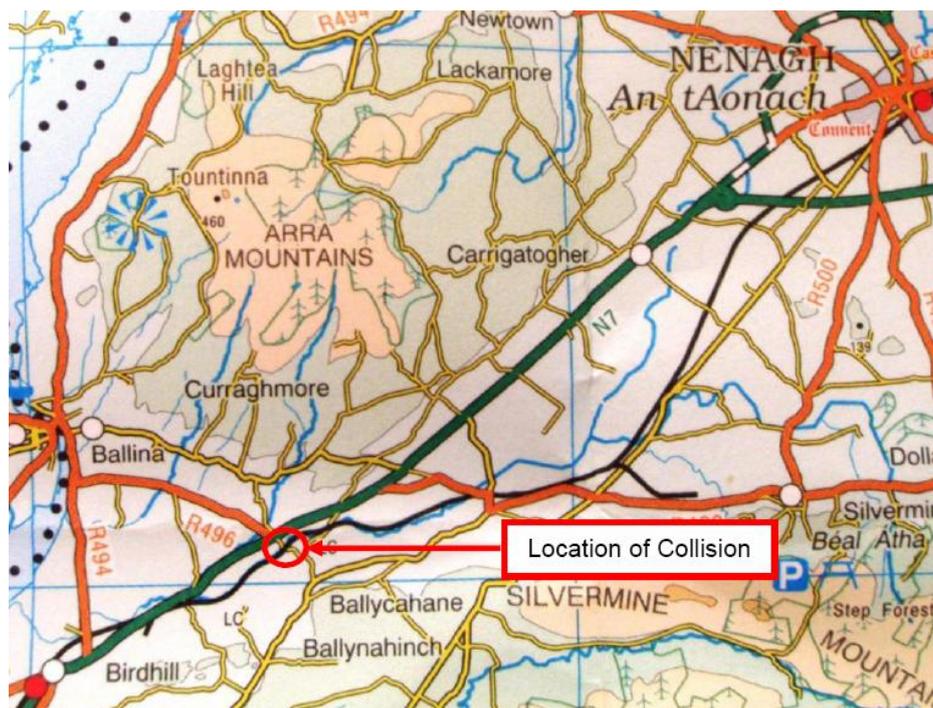
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1 Factual information

1.1 The accident

On the 31st of July 2008, the 16.45 hours (hrs) Iarnród Éireann (IÉ) service from Limerick to Ballybrophy (train identification number A463) departed Limerick Station. At approximately 17.20 hrs, on the approach to Level Crossing (LC) XN125, located in the townland of Cappadine in County Tipperary, the train driver saw a road vehicle stopped with its front protruding onto the railway line. The train driver sounded the horn and made an emergency brake application. The train struck the road vehicle (car) then continued to travel approximately 130 metres (m) past the LC before coming to a stop. The car had been travelling from the direction of Ballinahinch towards LC XN125 when it stopped fouling the railway line, see location map in figure 1. The train was a Diesel Multiple Unit (DMU) consisting of units 2724 and 2715, crewed by a driver and a ticket checker with four passengers on board at the time of the collision. The car, a Toyota Corolla, was occupied by a driver and a front seat passenger.

Figure 1 – Location map



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The ticket checker, who had been travelling in the leading unit behind the driver's cab, went to the train driver who explained that the train had struck a car. The ticket checker then left the train and walked back to the car. The ticket checker spoke to the car driver who advised him that no one was injured, the car driver then drove away from the LC. The train driver checked that none of the passengers were injured, then contacted the Signaller at Birdhill cabin by train radio and the District Traction Executive by mobile phone. The train driver inspected the train and found no apparent damage. A brake test was carried out and once permission was obtained from the District Manager, the train continued its journey. The District Manager reported the accident to Central Traffic Control at Connolly Station.

IE reported the collision to An Garda Síochána, who contacted the driver of the car and advised IE that the occupants were not injured.

The accident occurred during daylight hours and the weather was overcast with some light rain.

