



Investigation Report 2011-R004



**Gate Strike at Buttevant Level Crossing (XC 219), County Cork,
on the 2nd July 2010**

Document History

Title	Gate Strike at Buttevant Level Crossing (XC 219), County Cork, on the 2 nd July 2010
Document type	Investigation Report
Document number	2011-R004
Document issue date	27/06/2011

Revision number	Revision date	Summary of changes
1	29/06/2011	Edit to footer.

Purpose of the Railway Accident Investigation Unit

The Railway Accident Investigation Unit is an independent investigation unit within the Railway Safety Commission. The purpose of an investigation by the Railway Accident Investigation Unit 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 Railway Accident Investigation Unit'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 10:22, on Friday the 2nd of July 2010, the 08:00 Heuston to Cork passenger service passed through the Buttevant Level Crossing without incident. Approximately thirty seconds later a Track Recording Vehicle approached Buttevant Level Crossing in the opposite direction, as the Gate Keeper was in the process of closing the gates across the railway line. The Track Recording Vehicle struck one of the gates which resulted in damage to the gate and the Track Recording Vehicle. There were no injuries or fatalities as a result of this accident.

The immediate cause of this accident:

- The Gate Keeper was in the process of closing the level crossing gates across the railway line as the Track Recording Vehicle arrived at the level crossing.

The causal factors were:

- The Gate Keeper did not fully adhere to the operation instructions provided for the opening and closing of the level crossing gates;

The contributory factor was:

- The Gate Keeper's co-ordination and concentration may have been affected by the presence of Cannabis in his system;
- There was no engineered safeguard introduced at the Level Crossing to ensure that the Level Crossing gates could not be opened to road traffic when a train was approaching, as the system was dependent on the full adherence of the gate keepers to the operation instructions.

The underlying factor was:

- No formal risk assessment process was carried out at the Level Crossing since its initial installation to measure its compliance against criteria introduced in Iarnród Éireann's current signalling standard.

From this investigation, the Railway Accident Investigation Unit have made two safety recommendations:

- Iarnród Éireann should identify similar manned level crossings where human error could result in the level crossing gates being opened to road traffic when a train is approaching; where such level crossings exist, Iarnród Éireann should implement engineered safeguards; where appropriate;
- Iarnród Éireann should review its risk management process for manned level crossings to ensure that risks are appropriately identified, assessed and managed to ensure that existing level crossing equipment is compliant with criteria set out in Iarnród Éireann's signalling standards, where appropriate.

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1 Factual information

1.1 Parties involved

1.1.1 Organisations

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:

- Operations Department – responsible for the operation of trains, except in depots, and the supervision of train drivers and gate keepers;
- Signalling, Electrical and Telecommunications Department – responsible for the design, installation and maintenance of signalling equipment;
- Safety & Security Department – responsible for the issue of the gate keeper instructions on the operation of the level crossing;
- Human Resources – responsible general human resources activities, including the creation of policies and standards relating to employee welfare.

The Railway Safety Commission (RSC) is the *national safety authority* established under the Railway Safety Act 2005 and has responsibility for matters of railway safety on passenger carrying systems and freight carrying systems where they interface with public roads. The RSC has three main functions set out in Section 10 of the Railway Safety Act 2005. These main functions are to:

- Foster and encourage railway safety;
- Enforce the Railway Safety Act 2005 and other legislation relation to railway safety;
- Investigation and report on railway incidents and accidents.

Lloyd Rail is a privately owned company that operates *On Track Machines* (OTMs) on behalf of IÉ. The *Track Recording Vehicle* (TRV), an OTM, was being operated by Lloyd Rail at the time of the accident.

¹ All abbreviations are explained in the list of abbreviations.

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

1.1.2 Staff involved

A *gate keeper*³ is the person in charge of a gate at a level crossing on a railway. The Gate Keeper involved in the accident was an IÉ employee, passed as competent to operate Buttevant Level Crossing on the 22nd June 2010. He is positioned in a raised cabin at Buttevant Level Crossing from where he performs his duties. He had previously worked at Myrtlehill Level Crossing from the 8th September 2008.

A TRV Driver and Operator were on board the TRV at the time of the accident. Both were employed by Lloyd Rail and were deemed competent. Both the TRV Driver and Operator were deemed competent, and had followed the procedures in the IÉ Rule Book for the operation of TRVs on the IÉ railway.

1.2 The accident

On Friday 2nd July 2010, at 09:38, a TRV departed Cork in the *Up Direction* for Inchicore Works under a *Special Running Notice*. At 10:14:08 the TRV struck the *Strike-In-Point* for Buttevant Level Crossing (which will now be referred to as the Level Crossing for the remainder of this investigation report) on the *Up Line*. This initiated the procedures for the Gate Keeper to close the gates of the Level Crossing to road traffic, therefore opening the gates to rail traffic. See Figure 1 for location of the Level Crossing.

