RAIU

Railway Accident Investigation Unit

# Investigation Report 2011-R005


## Person struck at level crossing XE039, County Clare,

## 27th June 2010

## 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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## Summary

At approximately 22:00 on the 27th June 2010 the Train Driver of the 21:45 service from Ennis to Limerick sounded the horn on the approach to user worked level crossing XE039. As the Train Driver was sounding the horn he observed a farmer, 162 metres ahead of the train, pushing a cow through the gates of XE039 onto the railway, approaching the railway line from the Train Driver's right. As the train continued to approach XE039 the Train Driver applied the brake and sounded the horn twice. The Farmer continued to push the cow, the train struck the Farmer and the cow. As the train passed over XE039 the Train Driver heard a noise and saw the cow fall to the left of the train, he was not aware that the train had struck the Farmer. The train stopped 200 metres beyond XE039. The Train Driver went back to XE039 on foot and found both the Farmer and the cow on the side of the track on the opposite side of the track to the one had they approached from. The Train Driver requested the assistance of the emergency services, who were contacted by the Galway Line Signalman. The ambulance service arrived via a bridge over the railway 552 metres from XE039 and was then guided to the access road for XE039. The Farmer was fatally injured and pronounced dead at the scene.

The immediate cause of the accident was:

- The train arrived at XE039 as the Farmer was attempting to move the cow clear of the railway line.

The contributory factors identified were:

- The vegetation at XE039 may have affected the Farmer's ability to see the train.

The underlying factors were:

- The information provided to staff carrying out measurement surveys at level crossings did not provide information on the minimum safe distance from the nearest rail that the viewing distances should be measured from;
- The time required to cross the railway safely where the crossing route is skewed was not taken into account in the calculation of the warning time of approaching trains.

The additional issue identified was:

- The information available to Centralised Traffic Control on the location and access to the level crossing was not used to assist the emergency services to locate and access the accident site.

The following safety recommendations are made:

- Iarnród Éireann should ensure that risk assessments are produced for all user worked level crossings to identify all hazards specific to particular level crossings;
- Iarnród Éireann should review their documentation on the measurement of viewing distances at existing user worked level crossings to ensure that the viewing distances provide sufficient views of approaching trains to allow level crossing users cross safely;
- Iarnród Éireann should review their procedures for the management of accidents to ensure that communication with the emergency services is clear and provides the necessary information to locate an accident site without undue delay and access it by the most appropriate point.

And the following previous safety recommendation from June 2008 is being reiterated:

- Iarnród Éireann to develop and implement a vegetation management programme that addresses vegetation management on a risk basis, prioritising high risk areas.

## Contents

# 1 Factual information

## 1.1 Parties involved

Iarnród Éireann (IÉ)[1] is the *railway undertaking*[2] that owns and operates mainline railway services in Ireland. IÉ is also the railway *infrastructure manager*, managing the design, installation, testing, inspection, maintenance and renewal of the railway's physical assets.

The IÉ departments associated with this accident are:

- The Operations Department – responsible for the supervision and operation of trains on the mainline, this includes the supervision of train drivers and the control of train movements through Centralised Traffic Control (CTC) in Dublin and regional controlling signal cabins;
- The Chief Civil Engineer's (CCE) Department – responsible for the design, inspection, maintenance and renewal of the railway's structural infrastructure, including level crossings (LCs), and the management of risks relating to the use of LCs.

The Railway Safety Commission (RSC) is the *national safety authority*, which is responsible for the regulatory oversight of railway safety in Ireland in accordance with the Railway Safety Act 2005 (Government of Ireland, 2005a) and European railway safety directive (European Union, 2004).

The roles involved are detailed below:

- The Train Driver – The driver of the train at the time of the accident;
- The Farmer – The LC user involved in the accident, he was one of two LC users of the LC designated XE039, working on farmland on both sides of the railway;
- The Limerick Check Signalman – The *controlling signalman* for the Limerick to Killonan line;
- The Galway Line Signalman – The controlling signalman for the Limerick to Claremorris line, which is the line the train was operating on;
- The Traffic Regulator – The person based in CTC, overseeing the control of train movements;
- Emergency Services Operators – Manage the calls made to the national emergency services telephone number (no.) 999 and the European Union emergency services telephone no. 112, they responded to the calls from IÉ.

[1] All abbreviations are explained in the list of abbreviations.

[2] All terms in italics are explained in the glossary of terms.

### 1.2 The accident

At approximately 22:00 on the 27th June 2010 the Train Driver of the 21:45 service from Ennis to Limerick, train identification no. A489, sounded the horn on the approach to LC XE039. As the Train Driver was sounding the horn, he observed the Farmer further along the railway ahead of the train pushing a cow through the gates of XE039 onto the *railway line* on the *Down side* of the line, on the Train Driver's right. As the train continued to approach XE039 the Train Driver applied the brake and sounded the horn twice. The Farmer continued to push the cow onto the track, the train struck the Farmer and the cow. As the train passed over XE039 the Train Driver heard a noise and saw the cow fall to the left of the train on the *Up side* of the track, he was not aware that the train had struck the farmer. The train stopped with the front of the train 200 metres (m) beyond XE039. See Figure 1 for the location of the accident.

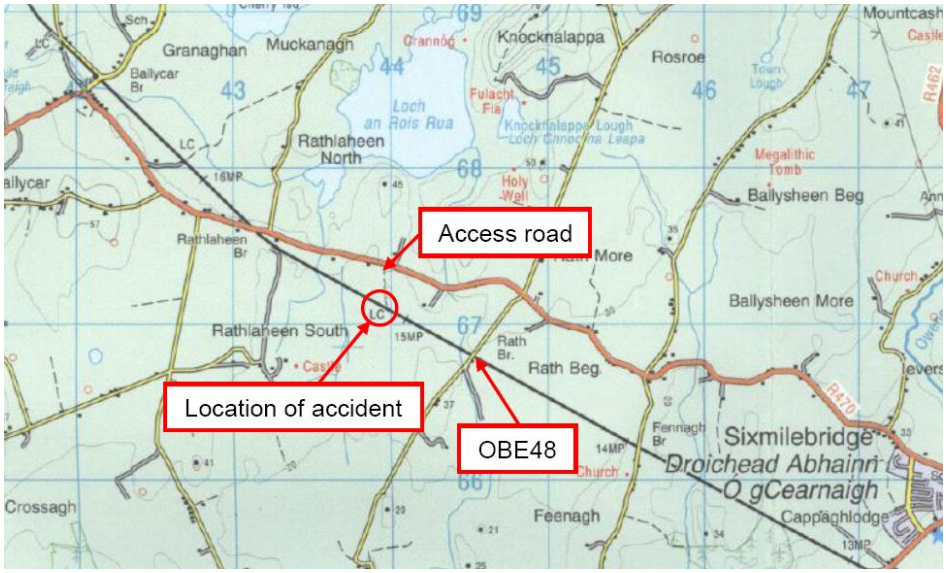


Figure 1 – Location Map
Ordnance Survey Ireland Licence No. EN 0058211
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The Train Driver went back to XE039 on foot and observed both the Farmer and the cow lying in the *cess* on the Up side of the track.

The Train Driver rang the Limerick Check Signalman, using his personal mobile telephone, to advise that the Farmer had been struck and the emergency services were required. He could not ring the controlling signalman, the Galway Line Signalman, as he did not have the telephone no. with him at the LC.