1.2 Level crossing

1.2.1 Description

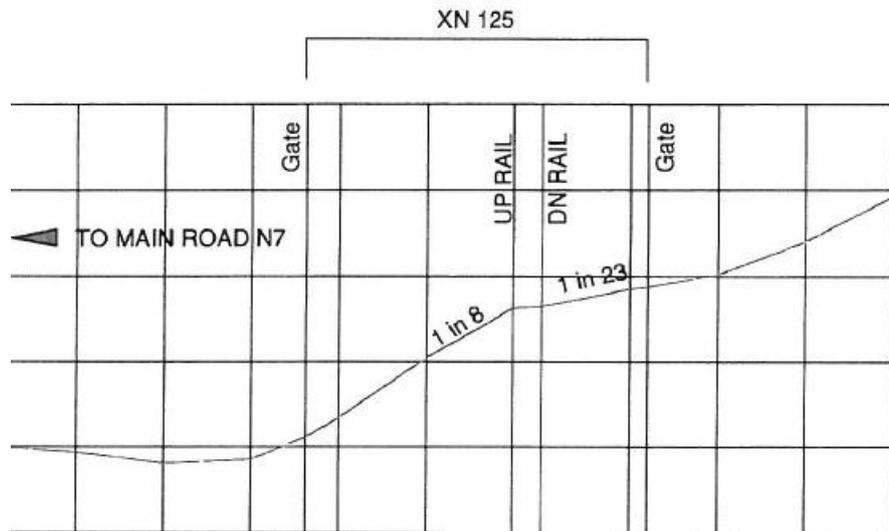
XN125 is located at 39 ¼ miles from Ballybrophy on the Ballybrophy to Killonan line, it is situated in the townland of Cappadine, north east of Birdhill in County Tipperary. XN125 is a user worked public road crossing. There are two LCs within approximately half a mile of XN125 in either direction.

The crossing had twelve foot iron gates on either side with fencing made up of concrete posts and wire between the gates and the railway line. There was an iron gate within the crossing on the Up side providing access to a field. The crossing surface was tar and chip. The route across the LC changed orientation, see photo 1, and the approach to the crossing was on a gradient at both sides, see figure 2.

Photo 1 – View of XN125 from N7 side



Figure 2 – Gradient profile of XN125



The signage present at the LC and on the approach consisted of the following on each side of the LC:

- Stop sign;
- Stop, look and listen sign;
- Crossing number;
- Railway cross code;
- Puffing Billy;
- Danger level crossing;
- Have you shut the gates;
- Warning railway crossing ahead;
- Do not trespass;
- Keep these gates shut.

No signage marking the safe stopping position for crossing users was provided.

There is no IÉ standard that clearly identifies the signage required at crossings. IÉ standard I-PWY-1307¹ prompts staff to check for missing signage but gives no reference to a list of signage that should be fitted. In addition, IÉ Technical Information Sheet MW50² identifies a list of signage to be fitted, as does the Report of Committee of Inquiry into Accommodation Level Crossing Safety³.

¹ Iarnród Éireann standard I-PWY-1307 'Standard for Track Patrolling', Issue 1.1, dated 05/09/2006.

² IÉ Maintenance of Way Technical Information Sheet MW50 'Accommodation Level Crossings', dated 1st January 1983.

³ Iarnród Éireann 'Report of Committee of Inquiry into Accommodation Level Crossing Safety', dated 13th July 1990.

Whistleboard signs, marking the location where a train driver is required to sound the horn, are positioned on the approach to LCs where the available views of the train are restricted. Whistleboards are located at 212 m from the LC on the Killonan side and 206 m from the LC on the Ballybrophy side. For a train travelling from the Killonan side at maximum permitted line speed, the sounding of the horn at the whistleboard would occur 11.7 seconds (s) prior to the train arriving at XN125.

The railway fencing and cattle grids at the crossing were severely damaged rendering them ineffective. The surface of the crossing and the approach road were in poor condition. See photos 2 and 3.

Photo 2 – LC fencing and cattle grids



Photo 3 – LC surface



The vegetation within the boundaries of the railway was overgrown adjacent to the crossing and along the railway line, reducing the sighting distance of the railway for users of the LC. There was no vegetation management plan in place at the time of the accident. An informal procedure was in place whereby vegetation was cut back twice a year depending on funding. According to IÉ, hedge cutting was carried out along the line in Autumn 2007 and weed spraying had taken place in July 2008, however no records are maintained for this activity.

XN125 was inspected on Mondays, Wednesdays and Fridays by Patrol Gangers in accordance with IÉ standard I-PWY-1307 'Standard for Track Patrolling'. Records of these inspections indicate that on both the 27th of June 2008 and the 25th of July 2008 XN125 was identified as being in need of repair, no detail of the extent of the repairs required were included. The record of actions taken shows that only temporary repairs of the LC surface had taken place. These records were also found to be incomplete. No other inspection or maintenance records were available, including for IÉ standard I-PWY-1107⁴ 'Track and Structure Inspection Requirements'.

⁴ Iarnród Éireann standard I-PWY-1107 'Track and Structure Inspection Requirements', Issue 1.0, dated 05/09/2006.