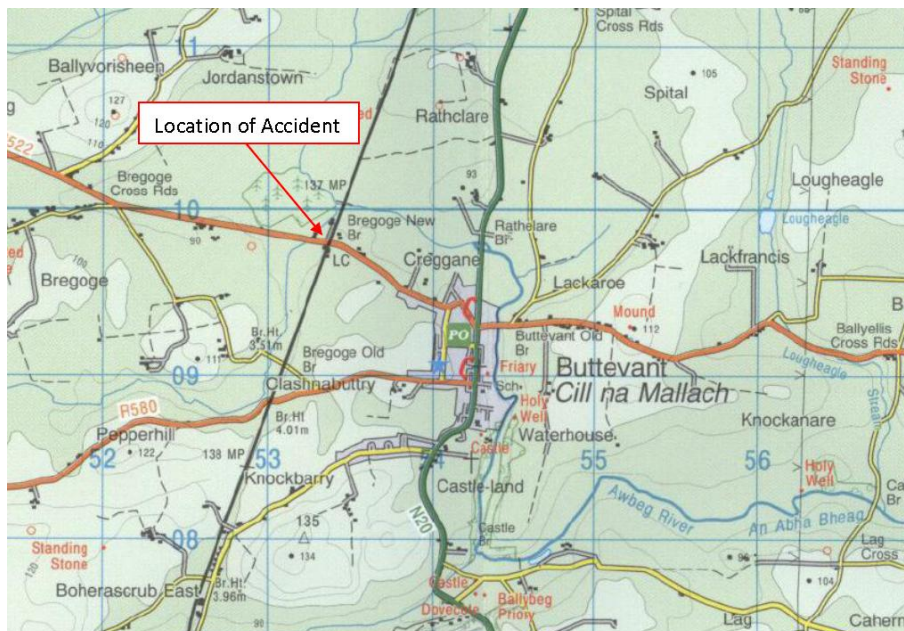
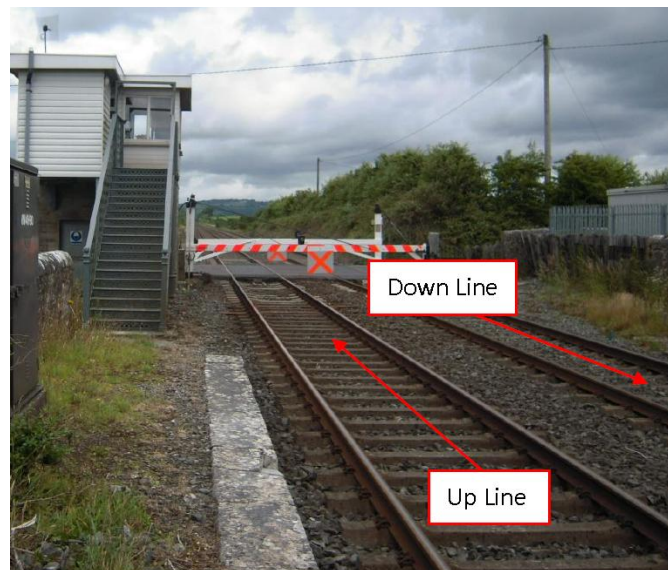


Figure 1 – Location Map

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³ Gate Keepers are also referred to as Level Crossing Keepers and Crossing Keepers

At 10:20:41 the 08:00 Heuston to Cork passenger service (which will now be referred to as the Train for the remainder of this investigation report) struck the Strike-In-Point for the Level Crossing on the *Down Line*. See Photograph 1 for Up and Down Line directions relative to the Level Crossing.



Photograph 1 – Line directions relative to the raised cabin

At 10:22:47 the Train passed through and cleared it at 10:22:59. The Train was the first to arrive at the Level Crossing as it was travelling at a faster speed than the TRV. After the train passed through the Level Crossing, the Gate Keeper then began opening the Level Crossing gates to road traffic, therefore closing them across the railway line.

At 10:23:26 the TRV arrived at the Level Crossing, striking the Down Line gate which the Gate Keeper was in the process of closing across the railway. The TRV Driver applied the emergency brake but continued through the Level Crossing, coming to a stop 214 metres (m) beyond the Level Crossing.

On the day of the accident the weather was dry with scattered showers, with a temperature of 17 degrees Celcius and a south-east wind of 16.7 kilometres per hour (km/h).

1.3 Infrastructure

1.3.1 Infrastructure information

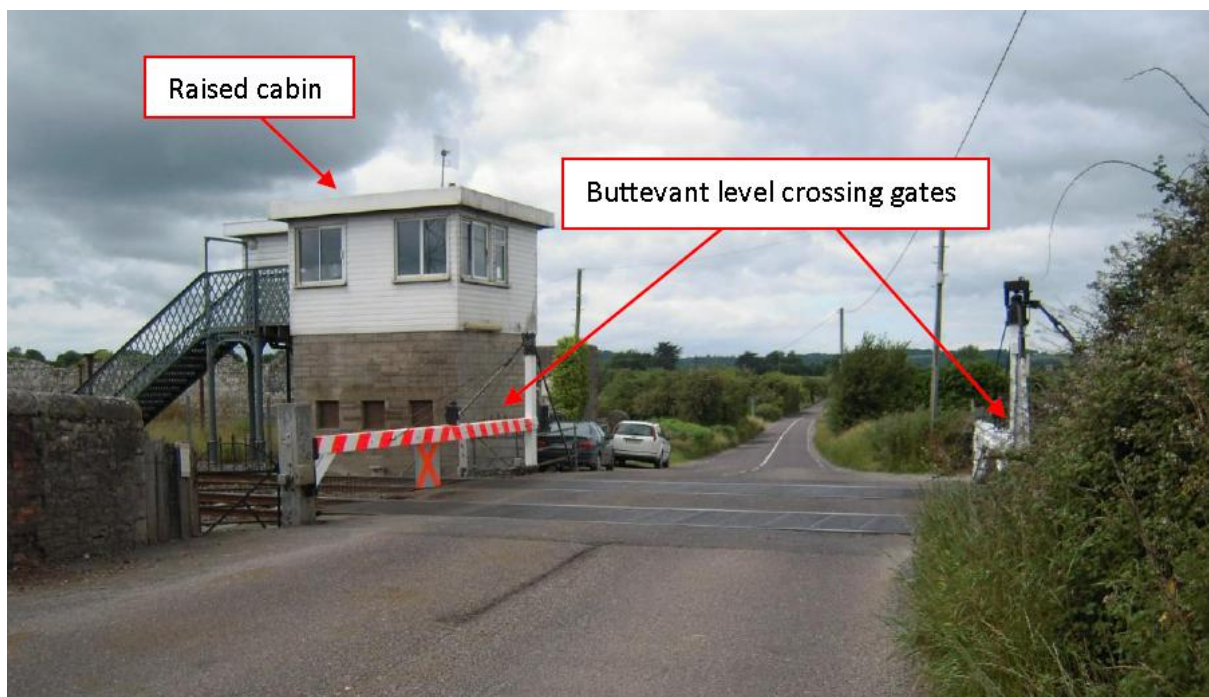
The line at the site of the accident is a *double track* route from Dublin to Cork. The track is plain line with flat bottom *continuous welded rail (CWR)* mounted on concrete sleepers in ballast.