The Limerick Check Signalman rang the controlling signalman for the Limerick to Claremorris line, the Galway Line Signalman, and requested the attendance of the emergency services.

At approximately 22:30 the ambulance service arrived via a bridge over the railway, *overbridge* OBE48, see Figure 1.

The Train Driver guided the ambulance service to the access road that leads to XE039, see Figure 1.

The Farmer was fatally injured in the accident and was pronounced dead at the scene.

The accident occurred just before sunset, the weather was dry with some cloud.

## 1.3 Infrastructure

### 1.3.1 General description

The Limerick to Claremorris line, which is operational between Limerick and Athenry, is a single track section comprised of *Continuous Welded Rail* (CWR) on ballasted track with 54 kilogram rail on concrete sleepers. It is located in the Athlone *Division*.

Overbridge OBE48 is located at 14 miles 1291 yards as measured from Limerick. This is positioned 552 m from XE039 travelling in the *Up direction*.

### 1.3.2 Level crossing

XE039 is located at 15 miles 135 yards from Limerick on the Limerick to Claremorris line, situated in the townland of Rathlaheen South outside the town of Sixmilebridge in County Clare. XE039 is an Occupation type LC. This means that it has manually operated gates that are opened and closed by the LC user, which are normally kept closed across the road.

XE039 has a skewed crossing route and is at an acute angle to the railway line, see Figure 2. The surface of the road approach on both sides of the LC is unpaved. The surface on both sides of the track is ballast. The surface between the rails consists of Strail units, which are made of rubber. There are cattle grids the full width of XE039 on the railway approaches to prevent cattle straying along the railway line.

There are metal gates positioned on both the Up and Down *sides* of XE039, see Photograph 1. The gates are positioned approximately 3.18 m from the nearest rail on the Up side of XE039 and 2.91 m from the nearest rail on the Down side of XE039. There is a wicket gate on the Down side of the LC gate on the Down side of the track to allow pedestrians cross without opening the LC gate on the Down side of the railway line. The surround of the wicket gate is made of concrete and the wicket gate is made of timber. The gates at XE039 are fitted with padlocks. The two LC users were both provided with keys to the padlocks and the gates were normally kept closed and padlocked.

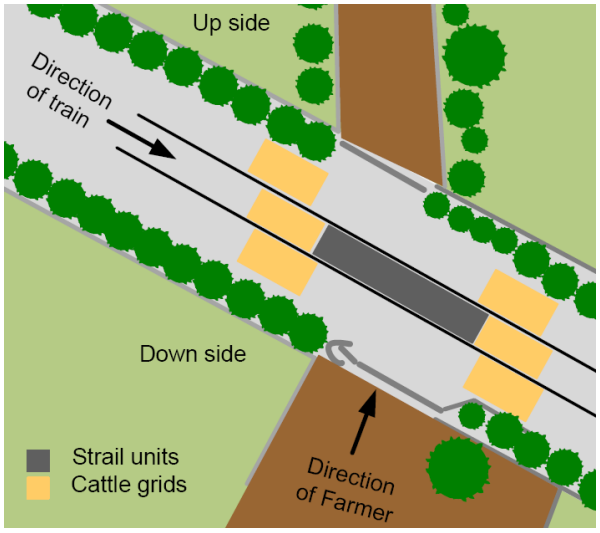



Figure 2 – Layout of XE039

Photograph 1 – XE039 from Down side

The access road to XE039 is a cul de sac with the road approaching from the Up side. There are no dwellings on the Down side of the railway at XE039.

The boundary fencing for the railway is wire and concrete post. There are hedges along the boundary fence on both sides of the railway at XE039.

Photograph 2 shows the approach from the Down direction, which is the direction the train travelled from. The vegetation along the Down side of the railway is shown in Photographs 2 and 3.

Photograph 2 – Approach from Down direction


Photograph 3 – Vegetation on Down side

XE039 is on the *flight path* for Shannon airport, which crosses the railway, and the *glide slope* for the airport is approximately 345 m above the LC. It was observed that the noise of airplanes at XE039 is sufficiently loud to reduce a person's ability to hear the engine and track noise of an approaching train. Flights were scheduled at Shannon airport around the time of the accident but it was not possible to determine if any airplanes were overhead as the train approached.

### 1.3.3 LC risk management

Risk at LCs is managed separately by IÉ and the LC user.

In this instance, as the LC user was a farmer, the LC is considered as part of his place of work and a written risk assessment is required to be produced under the Safety, Health and Welfare at Work Act 2005 (Government of Ireland, 2005b). It was not possible to establish if the Farmer carried out a risk assessment relating to crossing the railway.

IÉ issue a booklet on safe use of user worked LCs to the known LC users to assist with their management of risk at user worked LCs. The Farmer was in possession of this booklet.

IÉ manage the risk at user worked LCs on an ongoing basis through surveys carried out as part of their standards on inspection of LCs.

IÉ has a risk ranking tool in the form of a computer program to evaluate the risks relating to each individual LC on the railway system referred to as the LC Risk Model (LCRM). This was developed by IÉ with the assistance of Sotera Risk Solutions and the working of the LCRM is explained in Sotera Risk Solutions' document 'Level crossing risk model: theory report', reference J1097/Doc008, issue 01 (Sotera Risk Solutions, 2008). Based on defined information input into the program for each LC the tool establishes the level of risk at the LC and ranks all of the LCs on the railway system in order from the LC with the highest risk, ranked as number 1, to the LC with the lowest risk.

The accidents types considered in the LCRM are (Sotera Risk Solutions, 2008):

- Collision between a train and a road vehicle;
- Collision between a train and a pedestrian;
- Collision between a train and an animal where the animal gained access to the line at an LC;
- Collision between a train or road vehicle and a crossing keeper.

The LCRM addresses the risks to LC users, crossing keepers, passengers and staff on board trains. (Sotera Risk Solutions, 2008)

For each LC the following risk factors are recorded: the usage and types of users; the approaches; the features of the LC; abuse at the LC; its condition; whether there is any feature near the LC that could increase the severity of an accident; proximity to a station; the cost of upgrade. (Sotera Risk Solutions, 2008)

Based on the risk factors the following outputs are generated:

- Collective risk ratings for each of the four types of accident as well as derailments;
- Individual risk ratings for each of the exposed groups of persons considered;
- Risk ratings for the unfamiliar pedestrian and road vehicle users;
- LC ranking for collective and individual risk;
- The issues that drive risk are ranked for the LC;
- A chart showing the viewing distances and how they compare with the IÉ requirement and the RSC guidance.

Collective risk is the totality of risk to all exposed groups from one or more hazardous events. Individual risk is the risk to a typical person exposed to one or more hazardous events. (Sotera Risk Solutions, 2008)

IÉ advised the Railway Accident Investigation Unit (RAIU) that the risk ranked list of LCs generated by the LCRM is used to allocate funding for works under the Railway Safety Programme, which is an investment programme aimed at improving safety on the railways. The LCRM is not used as a tool to carry out risk assessments for ongoing risk management of each LC.

### 1.3.4 Inspection

The railway is inspected weekly by a patrol ganger who reports to a Permanent Way Inspector (PWI), who in turn reports to the Chief PWI, who reports to the Assistant Divisional Engineer (ADE) with overall responsibility for the Division lying with the Divisional Engineer (DE).