1.2.2 Sighting distance at level crossings

IE Technical Information Sheet MW50 details the sighting distance of approaching trains for crossing users to cross safely with normal vigilance. This is based on the Goold's Cross Report 1966⁵ and gives the position of measurements for the viewing point as 3.66 m from the nearest rail and at a height of 1.22 m above ground. Based on this, the actual sighting distance was measured as 183 m.

MW50 gives:

- A reaction time of 1.5 s for crossing users;
- A crossing speed of 1.34 metres per second (m/s), which is equivalent to 4.8 km/h;
- A crossing distance of 5.5 m;
- A standard vehicle length of 7.3 m, to allow for an agricultural tractor and trailer;
- Crossing time of 9.5 s.

This gives a safe crossing time of 11 s, where the safe crossing time is the crossing time (9.5 s) plus the reaction time (1.5 s).

From this the minimum sighting distance can be calculated as follows:

$$\text{Minimum sighting distance (m)} = \text{Safe crossing time (s)} \times \text{Speed of train (m/s)}$$

For XN125 this gives a minimum sighting distance at the LC of 199 m based on the maximum permitted line speed of 65 km/h.

The sighting distance at XN125 was also reviewed against the Railway Safety Commission (RSC) guidelines⁶. The guidelines identify conditions for suitability of user worked crossings and states that the sighting time of an approaching train should be the railway company's safe crossing time plus a margin of 5 s. Using the RSC guidelines, the viewing time prior to the arrival of a train is 16 s (safe crossing time of 11 s plus 5 s margin). Applying this to IE's MW50 formula gives:

$$\text{Minimum sighting distance (m)} = [\text{Safe crossing time} + 5 \text{ s margin}] \times \text{Speed of train (m/s)}$$

⁵ Coras Iompair Éireann 'Report of Committee, Derailment at Goold's Cross on 5th August, 1965', dated February 1966.

⁶ RSC publication 'Guidelines for the Design of Railway Infrastructure and Rolling Stock, Section 5 – Level Crossings', Issue 01, dated 2008.

For XN125, this gives a minimum sighting distance at the LC of 289 m based on the maximum permitted line speed of 65 km/h.

The actual sighting distance of an approaching train at XN125 from the viewing point defined in MW50 was measured and is compared with the IÉ and RSC values in table 1 below.

Table 1 – Sighting Distance at XN125

Sighting Distance Type	Sighting Distance (m)	Sighting Distance Deficit (m)
Actual	183 m	Not applicable
MW50 requirement	199 m	16 m
RSC guidance	289 m	106m

1.2.3 Level crossing risk assessment

The risk rating of XN125 was classified in the AD Little Report⁷ on Targeting Safety Investment at LCs in 1999 as 5, 'grey', meaning that it was a tolerable risk LC. However, using local knowledge, the Divisional Engineer assigned the crossing as an engineering black LC, meaning that it was an intolerable risk LC.

The National Roads Authority (NRA) were constructing a bridge over the new N7 route, which led to increased usage of the crossing. No additional risk assessment was carried out by IÉ for the altered activity over XN125.

1.2.4 Crossing use

Gates are provided at LCs to segregate the railway from the road and these must be maintained closed across the roadway to ensure safety of LC users and railway users. Closure of LC gates is prescribed in Part 14 (Section 131) of the Railway Safety Act 2005.

There is a history of the gates being left open at XN125. The Divisional Engineer requested the erection of Closed Circuit Television (CCTV) cameras to record continual misuse at XN125 in May 2007, these cameras had not been erected at the time of the accident.

In this instance, the car approached the LC while there was another car using the LC, therefore, the gates were already open, however, it is not known whether the previous driver opened the gates or if they had been left open. The car driver was not a local resident and did not use the LC on a regular basis, but was aware that the car was at an LC. The car driver wore two hearing aids, but was deemed fit to drive. Neither occupant of the car heard the train horn.

⁷ AD Little 'Targeting Safety Investment at Level Crossings', dated September 1999.

1.3 Track

The line from Ballybrophy to Killonan is single track with jointed rail. The maximum speed on this line is 65 km/h.

1.4 Signalling and communications

The signalling system is Manual Token Block between Ballybrophy and Roscrea and Electric Token System between Roscrea and Birdhill as well as between Birdhill and Killonan. The trackside signals are a combination of semaphore and colour light.

The communication system on the Ballybrophy to Killonan line consists of an open channel radio system referred to as mode C. This provides communication between the signal cabins and train radios, as well as between signal cabins and lineside telephones. This system allows limited communication with the local signalman.