No factors in relation to the condition of the track were found to have contributed to the accident.

1.3.2 Buttevant Level Crossing

The Level Crossing, installed twenty three years ago, is located on a public regional road, R522, which connects Buttevant and Liscarrol, at 137 miles 237 yards from Dublin Heuston, on the Dublin to Cork Line, in the Mallow to Charleville section.

The Level Crossing, asset identification number (no.) XC 219, is a Gate Keeper attended 'CX' type crossing, which means that the default position of the Level Crossing gates is open to the public road (and closed across the railway line). The Level Crossing gates are opened and closed by the Gate Keeper who is located in the raised cabin adjacent to the Level Crossing where he has clear views of the railway line and public road, see Photograph 2.



Photograph 2 – Buttevant Level Crossing with raised cabin

A *risk assessment* exists in relation to the occupational safety of the Gate Keepers at the Level Crossing. However, no formal risk assessment in relation to the Level Crossing equipment design was created for the Level Crossing at the installation stage, or since its installation. IÉ have advised that, risk assessments would not have been customary at the time of installation, and a more informal approach to risk assessment was likely to have been adopted.

1.4 Signalling and communication

1.4.1 General description

The *double track* route between Dublin and Cork is signalled using three and four aspect *colour light signals*, controlled by the Mainline Signaller based in Centralised Traffic Control (CTC) at Connolly Station. In the location of the Level Crossing, the area is signalled using three aspect colour light signals. *Track Circuit Block* (TCB) regulations apply to this route. *Continuous Automatic Warning System* (CAWS) operates throughout this route.

The signals protecting the Level Crossing are *automatic signals* which are interlocked with the Level Crossing. Therefore when the Level Crossing gates are open to the railway line the signals will automatically show a *proceed aspect* provided the *track circuits* in the section in front of the signals are unoccupied. Conversely when the Level Crossing gates are closed across the railway line the signals will automatically show a *danger aspect*.

The means of communication between train drivers and the Mainline Signaller on the route is through train radio.

1.4.2 Approach and route locking

IE signalling standard, I-SIG-2022 – Principles of Interlocking, issued in August 2002, identifies a number of interlocking principles to be applied on the IE network, including:

- Section 3.4.1 states that interlocking systems “will ensure that the interlocking associated with a signal or other movement authority is only released when it is safe to do so”;
- Section 3.4.2 states that the signalling system shall include interlocking between signals and manned level crossing which may present a hazard to a moving train;
- Section 3.6.3 states that “signal levers shall be *backlocked* where required in order to prevent the release of mechanical locking on the frame until such time as it is safe to do so”;
- Section 3.7.7 of “At local level crossing control points interlocking shall be provided between the protecting signals and the level crossing gates or barriers with *approach locking* or *route locking* as appropriate”;

Also stated in 7.1.1 in relation to the provision of approach locking the standard states the “approach locking shall prevent the changing of the route ahead of a signal, until it is safe to do so, once the signal has displayed a proceed aspect.” Section 7.1.2 identifies the “opening of level crossings to road traffic where the level crossing is interlocked with the signalling” as a changing of route.

Approach locking or route locking were not provided at the Level Crossing, however, 7.1.6 of the standard states that “Where a train movement can be observed by the signaller or other person controlling the movement and *risk assessment* shows that approach locking need not be provided, it may be omitted subject to the approval of Iarnród Éireann.”

As this standard was introduced fourteen years after the installation of the Level Crossing, its requirements in relation to approach locking or route locking were not included at the installation stage of the Level Crossing, nor were they subsequently introduced after the introduction of the standard.

1.4.3 Signalling download for the accident

Information was downloaded from the signalling systems in relation to the *occupancy* of track circuits (illustrated as unique identifiers starting with the letter B in Figure 2) in the area of the accident. This download provides information on when the TRV and the Train approached the Level Crossing (illustrated as a yellow line in Figure 2). However, the download does not record information regarding aspects displayed in the automatic signals, position of the gates or actions of the Gate Keeper.

Once a train (or TRV in the case of the accident) enters the track circuit associated with the Level Crossing, known as the *Strike-In-Point*, this initiates the gate keeper to close the Level Crossing gates to the public road. In the location of the accident these are track circuits B743 and B748, for the Up and Down directions, respectively, see Figure 2. The signals associated with these track circuits will now show a danger aspect to prevent other trains entering the section, these are signals 857 and 862 in the Up and Down directions, respectively.

When the gates have been closed to the public road, the Level Crossing *protecting signals* show a proceed aspect for the train to continue through the Level Crossing. The protecting signals for the Level Crossing are signals 859 and 858 in the Up and Down directions, respectively. When a second train is approaching, the same process applies, however, there is no second initiation for the gate keeper, as he/she would already be in the process of opening the Level Crossing gates to the railway.

When the train/trains *clears* the track circuits associated with the Level Crossing the gate keeper can then begin the process of closing the gates to the railway. In the case of the Up and Down direction, the track circuits are B745 and B748, respectively.