IÉ standard I-PWY-1107 'Track and Structures Inspection Requirements' (IÉ, 2006b) details the inspection requirements for LCs. IÉ standard I-PWY-1307 'Standard for Track Patrolling' (IÉ, 2006c) gives the inspection requirements for patrol gangers. Table 1 summarises these requirements.

**Table 1 – LC inspection requirements**

| Standard | Carried out by | Frequency | Type of inspection |
|---|---|---|---|
| I-PWY-1107 | PWI | 2 monthly | Inspection car |
| | PWI with patrol ganger | 4 monthly | Visual with patrol ganger |
| | | Yearly | Check rails for corrosion |
| | Chief PWI | 2 monthly | Inspection car |
| | | As directed | Walk |
| | ADE | 2 monthly | Inspection car |
| | DE | 6 monthly | Inspection car |
| | Technical staff | 5 yearly | Measurement survey |
| I-PWY-1307 | Patrol ganger | Once a week | Visual |
| | | Yearly | Survey |

I-PWY-1307 requires weekly patrol ganger inspections to cover LCs and vegetation (IÉ, 2006c) including:

- Obstructions in flangeways;
- Corrosion at foot of rails;
- Damaged or faulty barriers/gates;
- Open gates at user worked LCs – close these;
- Damaged or faulty telephones (if applicable);
- Damaged or missing signs;
- Overgrowth obstructing train drivers' view of signals;
- Overgrowth obstructing train drivers' view of user worked LCs.

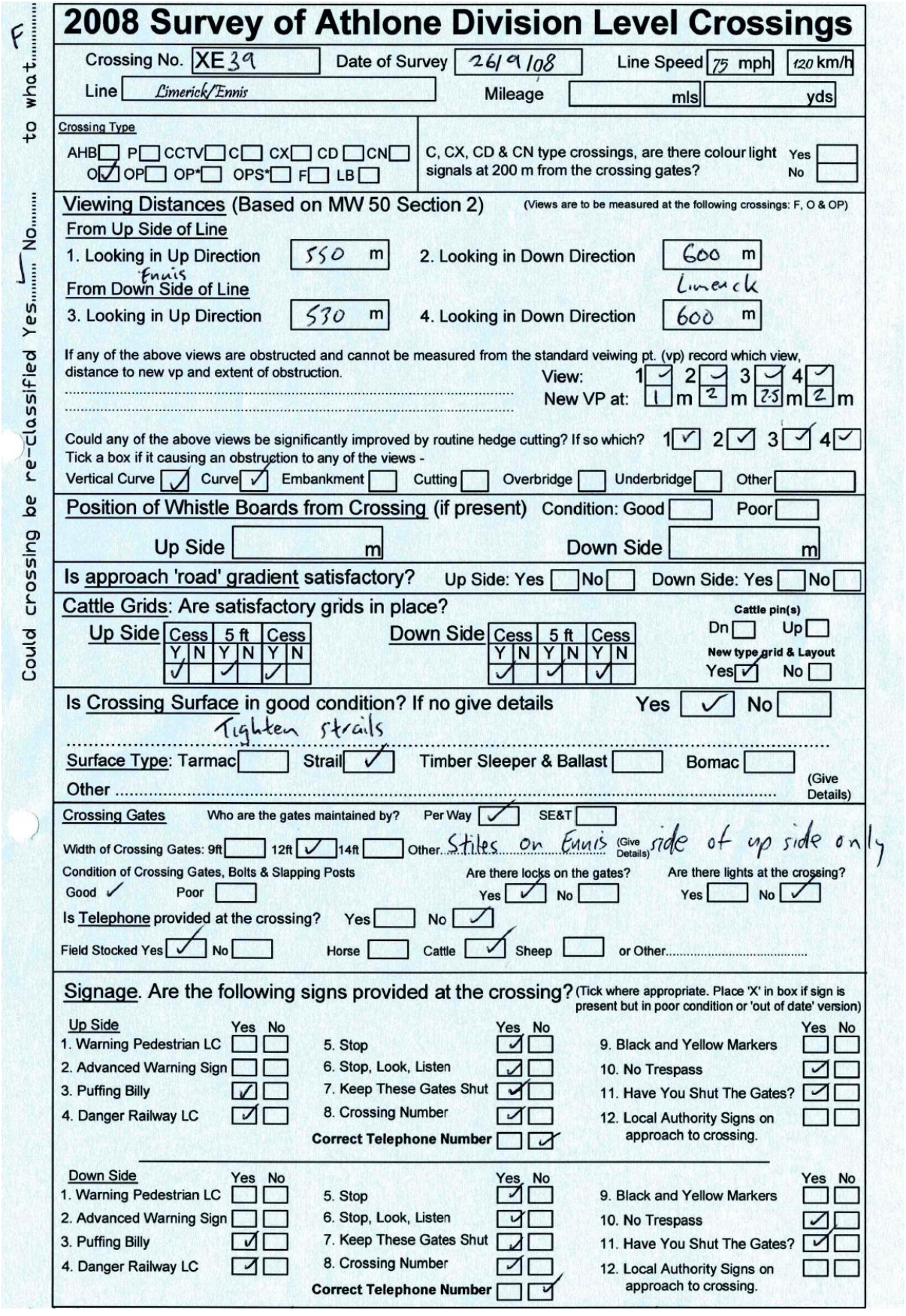
The records of the weekly visual inspections were reviewed and show no issues with XE039. The LC users' view of the railway line is not covered in the weekly inspections.

The yearly LC survey by the patrol ganger records:

- LC no.;
- Local name;
- Line;
- Mileage;
- Line speed;
- Type of LC;
- LC user details;
- Tick box on whether or not the views are good for all four views;
- Position and condition of whistleboards;
- Whether or not the approach road gradient is satisfactory;
- Whether or not satisfactory cattle grids are in place as well as their location;
- Whether or not the LC surface is in good condition;
- Width, condition and fitting of locks to gates;
- Whether or not there is a telephone at the LC;
- The signage present at the LC.

No patrol ganger yearly surveys were carried out for XE039.

The measurement survey carried out by technical staff on the 26th September 2008 in accordance with I-PWY-1107 is shown in Figure 3. The viewing distances for all four views are shown as having potential for improvement by routine hedge cutting. The line speed is shown as 75 miles per hour, 120 kilometres per hour (km/h), rather than the correct speed limit of 50 miles per hour, 80 km/h. The form shows that IÉ identified that XE039 could be re-classified as a Field type LC based on the fact that the LC was being used solely to access farm land rather than to access a dwelling. The form also indicates that cattle are kept in the fields adjacent to XE039. The measurement survey also shows that the required signage was present at the LC. The contact telephone no. for the controlling signalman was not present, however, this is was in place at the time of the accident.



# 2008 Survey of Athlone Division Level Crossings

Crossing No. XE39 Date of Survey 26/9/08 Line Speed 75 mph 120 km/h

Line Limerick/Ennis Mileage mls yds

Crossing Type

AHB ☐ P ☐ CCTV ☐ C ☐ CX ☐ CD ☐ CN ☐

O ☑ OP ☐ OP* ☐ OPS* ☐ F ☐ LB ☐

C, CX, CD & CN type crossings, are there colour light signals at 200 m from the crossing gates? Yes ☐ No ☐

## Viewing Distances (Based on MW 50 Section 2)

(Views are to be measured at the following crossings: F, O & OP)

From Up Side of Line

1. Looking in Up Direction (Ennis) 550 m
2. Looking in Down Direction (Limerick) 600 m

From Down Side of Line

3. Looking in Up Direction 530 m
4. Looking in Down Direction 600 m

If any of the above views are obstructed and cannot be measured from the standard veiwing pt. (vp) record which view, distance to new vp and extent of obstruction.