1.5 Rolling stock

The train was a two carriage 2700 class DMU consisting of units 2724 and 2715, with unit 2724 leading. The class 2700s entered service in 1999. Unit 2724 is fitted with an event recorder supplied by Cesis. The train wheel diameter on the event recorder was incorrect. This meant that the actual speed of the train was greater than that displayed to the driver. Therefore the driver believed that the train was travelling below the speed limit. Table 2 outlines the chain of events from the event recorder using the correct wheel diameter.

Table 2 – Train Chain of Events

Approximate Distance from XN125	Action	Actual Train Speed	Time
190 m before	Horn was sounded	71 km/h	17:18:40
90 m before	Long blast of horn followed by a series of blasts	71 km/h	17:18:46
70 m before	Emergency brake demand by driver	69 km/h	17:18:47
At XN125	Horn ceased to operate	64 km/h	17:18:51
50 m past	Brake response attained emergency brake level	53 km/h	17:18:54
130 m past	Train stopped	0 km/h	17:19:08

1.6 Operations

Trains operating in passenger service on the Ballybrophy to Killonan line only require a driver. The ticket checker was present for revenue purposes.

1.7 Fatalities, injuries and material damage

1.7.1 Injuries

There were no injuries to railway personnel, passengers or the occupants of the car.

1.7.2 Damage to rolling stock

DMU 2724 sustained minor damage to the cow catcher and the sandbox at the leading end. There was no damage to DMU 2715.

1.7.3 Damage to the road vehicle

The car involved sustained extensive damage, including damage to the front bodywork, chassis and engine.

1.8 History of accidents/incidents

A near miss was recorded on the 22nd of April 2005 at XN125. The driver of the 7.00 hrs train from Limerick to Ballybrophy saw a car drive onto the railway track and stall for approximately 2-3 s before moving clear of the track. Letters were sent to local residents after this incident to highlight the consequences of misuse of the gates.

2 Analysis

2.1 Safe stopping position

The layout, signage and marking of an LC are important in allowing the user identify a safe stopping position clear of the railway line. The position in which the car stopped was fouling the railway line. The car driver may have stopped in a position that was fouling the railway line due a number of factors, these include:

- Distraction caused by the presence of a second car at the LC;
- Lack of awareness by the driver of the risks relating to stopping on the railway line;
- Lack of road markings or signage at XN125 indicating a safe stopping position clear of the railway line;
- Lack of awareness of the overhang of trains beyond the track;
- The angle at which the road crosses the railway;
- The changing orientation of the road through the crossing;
- The poor condition of the crossing surface;
- The lack of visibility of the railway line due to the vegetation.

Each of these or a combination could have led to the car driver stopping in a position that was fouling the railway line.

It can be difficult for an LC user to determine a safe position to stop at when crossing an LC. Clear marking of a safe stopping position at which the driver should stop and check for the presence of a train can mitigate against the risk of drivers stopping in a position that is fouling the railway line. And in this case, such markings may have prevented the accident.

2.2 Train awareness

At user worked public road LCs, the user should stop at a safe distance from the railway line and ensure that there are no trains approaching before proceeding across the LC. The user becomes aware of an approaching train by either seeing or hearing it. Therefore, to allow the user to decide if it is safe to cross, they require sufficient warning time. Based on the IÉ standard MW50, a person should be able to see a train 11 s before it reaches the LC, this is 5 s less than the RSC guidance. In addition, if it is not possible to achieve the 11 s sighting distance specified in MW50, whistleboards are used to remind train drivers to sound the horn in order to warn LC users of the presence of an approaching train. In this instance the car driver's sighting distance was reduced by the overgrown vegetation, which allowed only 10.1 s sighting distance. This placed a greater reliance on the driver hearing the train horn. The train horn was sounded at the whistleboard but neither occupant of the car heard it. Therefore, the effectiveness of use of whistleboards as a sole means to address a lack

of visibility of approaching trains appears to have been ineffective in this instance. The ability to hear the horn may have been affected by the following factors:

- The hearing ability of the user;
- Weather conditions such as wind and rain;
- Noise levels in the car such as radio or engine noise;
- Environmental noise such as farming machinery and road traffic;
- Vegetation.

3 Conclusions

The car driver came to a stop in a position that was fouling the railway line. There were no markings at the LC to indicate the safe stopping position for road users and it was found to be in a state of disrepair. In addition, the use of whistleboards was found not to provide sufficient mitigation against a lack of visibility of approaching trains.

Immediate cause, causal factors and contributory factors

The immediate cause of the collision:

- The road vehicle stopped in a position fouling the railway line.