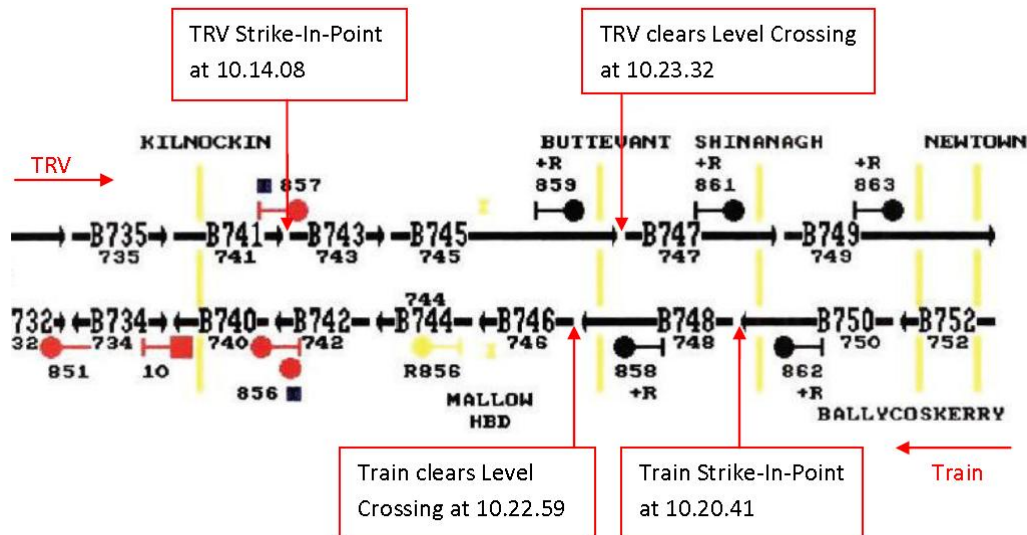


Figure 2 – Signalling system download

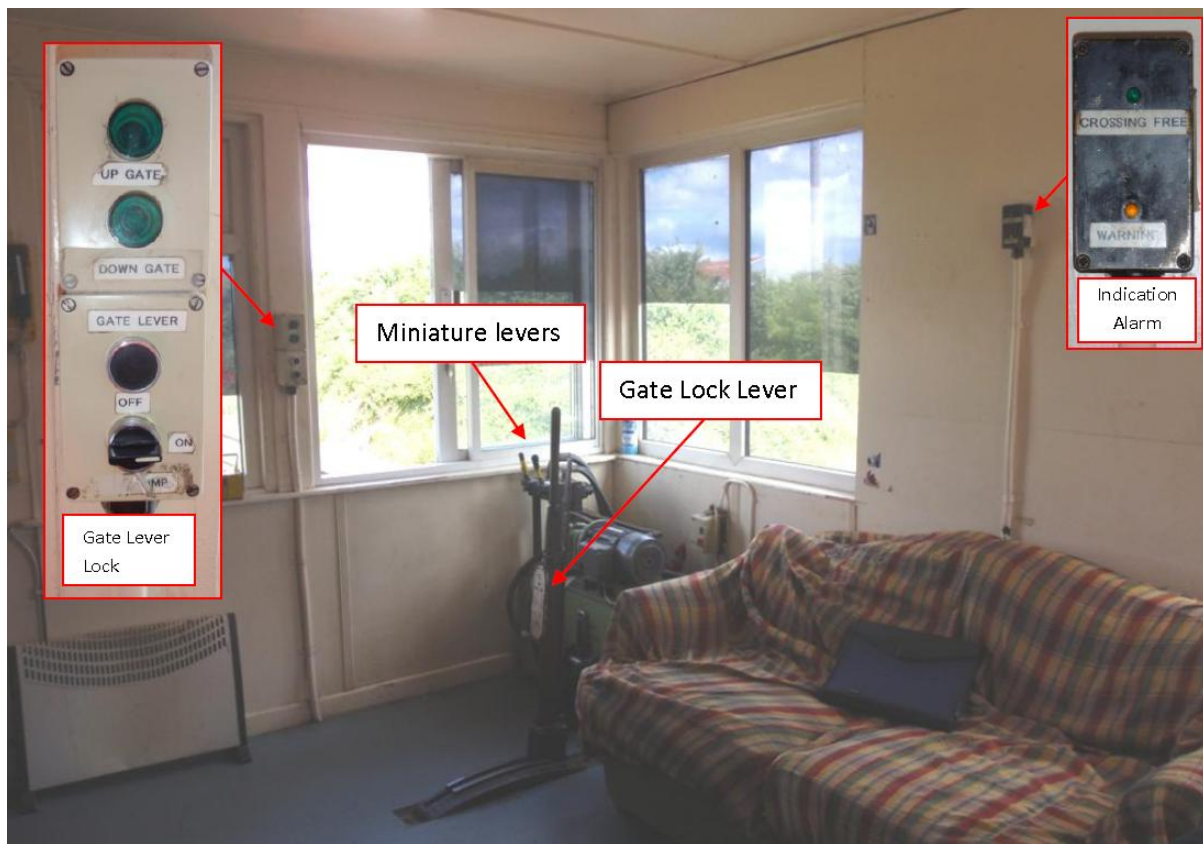
A summary of the signalling system download, including the actions of the Gate Keeper is summarised below in Table 1.

Time	Summary of Events
10:14:08	The TRV, travelling on the Up Line, hits the Strike-In-Point for the Level Crossing.
After 10:14:08	The Gate Keeper begins closing the Level Crossing gates to the public road, and thus opening them to the railway. When the gate keeper performs all his duties protecting signal 859 displays a proceed aspect. And then protecting signal 858 also automatically displays a proceed aspect.
10:20:41	The Train, travelling on the Down Line, hits the Strike-In-Point for the Level Crossing.
10:22:47	The Train passes through the Level Crossing.
10:22:59	The Train clears the Level Crossing and associated track circuits. The protecting signal 858 returned to green when the Train cleared its <i>overlap</i> , as the gates remained open to railway traffic. The protecting signal 859 for the TRV remained at green.
After 10:23	The Gate Keeper begins to close the Level Crossing gates across the railway line, the protecting signals now displays a danger aspect, however, the TRV is past its protecting signal 859.
10:23:26	The TRV passes through the Level Crossing, striking one of the Level Crossing gates.
10:23:32	The TRV clears the Level Crossing and associated track circuits.

Table 1 – Summary of events

1.4.4 Level Crossing Signalling Equipment

The raised cabin houses the signalling equipment for the Level Crossing (see Photograph 3).