View: 1 ✓ 2 ✓ 3 ✓ 4 ✓

New VP at: 1 m 2 m 2.5 m 2 m

Could any of the above views be significantly improved by routine hedge cutting? If so which? 1 ✓ 2 ✓ 3 ✓ 4 ✓

Tick a box if it causing an obstruction to any of the views -

Vertical Curve ✓ Curve ✓ Embankment ☐ Cutting ☐ Overbridge ☐ Underbridge ☐ Other ☐

## Position of Whistle Boards from Crossing (if present)

Condition: Good ☐ Poor ☐

Up Side m Down Side m

## Is approach 'road' gradient satisfactory?

Up Side: Yes ☐ No ☐ Down Side: Yes ☐ No ☐

## Cattle Grids: Are satisfactory grids in place?

| | Cess | | 5 ft | | Cess | |
|---|---|---|---|---|---|---|
| | Y | N | Y | N | Y | N |
| Up Side | ✓ | | ✓ | | ✓ | |
| Down Side | ✓ | | ✓ | | ✓ | |

Cattle pin(s) Dn ☐ Up ☐

New type grid & Layout Yes ✓ No ☐

## Is Crossing Surface in good condition? If no give details

Yes ✓ No ☐

Tighten strails

Surface Type: Tarmac ☐ Strail ✓ Timber Sleeper & Ballast ☐ Bomac ☐

Other ..... (Give Details)

## Crossing Gates

Who are the gates maintained by? Per Way ✓ SE&T ☐

Width of Crossing Gates: 9ft ☐ 12ft ✓ 14ft ☐ Other Stiles on Ennis side of up side only (Give Details)

Condition of Crossing Gates, Bolts & Slapping Posts: Good ✓ Poor ☐

Are there locks on the gates? Yes ✓ No ☐

Are there lights at the crossing? Yes ☐ No ✓

Is Telephone provided at the crossing? Yes ☐ No ✓

Field Stocked Yes ✓ No ☐ Horse ☐ Cattle ✓ Sheep ☐ or Other.....

## Signage. Are the following signs provided at the crossing?

(Tick where appropriate. Place 'X' in box if sign is present but in poor condition or 'out of date' version)

| Up Side | Yes | No |
|---|---|---|
| 1. Warning Pedestrian LC | ☐ | ☐ |
| 2. Advanced Warning Sign | ☐ | ☐ |
| 3. Puffing Billy | ✓ | ☐ |
| 4. Danger Railway LC | ✓ | ☐ |
| 5. Stop | ✓ | ☐ |
| 6. Stop, Look, Listen | ✓ | ☐ |
| 7. Keep These Gates Shut | ✓ | ☐ |
| 8. Crossing Number | ✓ | ☐ |
| Correct Telephone Number | ☐ | ✓ |
| 9. Black and Yellow Markers | ☐ | ☐ |
| 10. No Trespass | ✓ | ☐ |
| 11. Have You Shut The Gates? | ✓ | ☐ |
| 12. Local Authority Signs on approach to crossing. | ☐ | ☐ |

| Down Side | Yes | No |
|---|---|---|
| 1. Warning Pedestrian LC | ☐ | ☐ |
| 2. Advanced Warning Sign | ☐ | ☐ |
| 3. Puffing Billy | ✓ | ☐ |
| 4. Danger Railway LC | ✓ | ☐ |
| 5. Stop | ✓ | ☐ |
| 6. Stop, Look, Listen | ✓ | ☐ |
| 7. Keep These Gates Shut | ✓ | ☐ |
| 8. Crossing Number | ✓ | ☐ |
| Correct Telephone Number | ☐ | ✓ |
| 9. Black and Yellow Markers | ☐ | ☐ |
| 10. No Trespass | ✓ | ☐ |
| 11. Have You Shut The Gates? | ✓ | ☐ |
| 12. Local Authority Signs on approach to crossing. | ☐ | ☐ |

F to what..... Could crossing be re-classified Yes..... No.....

Figure 3 – LC measurement survey form (IÉ, 2008)

### 1.3.5 View of approaching trains

IÉ technical information sheet MW50 'Accommodation level crossings' (IÉ, 1983) details the viewing requirements of approaching trains for LC users to cross safely with normal vigilance at user worked LCs. MW50 gives the position of measurements, called the viewing position, to be at 3.66 m from the nearest rail and at a height of 1.22 m above ground to allow for the position of the driver of a vehicle. It also takes into account a reaction time of 1.5 seconds (s), a crossing speed of 1.34 metres per second (m/s), a crossing distance of 5.5 m and a standard vehicle length of 7.3 m based on an agricultural tractor and trailer.

Based on the above, the viewing distance must meet or exceed the minimum viewing distance as calculated by Formula A:

| |
|---|
| Minimum viewing distance (m) = [Safe crossing time of 11 s (crossing time + reaction time)] x Speed of train (m/s) |

MW50 advised that for a single track line this can be simplified to Formula B:

| |
|---|
| Minimum viewing distance (m) = Maximum line speed (miles per hour) x 5 |

Based on Formula A the minimum viewing distance is 244 m for the line speed for trains at XE039 of 50 miles per hour (80 km/h) and a safe crossing time of 11 s.

IÉ apply Formula B when calculating the minimum viewing distance. Based on the line speed for trains at XE039 of 50 miles per hour (80 km/h), this gives the minimum viewing distance of 250 m for XE039.

The crossing distance at XE039 was found to be approximately 8.5 m to move from a position of safety at 2 m from the nearest rail on one side of the railway line to a position of safety 2 m from the nearest rail on the other side of the railway line. This is 3 m more than the 5.5 m specified in MW50 and is a result of the skewed crossing route at XE039.

The crossing distance of 8.5 m gives a safe crossing time of 13.3 s for a vehicle 7.3 m long crossing at a speed of 1.34 m/s as per MW50.

Using Formula A the safe crossing time of 13.3 s gives a minimum viewing distance of 295 m based on the maximum permitted speed of trains of 80 km/h (22.22 m/s).

The viewing position being located 3.66 m from the nearest rail allows for viewing of trains from a vehicle whilst ensuring that the front of the vehicle is positioned no closer to the nearest rail than the safe distance of 2 m.

To compensate for viewing distances that are less than required, measured at 3.66 m from the closest rail, MW50 requires the use of *whistleboards* that advise a train driver to sound the train horn to warn of the approach of a train. The use of a whistleboard is intended to act as a substitute for an adequate viewing distance.

An internal memorandum was circulated to CCE staff in 2005 on the measurement of viewing distances at LCs (IÉ, 2005). The internal memorandum advised staff on the manner in which the measurement equipment was to be used and provided permission to measure the viewing distance at a viewing position less than 3.66 m from the nearest rail if views of the railway line were restricted. This means that a whistleboard would not be required to substitute for adequate viewing distances if the viewing distance as measured at the new viewing position meets the requirements of MW50. The internal memorandum did not specify a minimum distance from the nearest rail that the viewing distance could be measured from.

The viewing distances measured as part of the last measurement survey prior to the accident have been extracted from the measurement survey form in Figure 3 and are shown in Table 2.