The causal factors were:

- The lack of clear marking of a safe stopping position clear of the railway line for road users;
- The lack of effectiveness of the whistleboards as a mitigation for inadequate sighting distance.

The contributory factors were:

- The condition of the level crossing surface;
- The angle at which the road crosses the railway;
- The changing orientation of the road through the crossing;
- The overgrown condition of the vegetation.

4 Recommendations

The following safety recommendations⁸ are made:

- IÉ should assess the risks relating to road users' behaviour in identifying a safe stopping position at User Worked LCs and based on the outcome of this risk assessment, IÉ should introduce measures to allow safe use of this type of LC;
- IÉ should carry out risk assessments on LCs that fail to meet the viewing distances specified in the RSC guidance and implement appropriate measures in order to meet this guidance as a minimum.

⁸ Recommendations shall be addressed to the safety authority and, where needed by reason of the character of the recommendation, to other bodies or authorities in the Member State or to other Member States. Member States and their safety authorities shall take the necessary measures to ensure that the safety recommendations issued by the investigating bodies are duly taken into consideration, and, where appropriate, acted upon. (Railway Safety Directive, 2004/49/EC)

5 Previous RAIU Recommendations

The following is a list of previous RAIU reports and their recommendations that are relevant to this investigation.

'Report into the Collision at Level Crossing XN104 between Ballybrophy and Killonan on the 28th of June, 2007':

- IÉ to review the various sources of information relevant to level crossings and develop a standard, or suite of standards, consolidating information on: civil engineering specifications; signage specifications; visibility of approaching trains; and inspection and maintenance. Ensuring effective implementation and compliance;
- IÉ to develop and implement a vegetation management programme that addresses vegetation management on a risk basis, prioritising high risk areas;
- Iarnród Éireann to review the standards relating to on-board data recorders, ensuring that correct operation, accuracy and post incident downloads are effectively addressed.

'Report into the Fatality at Level Crossing XX 032 between Ballina and Manulla Junction on the 28th of February 2008':

- The RSC should carry out a review of the suitability of this type of level crossing on public roads. This review should include, but not be limited to, factors such as continual misuse, signage, user mobility, environmental and human factors;
- IÉ should, taking into account the close proximity of the three level crossings, close or upgrade some or all of these crossings;
- IÉ must identify crossings that are regularly misused and take proactive action to manage the increased risk created by this misuse.

6 Relevant actions already taken or in progress

The following actions have been reported by IÉ as already taken or in progress relevant to this report as of July 2009:

- The surface at XN125 has been changed to tarmac between the gates and across the track;
- New cattle grids have been installed;
- Drainage works have been undertaken;
- The views at the LC have been improved and discussions with adjacent landowners to facilitate further improvements are ongoing;
- CCTV monitoring of the LC is in the process of being set up.

7 Additional information

7.1 Acronyms

CCTV	Closed Circuit Television
DMU	Diesel Multiple Unit
ÍÉ	Iarnród Éireann
km/h	Kilometres per hour
m	Metre
m/s	Metres per second
RSC	Railway Safety Commission
s	Second

7.2 Glossary of terms

Block Section	A section of track between two fixed points for which entry to the section is controlled by the signalling system.
Central Traffic Control	Main railway operational control and signalling centre based in Dublin.
Diesel multiple unit	Self propelling train unit powered by diesel, which can operate as single units or as units coupled together.
Down Side	The right hand side of the track in the direction of travel towards Dublin.
Electric Token System	A system which uses electric token instruments at each end of the block section. The instruments contain a number of tokens, and are interlocked in such a way that removal of a token from one of the instruments prevents removal of another token until the first token is replaced in one of the instruments. Possession of this token allows a train to enter the section.
Event Recorder	A device fitted to trains to store key train parameters and driver actions.
Manual Token Block	A system where there is only one token for the block section. Possession of this token allows a train to enter the section.
Puffing Billy	Image of locomotive used to warn road users of the presence of the railway.
Railway Cross Code	Procedure for safely crossing the railway at user worked level crossings.
Railway Safety Commission (RSC)	The RSC is the statutory agency established under the Railway Safety Act 2005 with responsibility for matters of railway and cableway safety on passenger carrying systems and freight carrying systems where they interface with public roads. The principal functions of the RSC are to: foster and encourage railway safety; enforce the Railway Safety Act 2005 and any other legislation relating to railway safety; and investigate and report on railway accidents or incidents.
Up Direction	Direction of travel leading towards Dublin.
Up Side	The left hand side of the track in the direction of travel towards Dublin.