Photograph 3 – General arrangement of signalling equipment

This equipment includes:

- **Indication Alarm** – The Indication Alarm’s green “Crossing Free” lamp illuminates when the gates are closed across the railway line and there is no train approaching. The Indication Alarm’s yellow “Warning” lamp illuminates (extinguishing the green “Crossing Free” lamp) when a train crosses the *Strike-In-Point*. An audible alarm sounds when the yellow “Warning” lamp illuminates;
- **Gate Lever Lock** – The Gate Lever Lock houses the keyswitch to the Level Crossing gates hydraulic motor, which must be switched to “On” to allow the Level Crossing gates to open/close. The Gate Lever Lock also houses the detection lamps for the Level Crossing gates which illuminate when the gates are secure across the public road;
- **Miniature Levers** – The Miniature Levers allow the Gate Keeper to open/close the Level Crossing gates. These levers are interlocked with the Gate Lock Lever and can only be operated when the Gate Lock Lever is in the reverse position;
- **Gate Lock Lever** – The Gate Lock Lever is in the reverse position when the gates are opened to road traffic and closed across the railway line. In this case, the protecting signals

remain at danger. When the Gate Lock Lever is placed in the normal position, the protecting signals clear, allowing trains to proceed. This also silences the audible alarm.

It can be seen from Photograph 3 that all the above equipment is positioned in close proximity to each other, allowing the Gate Keeper to operate the equipment in a quick sequence from a single standing position, while maintaining a clear view of the Level Crossing.

IE staff, under the supervision of the RAIU, tested the Level Crossing equipment post accident, including the Indication Alarm and associated audible alarm, Gate Lock Lever and Gate Lever Lock. No faults were found with any of the Level Crossing equipment, and no faults have been recorded at the Level Crossing since the accident.

1.4.5 Gate Keeper Instructions

Described below are the instructions to the Crossing Keeper in relation to Buttevant Level Crossing taken from “Instructions to the Crossing Keeper for the Operation of Buttevant (XC219)”, Section “Operation of the Level Crossing”, issued on the 27th August 2007.

As a train approaches the level crossing, striking the Strike-In-Point, the yellow “Warning” lamp becomes illuminated, the audible alarm sounds, and the green “Crossing Free” lamp becomes extinguished on the Indication Alarm illustrated in Photograph 4.



Photograph 4 – Indication Alarm



Photograph 5 – Gate Lever Lock



Photograph 6 – Detection Lamps

On receiving these indications and the audible alarm, the Gate Keeper must immediately close and secure the gates across the public road. To close the gates across the public road, the Crossing Keeper must follow the instructions below:

1. Start the hydraulic motor by operating the keyswitch to the “On” position (see Photograph 5);
2. Operate the appropriate miniature lever to close the Level Crossing gates (see Photograph 3);
3. Check that the detection lamp for the appropriate gate has become illuminated steady white (see Photograph 6);
4. Operate the second gate in a similar manner;
5. When both gates have been closed and have been detected as closed, place the Gate Lock Lever (see Photograph 3) into the normal position in the frame.

The placing of the Gate Lock Lever into the normal position clears the protecting signals, allowing trains to proceed, this silences the audible alarm. The instruction further states (note the instruction emphasises through the use of capital letters):

“When the train(s) has/have passed through the crossing THE LEVEL CROSSING KEEPER MUST WAIT UNTIL THE YELLOW LAMP IS EXTINGUISHED AND THE GREEN “CROSSING FREE” LAMP IS AGAIN ILLUMINATED BEFORE OPERATING THE GATE LOCK LEVER which restores the control on the protecting signal. The gates may then be closed across the railway line.”

In relation to the approach of a second train, the instruction continues:

“If a second train is to operate through the crossing the yellow “Warning” Lamp will remain illuminated and the green “Crossing Free” lamp will not become illuminated thus indicating that the gates must be closed across the public road for its passing.”

1.4.6 Gate Keeper actions preceding the accident

At 10:14:09, when the Indication Alarm sounded in the cabin, the Gate Keeper correctly carried out the “Instructions to the Crossing Keeper for the Operation of Buttevant (XC219)”, and closed the Level Crossing gates to road traffic, therefore opening them to railway traffic. However, on the passing of the Train he then started the process of opening the gates to road traffic, by operating the Gate Lever Lock, throwing the Gate Lock Lever into the reverse position, and operating the miniature levers to open the Down Level Crossing gate to the public road. The TRV had not cleared the Level Crossing at this stage, and therefore struck the Down Level Crossing gate.

1.5 Operations

1.5.1 General description

The movement of trains on the Dublin to Cork line is controlled by the Mainline Signaller based in CTC. The maximum speed for the line at the location of the accident is 144 km/h.

The TRV was running on a Special Running Notice, which is a weekly operating publication giving details of all the planned variations from the working timetable.

1.5.2 IÉ Drugs and Alcohol Policy and Standard Documents

Section 89 'Sampling for Drugs', of the Railway Safety Act 2005 (the Act) identifies where an authorised person may require a *safety critical worker* to provide a sample of blood or urine. Two occurrences where drug sampling are required are:

- In the case of an incident, where the safety critical worker concerned was performing or had performed a safety critical task on the railway infrastructure, or on the train, which was involved in the incident;
- At random and in circumstances that are reasonable, where a safety critical worker is performing a safety critical task or has made himself or herself available to perform a safety critical task by attending work.

To comply with the Act, IÉ's Chief Safety & Security Officer issued IÉ's "Drugs & Alcohol Policy" in August 2007, which describes the reasons why the policy exists, the scope and objectives of the policy, the responsibilities of line management, human resource management and employees. Section 8 of this policy 'Responsibilities of employees' states:

"Employees must not report for duty under the influence of, nor consume when on duty, alcohol or performance impairing drugs".

Section 10 of this policy, 'Circumstances in which testing is carried out' states:

"As part of our normal selection process, all persons applying for employment within IÉ will be subject to testing for drugs. Existing employees transferring into a safety critical post will be subject to testing for drugs:

- Following a safety critical incident (whether an accident or other incident), where there are reasonable grounds to suspect that the actions or omissions of a person were pertinent to the incident, then that person must be subject to evidential alcohol and drugs testing;

- Where there is reason to suspect that a person is unfit to perform normal duties through the effects of alcohol or drugs then that person must be removed from duty and arrangements put in place for alcohol and drugs testing of the person concerned;
- Randomly, 5% of IÉ's employees will be subject to testing for drugs each year."

The policy also provides information on the short and long term affects of drugs and alcohol. In relation to Cannabis the policy states that the effects as "A relaxed, often talkative or giggly state. It affects concentration and co-ordination, making accidents more likely."