**Table 2 – Viewing distances at XE039 on 26th September 2008**

| **Position of LC user** | **Viewing distance** | | | |
|---|---|---|---|---|
| | **Down direction** | **Measured at** | **Up direction** | **Measured at** |
| Down side | 600 m | 2 m | 530 m | 2.5 m |
| Up side | 600 m | 2 m | 550 m | 1 m |

All four viewing distances measured in 2008, shown in Table 2, were taken at less than 3.66 m from the nearest rail.

For a vehicle this allowed the front of a vehicle to be positioned at less than the 2 m safe distance in the LC user booklet (IÉ, 2006a) and potentially encroach into the *swept path* of a train.

For a pedestrian, the viewing distance in the Up direction from the Up side was taken at 1 m from the nearest rail, which is less than the safe distance of 2 m specified in the LC user booklet (IÉ, 2006a).

The viewing distances met the 250 m viewing distance required by MW50 as the viewing positions were between 2.5 m and 1 m from the nearest rail. Hence, no requirement for whistleboards on either the Up or the Down approach to XE039 was identified.

According to IÉ's records, the vegetation was cut back at XE039 prior to the accident in April 2009.

Following the accident, the viewing distances for XE039 were measured by IÉ, this was done before the vegetation was cut back. Three of the four viewing distances at XE039 were measured at less than 3.66 m from the nearest rail as specified in MW50, see Table 3.

**Table 3 – Viewing distances at XE039 after the accident**

| Position of LC user | Viewing distance | | | |
|---|---|---|---|---|
| | Down direction | Measured at | Up direction | Measured at |
| Down side | 787 m | 3.66 m | 680 m | 2.06 m |
| Up side | 763 m | 2.08 m | 643 m | 2.6 m |

The views at XE039 on the side the Farmer approached from were photographed from the viewing position specified in MW50, at 3.66 m from the nearest rail at a height of 1.22 m, see Photographs 4 and 5. Photographs 4 and 5 were taken following cutting back of the vegetation after the accident.


Photograph 4 – Down side view in Down direction

Photograph 5 – Down side view in Up direction

Photograph 5 shows that the viewing distance looking in the Up direction from the Down side of the railway at the viewing distance of 3.66 m would not meet the 250 m required by MW50.

Photographs 2 and 3 shows vegetation on the Down side in the Down direction at XE039 the day after the accident. Based on the view shown in Photograph 4, taken from the viewing position, and extent of the vegetation visible in Photographs 2 and 3 it was not possible to determine if the vegetation could have intermittently blocked the view of the approaching train on the day of the accident. As can be seen in Photographs 4 and 5, the viewing position is outside the railway boundary.

The viewing distance was also measured at a viewing position less than 3.66 m from the nearest rail for 34 other LCs within the Athlone Division.

### 1.3.6 RSC guidance on the view of approaching trains

RSC has published guidance on the design of LCs 'Guidelines for the design of railway infrastructure and rolling stock, Section 5 – Level crossings', RSC-G-006-B, (RSC, 2008). It is noted that this guidance applies to new infrastructure, however, it is considered as there is no guidance for existing infrastructure.

This guidance gives the viewing time of an approaching train to be the crossing time as identified by the responsible railway organisation, in this case IÉ, plus a margin of 5 s. The crossing time, including the reaction time, is defined in MW50 (IÉ, 1983) as 11 s. This would give a viewing time prior to the arrival of a train of 16 s (crossing time of 11 s plus 5 s). This gives a viewing distance of 355 m for XE039, based on a line speed of 80 km/h (22.22 m/s) multiplied by 16 seconds. Taking into account the increased crossing time of 13.3 s for XE039 due to the skewed crossing route, the RSC guidance would give a viewing distance of 406 m if XE039 was a new LC.

### 1.3.7 LC user booklet

IÉ produced a booklet for LC users entitled 'The SAFE use of unattended railway level crossings' (IÉ, 2006a) advising them on how to operate user worked LCs. This was sent to the LC users for XE039 by registered post on the 30th April 2007. The previous version of the booklet, published in 2004, was also sent to the LC users for XE039 on the 10th November 2005. The Farmer kept both copies of the booklet sent to him by IÉ. The relevant parts of the LC user booklet are given below (IÉ, 2006).

Clause 1.3 warns:

- Trains can be very silent and this is particularly the case on modern CWR track.

XE039 is located on CWR track.

Clause 1.6 advises of the dangers of trains striking cattle:

- Collisions between trains and animals, including cattle, have resulted in derailments.

It is not known if the Farmer was trying to move the cow clear of the railway line to avoid a derailment when he was struck.

Clause 1.7 outlines the movements requiring protection:

- Crossing the line with slow, heavy, low-slung or cumbersome vehicles, vehicles conveying dangerous substances and with herds of animals needs special protection. See sections 11, 15 and 16 of this booklet.

Obtaining special protection involves preplanning the movement and contacting the controlling signalman to request permission to cross the railway in advance and in good time. The requirements summarised in clause 1.7 are not normally adhered to by LC users on the Limerick to Claremorris line, IÉ advised that the LC users do not contact the controlling signalman when crossing the railway. LC users are required to pay for the attendance of IÉ staff if required. No specific action was taken by IÉ to address the lack of LC user contact for special protection arrangements.

Clause 1.10 gives the general rule for crossing the railway:

- Every time you cross the railway remember to stop, look and listen.

Clause 6.4 advises:

- If you see a train approaching or hear the horn sounding do not use the LC. Clear the line immediately of any movement under way.

Clause 7.6 includes:

- Stop clear of the railway line where you get a good view along the track in both directions. Look for the approach of trains, especially in poor visibility or at night. Watch out for the light on an approaching train. Listen for horns or the sound of an approaching train.

Clause 10.3 gives the safe position for a pedestrian relative to the railway line:

- When standing clear of the railway line, keep at least 2 m from the nearest rail.

Clause 11.1 advises:

- The movement of a herd of cattle (i.e. more than two animals) should be carefully planned. Information on train times may be obtained from the controlling signalman (see telephone no., clause 22.4).

In the case of the accident one cow was being moved across the railway, therefore, contact with the controlling signalman was not required.

Clause 11.7 advises:

- **Never** attempt to start a movement of animals across the line **unless** you know that you can complete it or curtail it safely and in time. Information on train movements, and permission in advance, as required, may be obtained from the controlling signalman, see clause 22.4.

It is not known at what point after the movement across the railway line had started that the Farmer became aware that the train was approaching.

Clause 21.1:

- As a LC user, you should make yourself aware of particular hazards the LC may hold for you.

It was not possible to establish whether or not the Farmer identified the particular hazards relating to his activities when crossing the railway.

Clause 21.2 gives a list of questions that help LC users to recognise potential hazards associated with the LC they use:

- Are gates left open a problem at the LC?
- Do you use the LC during bad weather such as fog and falling snow, or during the hours of darkness?
- Do children use the LC?
- Do you know where you must stop when checking for approaching trains?
- Do buildings, bridges, vegetation or other features in the vicinity of the LC, block your view of approaching trains?
- Does noise at the LC mask the sound of approaching trains?
- Does anything distract your attention while you are using the LC?
- Can anything in the vicinity frighten animals while they are crossing?
- Do you see the LC for any purpose other than that for which it was designed?
- If you are an infrequent LC user, are you aware of the dangers involved?
- Do tailbacks occur on the LC?
- Could steep gradients cause your vehicle to ground on the LC?