At the time of the accident IÉ's Drugs & Alcohol Policy had not been fully adopted, in that the 5% random testing of IÉ's employees for drugs each year had not been implemented in full.

Random testing was introduced by IÉ in March 2010. IÉ proposed that 100 safety critical workers required random testing for the remainder of 2010, a number agreed with the RSC. In fact, IÉ tested 101 of the 3,600 safety critical workers, achieving 2.8% random testing.

The Gate Keeper was subjected to the screening for drugs post accident, as per IÉ's Drugs and Alcohol Policy, for which he tested positive for Cannabis on the 2nd July 2010. IÉ's Chief Medical Officer (CMO) states, in his report dated the 8th July 2010, that the presence of this substance in the Gate Keeper's system "has significant implications for his ability to perform his duties in a safe and satisfactory manner".

1.6 Traction and rolling stock

1.6.1 Track Recording Vehicle

The TRV involved in the incident is vehicle no. 700, train identification no. Y261, see Photograph 7. The TRV was not in recording mode at the time of the accident. The length and weight of the TRV are 12.8 m and 23 tonnes, respectively. The TRV does have a forward facing camera, however, this only operates when the TRV is recording, and therefore was not recording at the time of the accident. The TRV does not have an event recorder fitted. The *maximum permissible speed* for a TRV is 64 km/h. The TRV is not equipped with CAWS receiving equipment.



Photograph 7 – Track Recording Vehicle

The TRV was travelling at approximately 64 km/h at the time of the accident.

The condition or operation of the TRV was not contributory to the accident.

1.6.2 The Train

The Train, identification no. A204, consisted of a Class 201 locomotive, no. 234. The Train consisted of Class Mark IV carriages, nos. 4135, 4132, 4116, 4106, 4119, 4407, 4203, and 4004. 4004 is the driving generator van.

The total length and weight of the Train is 210.35 m and 438 tonnes respectively. The locomotive was leading at the time of the accident. The Train has a maximum permissible speed is 160km/h.

The Train was travelling at approximately 144 km/h at the time of the accident, which is the maximum speed for the line at the location of the accident. The Train was equipped with CAWS receiving equipment.

The condition or operation of the Train was not contributory to the accident.

1.7 Fatalities, injuries and material damage

1.7.1 Fatalities and injuries

There were no fatalities or injuries as a result of this accident.

1.7.2 Infrastructure damage

The down gate of the Level Crossing was damaged.

1.7.3 Traction and rolling stock damage

The impact from the train striking the level crossing gate resulted in some minor damage to the TRV.

1.8 History of similar accidents and incidents

There were fourteen gate strikes by trains at 'CX' type level crossings over the ten years prior to this accident. It should be noted, that although these level crossing gates were struck by trains, none of the level crossings listed above had a similar signalling system to Buttevant Level Crossing.

These gate strikes occurred on the following dates and locations:

- 25th of January 2000 – XM148 Carrick Level Crossing;
- 22nd of December 2000 – XM047 Kiltoom Level Crossing;
- 16th of February 2001 – XM047 Kiltoom Level Crossing;
- 14th of July 2001 – XL065 Monard Level Crossing;
- 3rd of October 2001 – XH042 Kilcavan No. 1 Level Crossing;
- 28th of March 2003 – XX043 Foxford Level Crossing;
- 23rd of March 2004 – XE024 Cratloe Station Level Crossing;
- 10th of August 2004 – XS037 Ballymahon Level Crossing;
- 11th of October 2005 – XN177 Annacotty Level Crossing;
- 5th of November 2005 – XG043 Thomastown Level Crossing;
- 14th of April 2007 – XL101 Cappagh Level Crossing;
- 9th of September 2007 – XL065 Monard Level Crossing;
- 27th of September 2007 – XN164 Sallymount Level Crossing;
- 2nd December 2008 – XH066 Bridgetown Level Crossing.

2 Analysis

2.1 Operation of the Level Crossing

When a train approaches the Level Crossing, the yellow “Warning” Lamp of the Indication Alarm illuminates initiating the closure of the Level Crossing gates by the gate keeper. When the train passes, the green “Crossing Free” Indication Alarm illuminates indicating to the gate keeper that the gates may then be closed across the railway line.

When a second train approaches the Level Crossing, the yellow “Warning” Lamp will remain illuminated and the gates must remain closed. As with a single train, the gate keeper must wait for the “Crossing Free” Lamp to illuminate green before closing the Level Crossing gates across the railway line.

From the signalling system download it can be seen that the TRV is the first to strike in, activating the Indication Alarm and audible alarm in the cabin. The Gate Keeper then correctly carried out the instructions for opening the Level Crossing gates to rail traffic. Once the Level Crossing gates were opened to rail traffic, the protecting signals for the Level Crossing displayed proceed aspects for both the approaching TRV and Train (which had struck in at this time).

As the Train was travelling at a greater speed than the TRV, the Gate Keeper would have seen it approaching the Level Crossing first. From the actions taken by the Gate Keeper after the passing of the Train, in that he began to open the gates to the public road, it can be assumed that the Gate Keeper thought that the Train was in fact the only train approaching the Level Crossing, activating the Indication Alarm. Continuing with this assumption, it is likely therefore that the Gate Keeper did not check the Indication Alarm which would have been still displaying the yellow “Warning” Lamp, indicating that another train was approaching the Level Crossing.

As seen in Photograph 3, the positioning of the equipment allows the Gate Keeper to operate the equipment in a quick sequence. Therefore when the Gate Keeper moved the Gate Lock Lever to the reverse position (which was not backlocked). The audible alarm associated with the yellow “Warning” Lamp is likely to have sounded at this stage, but as the Gate Keeper was already operating the Miniature Levers, to open the gates to the public road, he was not unable to undo this action in time to prevent the TRV striking the Level Crossing gate.

It should be noted, that although the information related to a second train is included in the ‘Instructions to the Crossing Keeper for the Operation of Buttevant (XC219)’, he was able to perform this human error action as there was no engineering safeguard present at the Level Crossing.

2.2 Signalling protection and interlocking

The primary equipment for the indication of an approaching train, to the gate keeper, is the yellow “Warning” Lamp on the Indication Alarm and the associated audible alarm, which silences when the gate keeper places the Gate Lock Lever in the normal position. As all the equipment was tested and working correctly, post accident, it can be assumed that the “Warning” lamp on the Indication Alarm remained illuminated yellow on the passing of the Train and the audible alarm sounded when the Gate Lock Lever was placed in the normal position.

On the day of the accident, the Gate Keeper was able to close the Down Line gate across the railway line while both these indications were active as there was no engineered safeguard in place to ensure that the gates could not be closed across the railway line while the yellow “Warning Lamp” is illuminating and the audible alarm is sounding.

At the time, or since, the installation of the Level Crossing twenty-three years ago, no interlocking system (such as the signal level backlocking system) was introduced to ensure that the interlocking associated with a signal or other movement authority would only be released when it is safe to do so, as set out in IÉ’s signalling standard, I-SIG-2022 – Principles of Interlocking, Issue 1.0

However, this Level Crossing is likely to have been exempted from approach locking as the standard states that “interlocking should be applied to level crossings, unless the signalman can observe train movements and risk assessment shows that approach locking need not be provided.” This was the case at Buttevant where the Gate Keeper had unobstructed views of the railway. This substitution of engineered safeguards for Gate Keeper actions therefore relies on the Gate Keeper to carry out his/her instructions correctly with no allowance for human error.

Had approach locking or route locking been provided it would have acted as an engineered safeguard in preventing the Level Crossing gates to be opened to the public road, and closed to the railway as a train was approaching. The operation of the gates would therefore only be permitted when the Level Crossing track circuits were clear of all trains, and would not allowed for the human error to occur.

It should be noted however, that the signal aspects for the Level Crossing, on both the Up Line and Down Line, would have remained at danger, preventing any other trains entering the section.

2.3 Drugs and alcohol policy and standard

The Gate Keeper tested positive for Cannabis. The presence of this substance in the Gate Keeper's system may have affected his concentration and co-ordination in his duties as a Gate Keeper.

The apparent failure to carry out all the required checks, such as not checking the Indication Alarm, prior to closing the Level Crossing gate to the railway may have been, at least partly, as a result of the presence of this substance in the Gate Keeper's system.

At the time of the accident IÉ had not fully adopted their Drugs & Alcohol Policy or Standards, in that the 5% random testing of IÉ employees was not being carried out. If this had been fully adopted there was a 5% chance that the Gate Keeper may have been selected for testing.

3 Conclusions

At 10:22, on Friday the 2nd of July 2010, the 08:00 Heuston to Cork A204 passenger service passed through the Buttevant Level Crossing without incident, while the Level Crossing gates were open to the railway. Approximately thirty seconds later a Track Recording Vehicle approached Buttevant Level Crossing in the opposite direction, as the Gate Keeper was in the process of closing the gates across the railway line. The Track Recording Vehicle struck one of the gates which resulted in damage to the gate and the Track Recording Vehicle. There were no injuries or fatalities as a result of this accident.

The Gate Keeper did not fully adhere to the “Instructions to the Crossing Keeper for the Operation of Buttevant (XC219)” as he did not check the Indication Alarm, after the passing of the Train, to ensure that a second train was not approaching. The Gate Keeper may have assumed that the Train was the only train approaching the Level Crossing and therefore may not have checked the Indication Alarm which was displaying the yellow “Warning” Lamp. This omission may have been, at least partly, as a result of the the presence of Cannabis in his system, which is known to affect concentration and co-ordination.

Approach locking or route locking was not provided at the Level Crossing, which would have acted as an engineered safeguard, to ensure that the Level Crossing gates could not be closed across the railway line while the yellow “Warning” Lamp is illuminating on the Indication Alarm. The absence of this engineered safeguard therefore allowed the Gate Keeper to close the Level Crossing gates across the railway while the TRV was approaching. These risks were not identified by any risk assessment as IÉ’s Principles of Interlocking standard was issued fourteen years after the installation of the Level Crossing.

IÉ’s Drugs and Alcohol Policy was not fully adopted in that the 5% random sampling for drugs of safety critical staff, required of the Policy, was not fully adopted. However, given that there only a 5% chance of the Gate Keeper been randomly selected, is it unlikely that the Gate Keeper would have been tested prior to the accident occurring.

As a result of these finding, the RAIU find that the *immediate cause* of this accident is that:

- The Gate Keeper was in the process of closing the Level Crossing gates across the railway line as the Track Recording Vehicle arrived at the Level Crossing.

The *causal factor* was:

- The Gate Keeper did not fully adhere to the operation instructions provided for the opening and closing of the Level Crossing gates.

The *contributory factors* were:

- The Gate Keeper's co-ordination and concentration may have been affected by the presence of Cannabis in his system;
- There was no engineered safeguard introduced at the Level Crossing to ensure that the level crossing gates could not be opened to road traffic when a train was approaching, as the system was dependent on the full adherence of the gate keepers to the operational instructions.

The *underlying factor* was:

- No formal risk assessment process was carried out at the Level Crossing since its initial installation to measure its compliance against criteria introduced in IÉ's current signalling standard.

4 Relevant actions already taken or in progress

4.1 Level Crossing

Approach locking has been introduced at the Level Crossing to ensure that the Gate Keeper cannot close the Level Crossing gates, across the railway, while the proceed aspect is displaying for the train, and a train is in approaching the Level Crossing.

The Indication Alarm has been upgraded with larger LED lamps for the green “Crossing Free” Lamp and the yellow “Warning” Lamp, which give a clearer visual display to the Gate Keeper.

A technical risk assessment has been conducted for the operation of the Level Crossing in accordance with IÉ’s risk assessment procedures.

4.2 IÉ’s Drugs and Alcohol Policy and Standards

IÉ’s Drugs & Alcohol Policy is in the process of being re-issued and the random testing requirements have now been fully adopted, with IÉ expecting to meet this 5% random testing requirement in 2011. This will be enforced by the RSC.

4.3 Gate Keeper

Directly after the accident, the Gate Keeper submitted his resignation and therefore did not perform any safety critical work after the accident.