At the end of clause 21.2, the following is included in bold writing:

**This list is by no means exhaustive. There may be other hazards that apply to the LC you use.**

### 1.3.8 Infrastructure Asset Management System

IÉ has an Infrastructure Asset Management System (IAMS) that stores data on its infrastructure assets, including LCs. This system has a *Geographical Information System* (GIS) element that allows storing of information relating to specific assets, such as LCs, by the location of the asset, which is overlaid onto a map. IAMS is accessible to staff via the company computer network.

As part of the information on XE039, IAMS shows it on an ordnance survey map, with its co-ordinates, photographs of the LC and the nearest access route, including whether or not vehicular access is possible.

## 1.4 Signalling and communications

Signalling on the Limerick to Claremorris line between Limerick and Athenry is *Track Circuit Block* with *colour light signals*.

Communication between the controlling signalman and train drivers on the Limerick to Claremorris line is by means of a train cab secure radio system and *signal post telephones*.

## 1.5 Traction and rolling stock

### 1.5.1 General description

The train involved was a three carriage Class 2700 Diesel Multiple Unit (DMU). The Class 2700s entered passenger service in 1999. They have a maximum speed of 112 km/h. The train consisted of carriages 2724, 2715 and 2753, with carriage 2724 leading. The train had a mass of 132,000 kg and a length of 61.68 m.

The braking system on the Class 2700s is pneumatic with a maximum braking rate of 0.88 metres per second squared ($m/s^2$) in both full service braking and emergency braking.

The service brake is applied by moving the braking handle, which gives gradual application of braking up to the full service brake rate. The *reaction time* of the braking system to a full service brake application is of the order of 3.25 s.

The emergency brake can be applied by moving the braking handle beyond the full service brake position on the braking handle or by pressing one of the two emergency brake push buttons. An emergency brake application causes a more rapid braking response as the pressure in the brake pipe is vented rather than gradually reduced. Emergency brake applications cannot be cancelled. The reaction time of the braking system to an emergency brake application is of the order of 0.9 s.

The train was fitted with an event recorder that records the status of predefined equipment on the train, the sequence of events is shown in Table 4 with the time leading up to and following the accident.

**Table 4 – Event recorder data**

| Location relative to XE039 | Time (s) relative to XE039 | Train speed (km/h) | Description |
|---|---|---|---|
| 162 m before XE039 | -7 | 79 | The train horn is sounded. |
| 122 m before XE039 | -6 | 79 | The brake handle is in the braking position. |
| 74 m before XE039 | -4 | 79 | The train horn is sounded. The train begins to decelerate. |
| 35 m before XE039 | -1 | 74 | The train horn is sounded. The train continues to decelerate. |
| At XE039 | 0 | 71 | The brake handle is in a non-braking position. The train continues to decelerate. |
| 73 m after XE039 | +5 | 55 | The brake handle is in the braking position. The train continues to decelerate. |
| 141 m after XE039 | +10 | 44 | The emergency brake is applied. The train continues to decelerate. |
| 200 m after XE039 | +21 | 0 | Train is stopped. |

The Train Driver was sounding the horn on the approach to XE039, as he did this he observed the Farmer and cow passing through the gates at the Down side of XE039. The Train Driver made a brake application 1 s later, 2 s after this the train began to react to the brake application and began to decelerate. At the same time the Train Driver sounded the horn. The horn was sounded again 3 s later. The speed of the train displayed to the Train Driver had reduced to 71 km/h as the train reached XE039, striking the Farmer and cow. 141 m after XE039 the braking handle is moved to the emergency braking position and after this the emergency brake push button positioned on the desk of the driving cab was pushed. The train came to a stop 200 m beyond XE039, 21 s after the accident. From the deceleration of the train it can be observed that the Train Driver made a full service brake application and the maximum braking rate was been achieved by the time the train reached XE039. The performance of the train was not found to have contributed to the accident.

Based on the maximum braking rate for the train, it would take the train approximately 300 m to stop from 79 km/h in emergency braking and approximately 353 m to stop in full service braking. Leading to the train stopping beyond XE039 regardless of how the brakes were applied.

## 1.6 Operations

### 1.6.1 General description

The Class 2700 DMUs are driven in Driver Only Operation, meaning that the only crew on the train is the Train Driver. The movement of trains on the Limerick to Claremorris line is controlled by the Galway Line Signalman. The speed limit between Limerick and Ennis is 80 km/h.

### 1.6.2 Emergency response protocols

There are three emergency service regions, Dublin, Limerick and Castlebar. Each of these has a control room for the ambulance service, fire service and An Garda Síochána. There is no direct connection between IÉ and the emergency service control rooms.

The response to accidents and how to contact the emergency services is covered in: the IÉ Rule Book under section A 'Employment and rules concerning safety, security, communications and emergencies' (IÉ, 2007); the IÉ General Appendix under section A 'Accidents and emergencies' (IÉ, 1996); and IÉ railway safety standard no. 22 'Fatalities or serious injuries on the line' (IÉ, 2001).

The roles and responsibilities of staff, as indicated in Section A of the General Appendix under 'Dealing with accidents and other emergencies' are outlined below (IÉ, 1996).

The person in charge, in this instance the Train Driver, will:

- Alert the controlling signalman;
- Alert the emergency services, if required;
- Alert their manager.

The controlling signalman will:

- Stop trains if the line is obstructed or endangered;
- Alert the emergency services, if required;
- Alert CTC.

The traffic regulator in CTC will:

- Inform the emergency services as necessary;
- Inform management per standing instructions;
- Arrange for locomotive assistance, breakdown van or crane as required.

### 1.6.3 Emergency response to the accident

Following the accident at XE039, the Train Driver stopped the train and went back to XE039 on foot.

When the Train Driver observed that the Farmer had been struck by the train he contacted the Limerick Check Signalman on his personal mobile telephone to request assistance rather than go back to the train to use the cab secure radio, as he had his personal mobile telephone with him at XE039. The Train Driver rang the Limerick Check Signalman as this was the only telephone no. he had for a signalman on his personal mobile telephone.

The Limerick Check Signalman then contacted the Galway Line Signalman, who is the controlling signalman, to advise him of the fatality. During the call the Limerick Check Signalman providing the Train Driver's mobile no. and explained that the Train Driver was familiar with the area where the accident had occurred.

The Galway Line Signalman contacted the emergency services by dialling 999, identifying himself as the Galway Line Signalman and requesting all emergency services. The Emergency Services Operator required that one of the emergency services be selected, one minute into the call An Garda Síochána were selected and this was immediately changed to the ambulance service. The emergency services were advised that the person struck was fatally injured.

The Galway Line Signalman advised the emergency services that the location of the accident was the 15 milepost, outside Sixmilebridge. The emergency services queried where this was on the road network and the Galway Line Signalman advised that he would ring back. In the meantime an ambulance was dispatched to Sixmilebridge. Eight minutes after first contacting the emergency services the Galway Line Signalman advised them that the accident had occurred in the townland of Rathaline on the New Market on Fergus road. The correct name of the townland is Rathlaheen South. The Emergency Service Operator asked the Galway Line Signalman if the accident was near a bridge.

An ambulance arrived at overbridge OBE48 above the railway line at approximately 22:30. The Train Driver guided the ambulance service to the access road for XE039.