5 Previous RAIU recommendations

No previous RAIU safety recommendations were found to be relevant to this investigation.

6 Recommendations

As a result of the RAIU investigation, the RAIU have made two safety recommendations⁴.

As there was no engineered safeguard in place to prevent opening the Level Crossing Gates to road traffic while a train is approaching, the RAIU make the following safety recommendation:

IEÉ should identify similar manned level crossings where human error could result in the level crossing gates being opened to road traffic when a train is approaching; where such level crossings exist, IEÉ should implement engineered safeguards, where appropriate;

In anticipation of the above recommendation taking a considerable length of time, the RAIU make the following safety recommendation:

IEÉ should review its risk management process for manned level crossings to ensure that risks are appropriately identified, assessed and managed to ensure that existing level crossing equipment is compliant with criteria set out in IEÉ's signalling standards, where appropriate.

As IEÉ are on target to meet their 5% target for random testing for drug sampling in 2011, the RAIU does not deem that a recommendation in relation to random testing for drug sampling is warranted.

⁴ 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)

7 Additional information

7.1 List of abbreviations and acronyms

CAWS	Continuous Automatic Warning System
CTC	Centralised Traffic Control
CWR	Continuous Welded Rail
km/h	Kilometres per hour
m	Metre
RAIU	Railway Accident Investigation Unit
RSC	Railway Safety Commission

7.2 Glossary of terms

*Terms with * are taken directly from Ellis' British Railway Engineering Encyclopaedia*

Approach locking	The locking of any route from a signal, once the signal has been cleared, to prevent that route being changed until it is safe to do so.
Automatic signal*	A colour light signal that changes its aspect automatically based on occupation and clearance of the section.
Backlocked	A locking function in a mechanical interlocking which locks the lever to the appropriate position.
Causal factor	Any factor(s) necessary for an occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.
Colour light signals*	Signals which convey movement authorities to train drivers by means of coloured lights.
Continuous Automatic Warning System	A form of cab signalling and train protection system to aid train drivers in observing and obeying lineside signals.
Centralised Traffic Control	Based at Connolly Station, they controls train movements on the Heuston to Cork line.
Clear	In terms of track circuits, it is where the track circuit is no longer occupied.
Continuous Welded Rail	Rails welded together, utilising flash butt welding, to form one continuous rail that may be several kilometres long, or thermite welding to repair or splice together existing CWR segments.
Contributory factor	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.
Danger*	Universal term for red aspect.
Double track	A route with two tracks.

Down Line	Line on which trains normally travel away from Dublin.
Engineered safeguard	An engineered system that serves as protection to ensure safety.
Flat bottom Rail	A rail section having a flat base.
Gate Keeper	A person in charge of a gate/gates at a level crossing on a railway.
Hazard	Any circumstance, substance, device, object, or microorganism that can cause death, harm, injury, damage or loss.
Iarnród Éireann	A wholly owned subsidiary of Córas Iompair Éireann. IÉ is the owner and operator of the national mainline service in Ireland.
Immediate cause	The situation, event or behaviour that directly results in the occurrence.
Infrastructure manager	Organisation that is responsible for the maintenance of railway infrastructure.
Maximum permissible speed	The maximum speed at which trains may safely negotiate a section of track.
Milepost	A post placed at one mile intervals along the railway, (quarter mile intervals similarly marked).
National Safety Authority	The national body entrusted with the tasks regarding railway safety in accordance with European directive 2004/49/EC.
Occupy	Describing a track circuit with a train on it.
Overlap	The distance beyond a signal that is proved clear prior to the signal on the approach to it being cleared.
Proceed aspect*	A signal aspect which authorises a driver to pass that signal.
Protecting signal*	A signal that prevent trains from entering a section where conflicting movements may take place.
Railway undertaking	Organisation that operates trains.
Risk	Exposure to risk and the probability of harm to life, property or the environment.
Risk assessment	The process of identifying the hazard, assessing the risk and recommending appropriate controls.
Route locking	Interlocking which maintains the locking associated with a route in use until after the train has passed the equipment being locked.
Safety Critical work	Work by a person— (a) as a driver, guard, conductor or signaller or in any other capacity in which he can control or affect the movement of a vehicle; (b) in a maintenance capacity or as a supervisor of, or look-out for, persons working in a maintenance capacity; and for this purpose, a person works in a maintenance capacity if his work involves— (i) maintenance, repair or alteration of — (aa) the permanent way or other means of guiding or supporting vehicles, (bb) signals or any other means of controlling the movement of vehicles, or

		(cc) any means of supplying electricity to vehicles or to the means of guiding or supporting vehicles, or
		(ii) coupling or uncoupling vehicles; or
		(iii) checking that vehicles are working properly before they are used on any occasion, system;
		which could affect the health or safety of persons on a transport system;
Special Running Notice		A weekly operating publication giving details of all the planned variations from the working timetable.
Strike In Point		The location on the approach to a level crossing at which an approaching train triggers the operating sequence for the Gate Keeper.
Track Circuit		An electrical train detection system, based on proving the absence of a train.
Track Circuit Block		A method of signalling to trains in a section of line where safety is ensured by the use of track circuits or other means of automatic train absence detection system and without the use of block instruments.
Train radio		System which communicates voice and telegram messages between signalling centres and trains.
Underlying factor		Any factor(s) associated with the overall management systems, organisational arrangements or the regulatory structure.
Up Line		Line on which trains normally travel towards Dublin.

7.3 References

Iarnród Éireann (2007) Drugs & Alcohol Policy, Issue No. 1

Iarnród Éireann (2007) General Appendix

Iarnród Éireann (2007) Railway Safety Standard 30, Drugs & Alcohol, Issue No. 3.

Iarnród Éireann (2007) Rule Book

Iarnród Éireann (2007) Instructions to the Crossing Keeper for the operation of Buttevant (XC219).

Iarnród Éireann (2002) Principles of Interlocking. I-SIG-2022, Issue 1.0.

Ireland (2005) Railway Safety Act 2005, Dublin, Government Publications Office.