The Traffic Regulator in CTC was advised of the accident, however, he was not involved in the management of the accident. The information in IAMS on the location and access points to XE039, which is available to the Traffic Regulator, was not used to direct the emergency services to the scene of the accident.

The contact information for the Train Driver was not given to the Emergency Services Operator.

## 1.7 Fatalities, injuries and material damage

### 1.7.1 Fatalities and injuries

The Farmer, who was crossing XE039 on foot with a cow, was fatally injured.

### 1.7.2 Infrastructure damage

There was no infrastructure damage as a result of the accident.

### 1.7.3 Traction and rolling stock damage

There was no damage to traction and rolling stock as a result of the accident.

## 1.8 History of occurrences

There was one previous occurrence at XE039 recorded by IÉ in the ten years leading up to the accident:

- There was a near miss between a train and a tractor attempting to cross the railway on the 2nd August 2008. The train involved was the 15:05 service from Ennis to Limerick.

# 2 Analysis

## 2.1 Movement across the railway line

The Farmer was attempting to cross the railway line at XE039 with a cow as the 21:45 service from Ennis to Limerick approached the LC. The Train Driver sounded the horn, however the movement continued. The Farmer and the cow were struck by the train and were found lying in the cess on the Up side of the railway line. This indicates that they continued to cross the railway line as the train approached and were closer to the Up side of the railway line when they were struck. It was not possible to determine at what point the Farmer became aware of the presence of the train or why the Farmer continued the movement across the railway line as the train approached. The Farmer was fatally injured and pronounced dead at the scene.

Based on the braking performance of the train it is unlikely that had the Train Driver made an emergency brake when the Farmer was observed that the accident would have been prevented. The train would have stopping beyond XE039 regardless of how the brakes were applied. The maximum additional time that an emergency brake application would have given before the train reached XE039 is approximately 0.4 s from the moment the brake handle was applied and the speed of the train would have reduced to approximately 62 km/h at XE039. The 1 s between the sighting of the Farmer and the application of the train brakes by the Train Driver shown by the event recorder demonstrates that there was no delay by the Train Driver in responding to the presence of the Farmer.

The skewed crossing route at XE039 meant that the crossing distance is increased from the 5.5 m specified in MW50 for a crossing route perpendicular to the railway line to 8.5 m, giving a safe crossing time of 13.3 s. This gives a minimum viewing distance of 295 m using Formula A from MW50 based on the maximum permitted speed of trains of 80 km/h. The increase in the required crossing time was not identified by IÉ, however, the viewing distances as measured by IÉ from the viewing positions less than 3.66 m from the nearest rail shown in Table 3 did exceed 295 m. It should be noted that for the Farmer crossing with the cow, the crossing route may not have been as skewed as for vehicular users as it would be possible to cross closer to the gate posts. It was also noted that the IÉ requirements for measuring the viewing distances are based on a safe crossing time of 11 s for a single track line, whereas the RSC guidance for new infrastructure gives an additional 5 s safe crossing time which would allow LC users additional time to cross the railway line.

The viewing distances for XE039 were found to have been measured at less than the 3.66 m from the nearest rail specified in MW50 for three of the four views as shown in Table 4. This meant that in order to view trains approaching from both directions, the Farmer would have had to be positioned 2 m from the nearest rail. As the Farmer was moving a cow across the railway line in front of him this meant that the cow would already have been within the swept path of an approaching train by the time the Farmer could make the determination of whether or not it was safe to cross the railway line in accordance with clause 11.7 of the user booklet (IÉ, 2006). This meant that an accident involving the cow would have been inevitable. Depending on the position of the Farmer when he became aware of the train, the impending accident with the cow may have affected the Farmer's decision to continue forward across the railway line or go back towards where he came from in order to move to a position of safety.

### 2.2 Risk management

The risks were intended to be mitigated by the LC user by following the instructions in the LC user booklet by (IÉ, 2006a):

- Stopping clear of the railway line at a minimum distance of 2 m to the nearest rail;
- Looking and listening for approaching trains;
- Contacting the controlling signalman when moving herds of cattle and long, low slung or slow vehicles across the railway;
- Carrying out a risk assessment for their activities.

It is not known if the Farmer had carried out a risk assessment for the use of LCs or not.

The risks were to be mitigated by IÉ through its standards, which require:

- Inspections to be carried out by staff in the CCE Department under I-PWY-1107 (IÉ, 2006b) and I-PWY-1307 (IÉ, 2006c);
- LC surveys to be carried out annually in accordance with I-PWY-1307 (IÉ, 2006c);
- Measurement surveys to be carried out 5 yearly in accordance with I-PWY-1107 (IÉ, 2006b);
- Measurement surveys to be carried out in accordance with the instructions in MW50 (IÉ, 1983) and the internal memorandum issued to staff (IÉ, 2005).

The controls put in place by IÉ were not found to be adequately managing the risks at XE039 as:

- The process for ongoing risk management did not identify potential hazards specific to XE039 such as the increased crossing time required due to the skewed crossing route and the reduced audibility of trains due to the flight path for Shannon airport;
- The LC users' view of the railway line was found not to be not covered in the patrol ganger weekly inspections and no patrol ganger yearly surveys were carried out XE039 allowing the viewing distances to go unmonitored between the measurement surveys;
- The viewing distances were shown as having potential for improvement by routine hedge cutting on the 26th September 2008, however, according to IÉ's records the vegetation was cut back at XE039 six months later in April 2009;
- The crossing distance at XE039 was taken by IÉ to be 5.5 m for its measurement surveys, however, the crossing distance was approximately 8.5 m due to the skewed crossing route;
- The internal memorandum (IÉ, 2005) provided permission to measure the viewing distance at a viewing position less than 3.66 m from the nearest rail if views of the railway line were restricted, however, a minimum safe distance from the nearest rail that the viewing distance could be measured from was not specified allowing measurements to take place from a position that could allow LC users to position themselves less than 2 m clear of the nearest rail and potentially encroach into the swept path of a train;
- No action was taken by IÉ in relation to LC users on the Limerick to Claremorris line not requesting special protection arrangements.

In addition, the capabilities of the LCRM are only used for the capital upgrade programme allowing the capabilities of the LCRM to go unused for ongoing risk management.

### 2.3 Emergency response

The location of the accident site was initially given in railway terms as the 15 milepost, this was in accordance with section A of the Rule Book (IÉ, 2007). The Galway Line Signalman did not have any other information to facilitate location of the accident and advised he would ring the emergency services back. The townland the accident occurred in was given eight minutes after initial contact was made with the Emergency Services Operator and the name of the townland provided was Rathaline, however, XE039 is located in the Townland of Rathlaheen South. The emergency services were not advised of the presence of an access road leading to XE039, resulting in their accessing the railway at overbridge OBE48, 552 m away from XE039 over ballasted track, delaying the emergency response. In this instance as the Train Driver was familiar with the area, he was able to guide the ambulance service to the access road, which allowed the ambulance be driven up to XE039.

The information in IAMS that was available to the Traffic Regulator was not transmitted to the emergency services. This includes the location of XE039 overlaid onto a map with co-ordinates and the access road for XE039. Had the information available to IÉ in IAMS been used the delay could have been avoided.

## 3 Conclusions

The Farmer was attempting to cross the railway line at XE039 with a cow as the 21:45 service from Ennis to Limerick approached the LC. The Train Driver sounded the horn, however the Farmer and cow continued across XE039 and were struck by the train. The Farmer was fatally injured and pronounced dead at the scene.

It was not possible to determine at what point the Farmer became aware of the presence of the train or why the Farmer continued the movement across the railway line as the train approached. However, it was possible to determine that the distance across XE039 is greater than the distance allowed by IÉ due to the skewed layout of the LC. The cow would also have been within the swept path of the train at the point when the Farmer reached the a position to check for train approaching from both directions. In addition, the safe crossing time allowed by IÉ was found to offer less time to cross than that specified in the RSC guidance for new infrastructure.

The IÉ risk management system in place was not found to be adequately managing the risks at XE039. In particular, IÉ's current instructions to staff on the measurement surveys at LCs permit the viewing distances to be measurement at a distance from the nearest rail that is less than the safe position advised to LC users. The increased crossing time required as a result of the skewed crossing route was also not identified.

The ability of the emergency services to locate and access the accident site was hindered by the lack of use of the information in IAMS that was available to CTC.

The *immediate cause* of the accident was:

- The train arrived at XE039 as the Farmer was attempting to move the cow clear of the railway line.

The *contributory factors* identified were:

- The vegetation at XE039 may have affected the Farmer's ability to see the train.

The *underlying factors* were:

- The information provided to staff carrying out measurement surveys at LCs did not provide information on the minimum safe distance from the nearest rail that the viewing distances should be measured from;
- The time required to cross the railway safely where the crossing route is skewed was not taken into account in the calculation of the warning time of approaching trains.

The additional issue identified was:

- The information available to CTC on the location and access to the LC was not used to assist the emergency services to locate and access the accident site.

## 4 Relevant actions already taken or in progress

The actions taken or in progress by IÉ in relation to this accident are:

- Whistleboards have been erected for XE039;
- Improved signage has been installed;
- Works are currently being undertaken for the replacement of 250 m of fencing;
- Convex mirrors are being erected at XE039.

## 5 Recommendations

As a result of the RAIU investigation three new safety recommendations[3] have been made and one safety recommendation is being reiterated.

IÉ's risk management system was not effectively identifying and managing the ongoing risks at XE039 as the hazards specific to this LC were not addressed, this has led to the safety recommendation:

**IÉ should ensure that risk assessments are produced for all user worked LCs to identify all hazards specific to particular LCs.**

An IÉ internal memorandum allowed the viewing distances to be measured at a position less than the safe position advised to LC users. In addition, IÉ document MW50 gives a safe crossing time that is less than the RSC guidance leading to a lesser viewing distance, this has led to the safety recommendation:

**IÉ should review their documentation on the measurement of viewing distances at existing user worked LCs to ensure that the viewing distances provide sufficient views of approaching trains to allow LC users cross safely.**

The difficulties experienced in requesting the assistance of the emergency services as well as the hindering of the emergency response through lack of communication of available information on the location and access point for the accident site has led to the safety recommendation:

**IÉ should review their procedures for the management of accidents to ensure that communication with the emergency services is clear and provides the necessary information to locate an accident site without undue delay and access it by the most appropriate point.**

[3] 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. (European Union, 2004)

The vegetation at XE039 was found to have provided restricted views that could have been improved through vegetation management, leading to the reiteration of the following safety recommendation from RAIU investigation report 'Report into the collision at level crossing XN 104 between Ballybrophy and Killonan on the 28th of June, 2007' published in June 2008 (RAIU, 2008):

**IÉ to develop and implement a vegetation management programme that addresses vegetation management on a risk basis, prioritising high risk areas.**

# 6 Additional information

## 6.1 List of abbreviations

| | |
|---|---|
| ADE | Assistant Divisional Engineer |
| CCE | Chief Civil Engineer |
| CTC | Centralised Traffic Control |
| CWR | Continuous Welded Rail |
| DE | Divisional Engineer |
| DMU | Diesel Multiple Unit |
| GIS | Geographical Information System |
| IÉ | Iarnród Éireann |
| kg | Kilogram |
| km/h | Kilometres per hour |
| LC | Level crossing |
| LCRM | Level Crossing Risk Model |
| m | Metre |
| m/s | Metres per second |
| $m/s^2$ | Metres per second squared |
| mm | Millimetre |
| N/A | Not applicable |
| no. | Number |
| PWI | Permanent Way Inspector |
| RAIU | Railway Accident Investigation Unit |
| RSC | Railway Safety Commission |
| s | second |

## 6.2 Glossary of terms

| | |
|---|---|
| Accident | An unwanted or unintended sudden event or a specific chain of such events which have harmful consequences including collisions, derailments, level crossing accidents, accidents to persons caused by rolling stock in motion, fires and others. |
| Causal factors | Any factor(s) necessary for an occurrence. Avoiding or eliminating any one of these factors would have prevented it happening. |
| Cess | The area alongside the railway line beyond the ballast shoulder. |
| Colour light signals | Signals that conveys the limit of movement authority to train drivers by means of coloured lights. |
| Continuous welded rail | Sections of rail that are welded together. |

| | |
|---|---|
| Contributory factors | Any factor(s) that affects, sustains or exacerbates the outcome of an occurrence. Eliminating one or more of these factor(s) would not have prevented the occurrence but their presence made it more likely, or changed the outcome. |
| Controlling signalman | The signalman designated to control a specific section of track. |
| Down direction | The direction of travel on a line away from where the mileposts are measured from. |
| Down side | The left side of the track when travelling in the Down direction. |
| Flight path | The route of airplanes. |
| Geographical Information System | A computer based system for the integration, storage, querying, analysis, modelling, reporting and mapping of geographically referenced data. |
| Glide path | The approach path for airplanes landing at an airport. |
| Immediate cause | The situation, event or behaviour that directly results in the occurrence. |
| Incident | Any occurrence, other than an accident or serious accident, associated with the operation of trains and affecting the safety of operation. |
| Infrastructure Manager | Organisation that is responsible for the establishment and maintenance of railway infrastructure as well as the management of control and safety systems for the railway infrastructure. |
| National Safety Authority | The national body entrusted with the tasks regarding railway safety in accordance with European directive 2004/49/EC. |
| Overbridge | A bridge that passes over the railway line. |
| Railway line | The area along the track extending as far as 1.5 metres outside the outermost rail on each side of the track. |
| Railway Undertaking | Organisation that operates a railway. |
| Reaction time | The time taken for the brake system to reach 90 percent of the braking rate requested. |
| Rolling stock | Rail vehicles. |
| Signal post telephone | Telephone positioned a signal post. |
| Swept path | The cross-sectional area occupied by a train along the track. |
| Track Circuit Block | A signalling system that uses track circuits to confirm the absence of trains in order to control the movement of trains. |
| Traction | Means of providing power to move rail vehicles. |
| Underbridge | A bridge that passes under the railway line. |
| Underlying factors | Any factor(s) associated with the overall management systems, organisational arrangements or the regulatory structure. |
| Up direction | The direction of travel on a line towards where the mileposts are measured from. |

| | |
|---|---|
| Up side | The left side of the track when travelling in the Up direction. |
| Whistleboard | A board positioned on the side of the track that indicates to train drivers that they are to sound the train horn. |

### 6.3 References

European Union (2004), Directive 2004/49/EC of the European Parliament and of the Council of 29 April 2004 on safety on the Community's railways and amending Council Directive 95/18/EC on the licensing of railway undertakings and Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification (Railway Safety Directive), 2004/49/EC, 29th April 2004.

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